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# Evaluation of Clinical Subacromial Impingement Test Positive Patients with Ultrasonographic Subacromial Impingement Test

Klinik Subakromial Sıkışma Testi Pozitif Hastaların Ultrasonografik Subakromial Sıkışma Testi ile Değerlendirilmesi

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## Evaluation of Clinical Subacromial Impingement Test Positive Patients with Ultrasonographic Subacromial Impingement Test

**ABSTRACT**

**Objective:** Knowing which of the special clinical tests used in subacromial impingement syndrome is more successful in making the diagnosis is important for patient evaluation, determining if further examination is necessary, and arranging treatment. Utilizing sonographic impingement as a reference diagnostic technique, the study sought to evaluate how well clinical test results performed in diagnosing patients with subacromial impingement syndrome.

**Material and Method:** The study involved 42 patients with shoulder pain and at least one positive subacromial impingement test, including Neer, Hawkins, or Yocum tests. Dynamic sonographic compression of the tendon in the coracoacromial area was examined by abducting the shoulder. Dynamic sonographic compression findings were compared with clinical examination tests.

**Results:** In 40.5% of the patients, the ultrasonographic impingement test was positive. Hawkins test was positive in 81% of patients, Neer test was positive in 69% of patients, and Yocum test was positive in 78.6% of patients. A significant relationship was found between the ultrasonographically evaluated subacromial impingement test and the Neer test, but no significant relationship was found with other special tests (Hawkins and Yocum test) (*p=0.02, p=0.4, p=0.12,* respectively).

**Conclusion:** We have demonstrated a significant relationship between the ultrasonographic finding of dynamic subacromial impingement and the Neer test, which is a non-invasive and device-independent physical examination test.

**Keywords:** Dynamic sonographic impingement, Hawkins test, Neer test, shoulder pain, subacromial impingement syndrome, Yocum test.

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**ÖZET**

**Amaç:** Subakromial sıkışma sendromunda kullanılan özel klinik testlerin tanıdaki başarısının bilinmesi hasta değerlendirmesinde, ileri tetkik gerekip gerekmemesi ve tedavi düzenlenmesi açısından önemlidir. Subakromial sıkışma sendromu tanılı hastalarda sonografik olarak sıkışma varlığını referans alarak klinik muayene testlerinin tanısal performansını belirlemek amaçlandı.

**Gereç ve Yöntem:** Çalışmaya Fizik Tedavi ve Rehabilitasyon polikliniğine şikâyeti omuz ağrısı olan ve muayenede en az 1 subakromial sıkışma testi pozitif olan (Neer, Hawkins veya Yocum testinden en az biri) 42 hasta dahil edildi. Omuza abdüksiyon yaptırarak korakoakromial alanda supraspinatus tendonuna ait dinamik sonografik sıkışma bulgusu değerlendirildi. Klinik muayene testleri ile dinamik sonografik sıkışma bulgusu karşılaştırıldı.

**Bulgular:** Hastaların %40,5'inde ultrasonografik olarak sıkışma testi pozitif idi. Hawkins testi %81 hastada, Neer testi %69 hastada, Yocum testi %78,6 hastada pozitif idi. Ultrasonografik olarak değerlendirilen subakromial sıkışma testi ile Neer testi arasında anlamlı ilişki saptandı, diğer özel testler (Hawkins ve Yocum testi) ile anlamlı ilişki saptanmadı (*p=0,02, p=0,4, p=0,12* sırasıyla).

**Sonuç:** Ultrasonografik dinamik subakromial sıkışma bulgusunun, non-invaziv ve cihaz bağımsız yapılabilen fizik muayene testlerinden Neer testi ile anlamlı ilişkisini göstermiş olduk.

**Anahtar Sözcükler:** Dinamik sonografik sıkışma, Hawkins testi, Neer testi, omuz ağrısı, subakromial sıkışma sendromu, Yocum testi.

## Introduction

Shoulder pain impacting 16% to 26% of adults is the third most common cause of musculoskeletal complaints, and roughly 1% of adults seek medical attention each year for new shoulder pain (1). Soft tissues in the vicinity of the shoulder joint become painfully compressed in a clinical condition known as shoulder impingement syndrome. Patients experience pain when lifting their arms or lying on the affected side (2).

The coracoacromial ligament (CAL) joins the scapula's acromion and coracoid process, forming an osteoligamentous static limitation against upper humeral head displacement (3). The subacromial space is bounded above the lower surface of the acromion, acromioclavicular joint, and CAL, and below the head of the humerus (4). The gap is traversed by the long head of the biceps tendon, the subdeltoid bursa, and the supraspinatus and subscapularis tendons (5).

There are over 180 distinct shoulder physical examination tests reported in the literature, and deciding which ones to utilize is difficult. Furthermore, several labels for the same test may be used, or alternative positivity criteria may exist for the same test. Again, numerous physical examination tests of the shoulder have been used to diagnose a variety of shoulder conditions (6). Positive results from the subacromial impingement test during a dynamic sonographic evaluation of a shoulder with normal still images may point to rotator cuff issues (7).

Knowing which of the special clinical tests used in subacromial impingement syndrome is more successful in obtaining the diagnosis is significant for determining whether further testing is necessary and for treatment planning. Based on this, we aimed to examine the diagnostic performance levels of clinical test results in patients with subacromial impingement syndrome, using the sonographic impingement finding as the reference diagnostic method.

## Materials and Methods

Before the Study, ethical approval was received from the local ethics committee (Ankara Dışkapı Training and Research Hospital, date: 04.04.2022 and decision no: 134/10). The study was conducted by the Declaration of Helsinki. Informed consent from the patients participating in this study was also obtained.

The study included 42 patients who presented to the physical medicine and rehabilitation outpatient clinic with shoulder pain (where all of them had positive painful arch test) and at least one positive subacromial impingement test (either the Neer, Hawkins, or Yocum test as they have high sensitivity in subacromial impingement syndrome test) (8-10). We also preferred these tests since we use them frequently in the outpatient clinic.

*Exclusion criteria*

The following conditions were not included in this study:

Those who have undergone a surgical procedure on the evaluated shoulder,

Those who have had steroid injections into the shoulder within the last 3 months,

Patients with a shoulder fracture and/or ongoing treatment due to a fracture,

Patients with frozen shoulder,

Patients with glenohumeral osteoarthritis, rotator cuff tendinitis-rupture, and subacromial bursitis,

Patients with bicipital tendonitis (since it frequently accompanies subacromial compression, it was excluded in order not to affect clinical test results.)

rheumatological disease, neuromuscular disease and/or serious comorbidities, cervical discopathy, and,

Those with a history of cervical trauma.

Patient demographics (including age, gender, employment, and level of education), dominant shoulder, affected shoulder, comorbidities, and clinical shoulder examination tests were recorded. Professional groups such as plasterers, assembly workers, and construction workers were included in the group with heavy work above shoulder level. While one physician performed the clinical examination for each patient, another physician performed the US evaluation for each patient. Clinical tests and ultrasonographic evaluations of the patients were performed by different physicians. The physician performing in US was not informed about the patients' clinic. The patient underwent all US examinations while seated and with their shoulder in a neutral position.

*Neer test:* The person performing the examination

administers the Neer test while standing behind the patient. While one hand prevents scapular rotation, the other hand flexes the patient's arm forward, closing the gap between the greater tuberosity and the anteroinferior aspect of the acromion until the patient feels pain or full flexion. If the patient experiences pain before fully flexing the arm, the test is positive (11,12) (Figure Ia).

**Figure I** (a)Neer Test (b)Hawkins Test (c)Yocum Test

*Hawkins Test:* For the Hawkins test, the examiner flexes the arm to 90° with the elbow flexed at 90° and then slowly brings it into internal rotation. The test is positive if pain is experienced (13) (Figure Ib). *Yocum Test:* The Yocum test involves forcing the arm into abduction and flexing the elbow until the hand rests on the opposite shoulder. After that, the patient elevates their elbow without moving their shoulder. If the patient experiences discomfort during the maneuver, the test is termed positive (14) (Figure Ic).

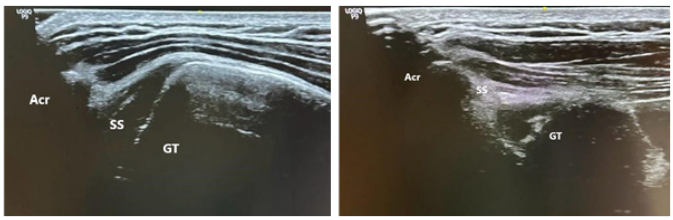


**Figure II** (a)Dynamic US testing for subacromial impingement in neutral position (Acr: acromion; SS: supraspinatus; GT: great tuberosity) (b)Dynamic US testing for subacromial impingement in abducted position (Acr: acromion; SS: supraspinatus; GT: great tuberosity)

*Ultrasonographic Evaluation*

First, with the probe on the lateral side of the shoulder, the supraspinatus tendon, subacromial bursa, and acromioclavicular joint were assessed in the transverse and longitudinal planes. Dynamic sonographic compression of the supraspinatus tendon in the coracoacromial area was examined by abducting the shoulder. The bicipital and subscapular tendons were evaluated from the anterior of the shoulder in two planes. The bicipital tendon was assessed both in the groove and distally. Externally rotating the shoulder was performed to examine the subscapularis tendon. From the posterior, the infraspinatus tendon and glenohumeral joint were assessed.

**Table I** Demographic and clinic data

| | |
|---|---|
| **Age (mean/SD)** | 54.2 (8.96) |
| **Gender n (%)** | |
| Female | 31 (73.8) |
| Male | 11 (26.2) |
| **Education level n (%)** | |
| Illiterate | 5 (11.9) |
| Primary school | 17 (40.5) |
| Middle school | 3 (7.1) |
| High school | 11 (26.2) |
| College | 2 (4.8) |
| University graduate | 4 (9.5) |
| **Symptom duration n (%)** | |
| 3-6 months | 15 (35.7) |
| 6-12 months | 8 (19) |
| >12 months | 19 (45.2) |
| **Occupation n(%)** | |
| Heavy work above shoulder level | 6 (14.3) |
| Light work above shoulder level | 36 (85.7) |
| **Dominant hand n (%)** | |
| Right | 42 (100) |
| **Affected shoulder n(%)** | |
| Right | 26 (61.9) |
| Left | 16 (38.1) |
| **Comorbidity n(%)** | |
| DM | 10 (23.8) |
| HT | 6 (14.3) |
| Thyroid disease | 5 (11.9) |
| Renal disease | 3 (7.1) |
| HL | 2 (4.8) |
| Heart valve disease | 2 (4.8) |
| COPD | 1 (2.4) |

DM: Diabetes mellitus; HT: Hypertension; HL: Hyperlipidemia; COPD: Chronic obstructive pulmonary disease

The patient was requested to raise their arm midway between flexion and abduction, with the hand in pronation and the elbow in extension, throughout the dynamic sonography evaluation. Between the acromion and the greater tubercle of the humerus,

in the coronal plane and along the supraspinatus tendon's long axis, was where the ultrasonic probe was positioned (15) (Figure IIa, Figure IIb).

**Table II** The rates of ultrasonographically evaluated subacromial impingement test and Neer test

| | Sonographic dynamic imp finding is positive | Sonographic dynamic imp finding is negative | Total | *p** |
|---|---|---|---|---|
| **Neer test is Positive n (%)** | 15 (35.8) | 14 (33.3) | 29 (69) | |
| **Neer test is Negative n (%)** | 2 (4.8) | 11 (26.2) | 13 (31) | *0.02* |
| **Total n (%)** | 17 (40.5) | 25 (59.6) | 42 (100) | |

*: Pearson's chi-square test

Ultrasonographic subacromial impingement was considered positive in the presence of one of the 4 findings given below:
(a) "Bundling" or fluid expansion of the SA-SD bursa lateral to the pinch point in the coracoacromial arch (16,17),
(b) "bundling" of the supraspinatus tendon lateral to the pinch point in the coracoacromial arch (17,18),
(c) protrusion of the coracoacromial ligament (19),
(d) less commonly, complete "blocking" of supraspinatus tendon movement due to "upward displacement of the humeral head to prevent its passage under the acromion" (15).

**Table III** The rates of ultrasonographically evaluated subacromial impingement test and Hawkins test

| | Sonographic dynamic imp finding is positive | Sonographic dynamic imp finding is negative | Total | *p** |
|---|---|---|---|---|
| **Hawkins test is Positive** | 15 (35.8) | 19 (45.2) | 34 (81) | |
| **Hawkins test is Negative** | 2 (4.8) | 6 (14.3) | 8 (19) | *0.4* |
| **Total** | 17 (40.5) | 25 (59.6) | 42 (100) | |

*: Pearson's chi-square test

*Statistical analysis*

The data were analyzed using the statistical software, Statistical Package for the Social Sciences (SPSS 22.0 for Windows). The Shapiro-Wilk test was utilized to assess the continuous variables in order to ascertain whether or not they displayed a normal distribution. For nominal variables, the data were reported as frequencies and percentages (%) in descriptive statistics. To investigate nominal variables, Pearson's Chi-Square test was used. When *p<0.05*, the results were considered significant.

**Table IV** The rates of ultrasonographically evaluated subacromial impingement test and Yocum test

| | Sonographic dynamic imp finding is positive | Sonographic dynamic imp finding is negative | Total | *p** |
|---|---|---|---|---|
| **Yocum test is Positive** | 11 (26.2) | 22 (52.4) | 33 (78.6) | |
| **Yocum test is Negative** | 6 (14.3) | 3 (7.14) | 9 (21.4) | *0.12* |
| **Total** | 17 (40.5) | 25 (59.6) | 42 (100) | |

*: Pearson's chi-square test

## Results

Of the total 42 patients, 31 were women (73.8%) and 11 (26.2%) were men. Average age: was 54.2. Demographic and clinic data of the patients are shown in Table I. The most common comorbidity was diabetes mellitus (10%), followed by hypertension with 6%, thyroid disease (hypothyroidism) with 5%, and renal disease (chronic renal failure) with 3%. 35.7% had symptoms for 3-6 months, 19% had symptoms for 6-12 months, and 45.2% had symptoms for more than 12 months. The dominant hand of all patients was right, and the right hand was affected in 61.9% of the patients. Ultrasonographic impingement test was positive in 40.5% of the patients. No pathology was detected in the bicipital tendon or subscapular tendon. The Hawkins test was positive in 81% of the patients, the Neer test was positive in 69% of the patients, and the Yocum test was positive in 78.6% of the patients. The ultrasonographically evaluated subacromial impingement test and the Neer test had a substantial relationship, but no significant connection was found with other specific tests (Hawkins and Yocum test). (*p=0.02, p=0.4*, and *p=0.12*, respectively). It is shown in Tables II, III, and IV.

## Discussion

In this study, which we conducted to investigate the diagnostic performance levels of clinical test results by using the presence of sonographic impingement as a reference diagnostic method in patients diagnosed

with subacromial impingement syndrome, we demonstrated its significant relationship with the Neer test. Shoulder physical examination tests are clinical examination techniques developed to assist in the diagnosis of shoulder problems. The evidence for the validity and usability of tests presented in the literature is called into doubt (6).

The special subacromial impingement test may be positive for many shoulder problems. We wanted to show which test is more associated with compression of the supraspinatus tendon. In this study comparing clinically evaluated special subacromial impingement tests and sonographic subacromial impingement tests, we found that the Neer test is more related. For a physical examination of the shoulder, numerous clinical diagnostic tests have been devised, including the Neer, Hawkins, Yergason, Speed, drop arm, horizontal abduction, and painful arc tests. In cases of subacromial impingement and other shoulder diseases, these tests may be positive (20,21).

The sensitivity of the Hawkins-Kennedy test and the Neer impingement test were reported to be 62.5% and 68.8%, respectively, in a study by Somerville et al., whereas 88.9% and 77% in a study by Mac Donald et al. (22,23). Patients were examined for subacromial impingement syndrome using five physical examination tests (Neer, Hawkins-Kennedy, Jobe, painful arch, and external rotation resistance tests) in research where the surgical diagnosis was utilized as a reference (24). The painful arch test, the Jobe test, and the external rotation resistance test provide the best diagnostic benefit and reliability, while the Neer test is clinically effective for screening subacromial impingement syndrome (24). In their study by Sengul et al. (25), in which they investigated the diagnostic performance levels of clinical tests based on magnetic resonance imaging findings in patients with shoulder pain, they showed that the Neer test had 73% sensitivity, 20% selectivity, 92% positive predictive value, and 69% accuracy in detecting supraspinatus lesions. The Hawkins test was shown to have a sensitivity of 51%, a specificity of 40%, a positive predictive value of 92%, and an accuracy of 50%.

While the Yocum test did not have an adequate diagnostic performance level in detecting supraspinatus lesions, acromioclavicular joint pathologies, and glenohumeral effusion, it was found to have a high diagnostic performance level in detecting subacromial and subdeltoid effusion. We did not observe a significant relationship between the Yocum test and the dynamic ultrasonographic test. While tests for impingement and rotator cuff conditions were typically found to be sensitive, their selectivity was shown to be low (25).

In Calis et al.'s study (8), the subacromial injection test was employed as the standard reference test. The results showed that the most sensitive diagnostic tests were the horizontal adduction test (82.0%), Neer test (88.7%), and Hawkins test (92.1%). The drop arm test (97.2%), the painful arc test (80.5%), and the Yergason test (86.1%) were shown to have the best specificity. In our study, we did not find a significant relationship between the most sensitive Hawkins test and US findings.

Highly sensitive tests appear to have low specificity scores in comparison to highly specific tests, which appear to have low sensitivity levels. Although this finding implies that these diagnostic tests are insufficient for definitive diagnosis, it also implies that they serve a significant role in clinical evaluation (8). Fodor et al. (26) reported that the Hawkins test (72.2%) was the most sensitive and the Neer test (95.3%) was the most specific in detecting subacromial impingement syndrome in their investigation comparing clinical tests with US findings. In their study, Gismervik et al. (6) found that the Hawkins test had the highest diagnostic likelihood ratio (2.86) (sensitivity 0.58, specificity 0.67) for impingement syndrome. In our study, we found a significant relationship between the Neer test and dynamic ultrasonographic test.

Wang and colleagues (19) assessed the degree of CAL protrusion in the resting position and compared it to the degree of protrusion in different test procedures in their study. They concluded that the Hawkins-Kennedy impingement test caused more CAL protrusion than Neer's impingement test and that the introverted and horizontally abducted shoulder experienced the most substantial morphological alteration in the CAL. They concluded that subacromial impingement syndrome (SIS) can be diagnosed more accurately with high-resolution ultrasonography, which is also a useful technique for the dynamic

assessment of impinging structures in clinical settings. Physical examination alone is insufficient for a reliable diagnosis of subacromial impingement since the presentation is diverse and routine clinical tests may be erroneous (27, 28). A dynamic ultrasound examination that includes a clinically relevant and well-performed physical impingement test has value (29).

## Conclusion

We have demonstrated a significant relationship between this important US finding and the Neer test, which is a non-invasive and device-independent physical examination test. In our study, magnetic resonance imaging (MRI) was not preferred due to its cost, long appointment, and imaging time, and most importantly, since subacromial compression is a dynamic finding and this cannot be achieved in MRI. Although the number of patients and the examination of a limited number of subacromial impingement tests are the limitations of our study, we think that our study is important and guiding in terms of showing which test is closest to the ultrasonographic result.

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