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Comparison of Patients with Different Pathologies in Terms of Shoulder Protraction and Scapular Asymmetry

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Abstract. [Purpose] The aim of this study was to compare cases with different shoulder and cervical pathologies in terms of shoulder protraction and scapular asymmetry. [Methods] A total of 216 patients, aged between 30–70 years, were included, 108 of which were in the patient group (subacromial impingement, rotator cuff problems, adhesive capsulitis, disc herniations) and 108 of which were in the control group. The control group consisted of cases with no prior neck and shoulder problems or pain. Pain was evaluated using the visual analogue scale (VAS); the asymmetry of scapula was evaluated using the Lateral Scapular Slide Test (LSST) with two additional positions; and the protraction of the scapula was evaluated using the shoulder protraction test. [Results] According to the data obtained, the affected side scapular asymmetry and protraction in the patient group were significantly greater than in the control group. When the patient groups were compared in terms of different pathologies, there were no differences between scapular asymmetry and shoulder protraction. [Conclusion] In conclusion, the pathologies of the neck and shoulder were found to cause scapular asymmetry and shoulder protraction. However, patients with different pathologies had similar scapular asymmetry and shoulder protraction.
Key words: Scapular asymmetry, Shoulder pathologies, Pain

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INTRODUCTION

Evaluation of the static position of the scapula is very important in the pathologies of the shoulder and neck. This is due to the fact that these pathologies are the second and third most common causes of musculoskeletal pain[1)]. The abnormal changes in the position of the scapula at different angles of the shoulder indicate a disturbance of the scapulohumeral rhythm, and these changes adversely affect the functions of the upper extremity[2, 3)]. The ratio of the scapulohumeral rhythm in healthy subjects should be 2:1 (humerus:scapula). In the pathologies limiting the movements of the glenohumeral joint, this rhythm can be reversed, resulting in loss of stability of the scapula[1)]. During the dynamic motion of the arm, the humerus and scapula must move simultaneously for an optimum level of coherence between the humerus and the glenoid. This adaptation is necessary to maintain the relationship between the scapula and the muscles of the humeral head[4)]. The muscle system is the most important structure that supports the passive position and active functional stabilization of the scapula[5)]. The rotator cuff (RC) muscles provide dynamic stabilization of the humeral head in the glenoid fossa during normal functional activity[6)]. Due to the inhibition and weakness of these muscles, the humeral head cranially displaces, impairing the stability of the shoulder. The position of the scapula varies depending on the strength of the muscles. Shoulder pathologies, such as subacromial impingement and glenohumeral instability, can lead to changes in the position of the scapula[7)].

There are numerous studies in the literature concerning scapular asymmetry in patients with unilateral shoulder and neck pathologies[8)]. This asymmetry is assessed in different ways, such as palpation, radiographic measurement methods, and the Lateral Scapular Slide Test (LSST)[1–9, 10)]. The LSST, described by Kibler, is a test used to determine scapular asymmetry, and there are various studies investigating its validity and reliability[2–11, 12)]. There are also studies investigating the scapular asymmetry in patients with subacromial impingement, in athletes and in healthy individuals[13, 14)]. However, there are limited studies in the literature about scapular asymmetry and protraction in patients with different cervical and shoulder pathologies. The aim of this study was to compare cases with different shoulder and cervical pathologies in terms of shoulder protraction and scapular asymmetry.

SUBJECTS AND METHODS

This study was carried out on patients who were admitted to hospitals in the city of Kutahya due to pain in the shoulder and the neck, were diagnosed, and defined their pain based on the VAS. Individuals without pain were included in the control group. A total of 216 subjects between

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Table 1. Demographic characteristics of the subjects

Variables	Patient Group (n=108)		Control Group (n=108)	
	X	Min-Max	X	Min-Max
Age (years)	50.7±12.1	30–70	45.2±10.7	30–70
Height (meters)	1.63±0.08	1.50–1.83	1.65±0.10	1.50–1.85
Weight (kg)	74.6±11.8	40–115	73.7±14.4	45–110
BMI (kg/m^2)	27.7±4.5	13.8–42.5	26.8±4.2	16.5–36.7
Sex				
Male (%)	29.6% (32)		39.8% (43)	
Female (%)	70.4% (76)		60.2% (65)	
Dominant				
Right (%)	92.6% (100)		94.4% (102)	
Left (%)	7.4% (8)		5.6% (6)	
Used to Exercises	35.5 % (38)		17.6% (19)	
Alcohol Usage	5.6% (6)		5.6% (6)	
Smoking Habit	22.4% (24)		22.2% (24)	

x, mean; min, minimum; max, maximum

the ages of 30 and 70 were included, 108 (45.2±10.7 years) of which were in the patient group and 108 of which were healthy individuals (50.7±12.1 years) included in the control group. The patients were selected by the convenience sampling method. All of the subjects provided an informed consent form for participation in the study. The study was conducted in accordance with the Declaration of Helsinki. The subacromial impingement group (SIG) was comprised of patients with a diagnosis of rotator cuff tear and impingement; the inflammatory group (IG) was comprised of patients with a diagnosis of adhesive capsulitis of the shoulder joint; and the disc herniation group (DHG) was comprised of patients with pain in the arm and the trapezius muscle due to disc herniation. For the patient group, the cases with problems in the dominant extremity were selected. The control group (CG) consisted of cases with no prior neck and shoulder problems or pain. Personal information of the participants, including smoking, drinking, and exercise habits, are presented in Table 1.

The severity of pain was determined by the VAS. The asymmetry of the scapula was evaluated with the LSST using a total of five test positions, including two modified positions[1]. The protraction of the scapula was evaluated by the shoulder protraction test. All the measurements were made by the same physiotherapist with a Holtain metal tape with an accuracy of ± 0.1 mm. The physiotherapist had 8.3 years of experience, and the procedures were repeated until he was assured of the accuracy of the measurements. A more detailed explanation of the tests is given below.

VAS: The VAS is a scale comprised of a vertical line 100 mm in length with 0, meaning "no pain," written on one end and 100, meaning "unbearable pain," written on the other. The patient indicates the level of the pain that is felt on the line. The reliability of the test was determined previously (r=0.98, N=39)[15].

Scapular Test: The Lateral Scapular Slide Test (LSST), which was described by Kibler in 1998, was used. The test was performed in three different positions. The distance between the inferior angle of the scapula and the spine at the 7th thoracic vertebra was measured bilaterally, and the difference between the two measurements was recorded. The reliability of the test was determined in 2006 by Thomas and James in patients with shoulder problems and healthy individuals[12].

Test position 1: Test position 1 was performed with the shoulder in a neutral position. The subject was asked to stand up with his arms hanging freely, and the measurements were made (Fig. 1) (r=0.96, N=33)[12].

Test position 2: The subject was positioned with the shoulder in 40° abduction. The hands of the subject were placed on the iliac crest, and the measurements were made (Fig. 2) (r=0.93, n=33)[12].

Test position 3: The subject was positioned with 90° abduction of the shoulder, full internal rotation and full radioulnar pronation, and the measurements were made (Fig. 3) (r=0.84, n=33)[12].

Furthermore, test additional positions, which were modified positions based on Kibler's test, were used.

Test position 4: For this modified test position, the subject was positioned with 90° flexion and full internal rotation of the shoulder, and the Kibler's test protocols were applied (Fig. 4).

Test position 5: For this modified test position, the hands of the subject were placed on the occiput. With the shoulder in abduction and external rotation, the Kibler's test protocols were applied (Fig. 5).

Protraction Test:

Test position 6: While the subjects were standing against a wall with full contact of the back and the heels with the wall, the distance between the acromion and the wall was measured bilaterally and noted (Fig. 6)[16].

Statistical Analysis: The SPSS 20 package was used. The descriptive data are given as mean, standard deviation, and percentage values. The independent samples t-test was used to compare the data from the control and patient groups. Analysis of variance (ANOVA) was used to com-

Fig. 1. Test position 1 standing in a dependent position

Fig. 2. Test position 2 with arms resting on hips with thumbs posterior

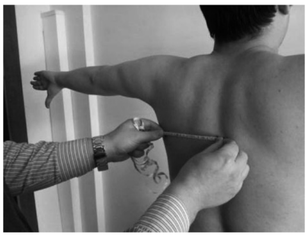

Fig. 3. Test position 3 with 90° of shoulder abduction and full internal rotation

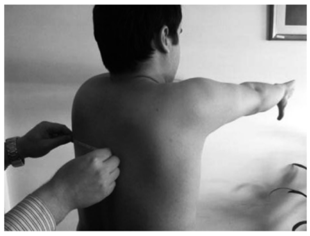

Fig. 4. Test position 4 with 90° of shoulder flexion and full internal rotation

Fig. 5. Test position 5 with the hands pleaced on the occiput

Fig. 6. Test position 6 standing against a wall

pare the control subjects and groups of patients with different pathologies. ANOVA with the post hoc Tukey's test was used to determine the groups showing a significant difference. A p value of 0.05 was considered significant.

RESULTS

The VAS score of the patients during the activities was 66 ± 23.7 (20–100) mm, and the resting VAS score was 40 ± 29.3 (20–100) mm. In the LSST and modified LSST, the scapular asymmetry and shoulder protraction on the affected side in the patient group were significantly higher ($p < 0.05$), which were measured on the dominant extremities of the patients. On the unaffected side, there was no difference in shoulder protraction ($p > 0.05$). The results and p-values are given in Table 2.

The patients included in the study were divided into different groups according to their pathologies. They were compared in terms of scapular asymmetry and shoulder protraction by means of the tests described above. There were no differences between the SIG, IG, and DHG groups according to the results for test position 1, 4, and 5 ($p>0.05$). However, the results of the CG group were statistically significant ($p <0.05$). According to the results for test position 3, there was a significant difference in the SIG and CG groups compared with the other groups ($p <0.05$). According to the results for test position 2, there were no significant differences in the SIG and the CG groups ($p>0.05$), whereas the DHG and CG groups were different from the others ($p<0.05$). There were no differences in the shoulder protraction values on the affected and unaffected sides in the patient group and CG group ($p>0.05$). The mean and the standard deviations of the groups are given in Table 3.

DISCUSSION

In this study, the scapular asymmetry and shoulder protraction of 216 cases (108 patients and 108 healthy individuals) were evaluated. We found that the pathologies of the shoulder and cervical region cause scapular asymmetry and

Table 2. Results for scapular asymmetry and protraction tests of subjects

Tests	Patient Group (n=108)		Control Group (n=108)	
	X±SD	Min-Max	X±SD	Min-Max
Test position 1 (cm)	0.90±0.07	0–4	0.31±0.04	0–2
Test position 2 (cm)	0.90±0.07	0–3	0.34±0.04	0–2
Test position 3 (cm)	0.93±0.07	0–3.5	0.35±0.04	0–3
Test position 4 (cm)	0.96±0.07	0–4	0.34±0.04	0–3
Test position 5 (cm)	0.82±0.06	0–3	0.27±0.04	0–2
Test position 6 (effect side) (cm)	12.17±2.30	6–19	11.50±1.99	5–18
Test position 6 (unaffected side) (cm)	12.01±2.32	7–22	11.53±2.04	5–18

cm, centimeter; X, mean; SD, standard deviation; min, minimum; max, maximum

Table 3. Results for scapular asymmetry and protraction tests of subjects with different pathologies

Tests	SIG n=33	IG n=40	DHG n=35	CG n=108
Test position 1 (cm)*	0.88±0.13	0.90±0.10	0.88±0.17	0.31±0.04[a]
Test position 2 (cm)*	1.14±0.19	0.86±0.08	0.72±0.14[a]	0.34±0.04[a]
Test position 3(cm)*	0.64±0.15[a]	1.09±0.11	0.81±0.09	0.35±0.04[a]
Test position 4 (cm)*	0.74±0.11	0.96±0.10	1.20±0.16	0.34±0.04[a]
Test position 5(cm)*	0.72±0.10	0.87±0.09	0.79±0.11	0.27±0.00[a]
Test position 6 (effect side) (cm)*	12.62±2.21	12.38±2.15	11.09±2.59	11.50±1.99
Test position 6 (uneffected side) (cm)*	12.34±2.30	12.20±2.12	11.40±2.84	11.53±2.04

SIG, subacromial impingement group; IG, inflammatory group; DHG, disc herniation group; CG, control group
*Anova, Tukey's test. a: different from other groups

shoulder protraction on the affected side. The pathologies of the included patients consisted of impingement, disc herniation, and acute pathologies.

In the literature, there are various studies about asymmetry of the scapula in patients with impingement or rotator cuff tear. Escamilla et al. (2009) reported that the infraspinatus and supraspinatus muscles play an important role in the position of the scapula and that at the maximal humeral elevation, there is scapular rotation of 45–55 degrees[17]. Schachter et al. (2010) emphasized the importance of scapula stabilizers in the pathologies of the shoulder and in athletes[18]. Furthermore, it was demonstrated in 32 patients with multidirectional instability of the shoulder joint that the scapulothoracic and glenohumeral joint rhythm changed due to a decrease in muscle strength and that these problems can be solved by physiotherapy[19]. Baltaci et al. (2007) revealed the effectiveness of rehabilitation in patients with shoulder problems[20].

The position of the scapula is very important for muscle balance. The scapula retains its external rotation during retraction, which forms a support for the function of the RC muscles. On the other hand, when the scapula is protracted, there is a decrease in the strength of the RC muscles due to the decreased ability to generate internal and external power. In a study in which 11 patients with a diagnosis of impingement were compared with 11 healthy individuals, Laudner et al. (2006) observed that the pathology caused a posterior tilt of the scapula[21]. Alizedah et al. reported in 2009 that there is a significant relationship between the contraction abilities of the muscles in the shoulder region and the position of the scapula and that shoulder protraction developed due to poor posture creates a disadvantage for muscle function[22]. Furthermore, they stated that not only do the changes in the position of the scapula interfere with muscle performance but also that poor posture has an effect on this situation. These studies showed that scapular asymmetry and protraction develop because of subacromial impingement syndrome.

In a similar study, DiVeta et al. reported in 1990 that scapular protraction leads to an abnormal position of the scapula and causes an increase in the distance between the inferior angle of the scapula and the spinous process of the vertebra[23]. Our results were in agreement with those in the literature, showing that pathologies such as impingement, rotator cuff tear inflammation, and disc herniation all cause scapular asymmetry and consequently protraction in the affected extremity.

However, no research exists comparing patients with different cervical and shoulder pathologies. In our study, patients with different diagnoses were divided into groups and compared and contrasted in terms of scapular asymmetry and protraction. In these cases, although there was significant scapular asymmetry and protraction compared with the healthy individuals, there were no differences among the patient groups.

In our study, the LSST and modified LSST positions were used to study the layout of the scapula. In order to determine the asymmetry of the scapula, many studies in the literature were examined. Lewis et al. (2002) claimed that superficial palpation of the scapula is a reliable method to determine scapular position[10]. Dennis et al. (1996) used the Lennie test and stated that this test, based on radiography, is reliable[9]. Kibler's Lateral Scapular Slide Test (LSST) has been used to determine scapular asymmetry[1]. Asymmetry can be determined by calculating the differences among the three different measurements in the various positions. By the LSST, values of less than 1 cm indicate a normal shoulder, whereas the values above 1 cm are pathological. Microtrauma of the shoulder joint can cause pain and impaired functions. In our study, the LSST values in the patient group were under 1 cm, and these patients all had symptoms due to the pathology of the shoulder. Our results for the 108 cases with scapular asymmetry indicate that the pathological value of 1 cm described by Kibler is too high.

There are studies suggesting that the LSST is variable and therefore produces unreliable results[2–11]. On the other hand, T'Jonck et al. (1996) stated that the LSST is a reliable method, which would be a promising method for future studies, after a period of adaptation. In a study with 27 patients with shoulder pain and 30 control subjects, Shadmehr et al. (2010) reported that the LSST has a low reliability[24, 25]. Thomas and James (2006) determined the reliability of the LSST test in 2006 in 33 men, and they found the test to be reliable by intrarater and interrater test evaluation[12]. The LSST test was used in our study. In addition, considering the discussions in the literature, two modified LSST positions were added. Although there are controversial results in the literature regarding the test results, we have been able to determine the asymmetry in our subjects using this test.

The number of cases (a total of 216, including 108 patients and 108 healthy individuals) in the study is high compared with other studies in the literature. One aspect that was different from other studies in the literature was the comparison of patients with different pathologies. However, due to the low number of patients with some of the pathologies, no significant differences were found. Although the values seem to be similar, we believed that the cases with different diagnoses would have different postures. In order to illustrate these differences, the evaluation methods could be expanded and the number of cases could be increased. Furthermore, a scoliometer or caliper could be used for the assessment. The three-dimensional electromagnetic tracking method has been used recently for examining the scapula at five different angles. However, there are some clinical problems regarding this technique. There are studies claiming that the validity and the reliability of these tests are impaired due to the movement of the skin between the sensor and the scapula[26]. The validity and the reliability of the tests used by Kibler were determined by Thomas and James (2006)[12]. However, the results of this test may vary due to the structural changes in the cases. For example, the inferior angle of the scapula can be affected by both the upward rotation and the protraction of the scapula. Further studies are needed for modified tests that can differentiate protraction from rotation and can be used as a guide in the planning of rehabilitation.

In conclusion, asymmetry of the scapula is observed in patients with cervical and shoulder pathology. This asymmetry results in protraction on the affected side. The LSST test is sufficient to determine scapular asymmetry and also a practical method for clinical applications. However, the value of 1 cm as a pathological indicator, as described by Kibler, is thought.

REFERENCES

1) Kibler WB: The role of the scapula in athletic function. Am J Sports Med, 1998, 26: 325–337. [Medline]
2) Odom CJ, Taylor AB, Hurd CE, et al.: Measurement of scapular asymmetry and assessment of shoulder dysfunction using the lateral scapular slide test: a reliability and validity study. Phys Ther, 2001, 81: 799–809. [Medline]
3) Donatelli R: Sports Specific Rehabilitation. Edinburgh: Churchill Livingstone, 2007, pp 175–190.
4) Johnson MP, McClure PW, Karduna AR: New method to assess scapular upward rotation in subjects with shoulder pathology. J Orthop Sports Phys Ther, 2001, 31: 81–89. [Medline]
5) Nijs J, Roussel N, Vermeulen K, et al.: Scapular positioning in patients with shoulder pain: a study examining the reliability and clinical importance of 3 clinical tests. Arch Phys Med Rehabil, 2005, 86: 1349–1355. [Medline] [CrossRef]
6) Bassett RW, Browne AO, Morrey BF, et al.: Glenohumeral muscle force and movement mechanics in a position of shoulder instability. J Biomech, 1990, 23: 405–415. [Medline] [CrossRef]
7) Porter BS: Tidy's Physiotherapy, 13th ed.: Yavuz Yakut, Hulya Kayıhan (Eds.) Elsevier Published, 2008, S21–68.
8) Ha SM, Kwon O, Yi C, et al.: Effects of passive correction of scapular position on pain, proprioception, and range of motion in neck-pain patients with bilateral scapular downward-rotation syndrome. Man Ther, 2011, 16: 585–589. [Medline] [CrossRef]
9) Sobush DC, Imoneau GG, Dietz KE, et al.: The lennie test for measuring scapular position in healthy young adult females: a reliability and validity study. J Orthop Sports Phys Ther, 1996, 23: 39–50. [Medline]
10) Lewis J, Green A, Reichard Z, et al.: Scapular position: the validity of skin surface palpation. Man Ther, 2002, 7: 26–30. [Medline] [CrossRef]
11) Sobush DC, Simoneau GG, Dietz KE, et al.: The lennie test for measuring scapular position in healthy young adult females: a reliability and validity study. J Orthop Sports Phys Ther, 1996, 23: 39–50. [Medline]
12) Curtis T, Roush JR: The lateral skapular slide test: a teliability study of males with and without shoulder pathology. N Am J Sports Phys Ther, 2006, 1: 140–146. [Medline]
13) Graichen H, Bonel H, Stammberger T, et al.: Three-dimensional analysis of the width of the subacromial space in healthy subjects and patients with impingement syndrome. AJR Am J Roentgenol, 1999, 172: 1081–1086. [Medline] [CrossRef]
14) Lin JJ, Hanten WP, Olson SL, et al.: Functional activity characteristics of individuals with shoulder dysfunctions. J Electromyogr Kinesiol, 2005, 15: 576–586. [Medline] [CrossRef]
15) Revill SI, Robinson J, Rosen M, et al.: The reliability of a linear analogue for evaluating pain. Anaesthesia, 1976, 31: 1191–1198. [Medline] [CrossRef]
16) Otman S, Kose N: Based Evaluation Principles on the Treatment Movement, 4th ed. Yucel, 4. Print, 2008, 44–50.
17) Escamilla RF, Yamashiro K, Paulos L, et al.: Shoulder muscle activity and function in common shoulder rehabilitation exercises. Sports Med, 2009, 39: 663–685. [Medline] [CrossRef]
18) Schachter AK, McHugh MP, Tyler TF, et al.: Electromyographic activity of selected scapular stabilizers during glenohumeral internal and external rotation contractions. J Shoulder Elbow Surg, 2010, 19: 884–890. [Medline] [CrossRef]
19 Kiss RM, Illyés A, Kiss J: Physiotherapy vs capsular shift and physiotherapy in multidirectional shoulder joint instability. J Electromyogr Kinesiol, 2010, 20: 489–501. [Medline] [CrossRef]
20) Baltaci G, Tunay V, Binnet M, et al.: Rehabilitation in arthroscopic subacromial decompression: six-year follow-up. Physiotherapy Rehabil, 2007, 18: 201–208.
21) Laudner KG, Myers JB, Pasquale MR, et al.: Scapular dysfunction in throwers with pathologic internal impingement. J Orthop Sports Phys Ther, 2006, 36: 485–494. [Medline]
22) Alizadeh MH, Daneshmandi H, Shademan B, et al.: The effects of exercise training on scapula position of muscle activity measured by EMG. World J Sport Sci, 2009, 2: 48–52.
23) DiVeta J, Walker ML, Skibinski B: Relationship between performance

of selected scapular muscles and scaptilar abduction in stuiding subjects. Phys Ther, 1990, 70: 470–476. [Medline]
24) T'Jonck L, Lysens R, Grasse G: Measurements of scapular position and rotation: a reliability study. Phys Res Int, 1996, 1: 148–158.
25) Shadmehr A, Bagheri H, Ansari NN, et al.: The reliability measurements of lateral scapular slide test at three different degrees of shoulder joint abduction. Br J Sports Med, 2010, 44: 289–293. [Medline] [CrossRef]
26) McClure P, Greenberg E, Kareha S: Evaluation and management of scapular dysfunction. Sports Med Arthrosc. 2012, 20: 39–48. [Medline] [CrossRef]