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Accuracy of physical examination against magnetic resonance imaging in subacromial impingement syndrome

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ABSTRACT

Background: Subacromial impingement syndrome (SIS) is a leading cause of shoulder pain, accounting for nearly half of all shoulder complaints. Accurate diagnosis is essential, yet challenging due to anatomical complexity and overlapping symptoms. While physical examination (PE) remains crucial, magnetic resonance imaging (MRI) offers superior soft tissue assessment. This study aimed to evaluate the diagnostic accuracy of specific PE tests for SIS in comparison with MRI.

Methods: A cross-sectional study was conducted on 38 patients with shoulder pain presenting to the Department of Orthopaedics, Era's Lucknow Medical College and Hospital, Lucknow, from May 2022 to May 2024. Patients underwent a series of PE manoeuvres including Passive abduction, Neer, Hawkins, Yocum, Jobe, Patte, Gerber, and Resisted abduction tests. MRI of the symptomatic shoulder was performed within five days of PE and interpreted by a blinded radiologist. Diagnostic performance of each PE test was evaluated using MRI as the reference standard.

Results: The mean participant age was 48.6 years; 63.16% were male. SIS was confirmed via MRI in 55.26% of participants. Among the PE tests, Passive abduction demonstrated the highest accuracy (68.42%), with sensitivity 72.00% and specificity 61.54%, and was the only test with statistically significant correlation to MRI (p=0.0448). Other tests such as Hawkins, Yocum, and Neer showed high sensitivity but lower specificity. The Patte test had the lowest diagnostic accuracy.

Conclusions: The Passive abduction test was the most reliable for diagnosing SIS. While some tests showed reasonable sensitivity, low specificity limited their overall accuracy. PE remains valuable but is best used in conjunction with MRI for optimal diagnosis.

Keywords: Subacromial impingement syndrome, Physical examination, MRI, Shoulder pain, Diagnostic accuracy, Orthopaedics

INTRODUCTION

Subacromial impingement syndrome (SAIS) is the most common shoulder disorder, accounting for 44-65% of all shoulder pain complaints during physician visits.[1] It includes a spectrum of subacromial space pathologies such as partial thickness rotator cuff tears, rotator cuff tendinosis, calcific tendinitis, and subacromial bursitis, which often result in functional loss and disability.[2] The subacromial space bounded by the humeral head below and the acromion, coracoacromial ligament, and acromioclavicular joint above contains critical structures like rotator cuff tendons and the bursa. Disruption of this space may lead to impingement.[3] Neer classified SIS into three stages: Stage I (edema and hemorrhage), Stage II (fibrosis and tendinitis), and Stage III (partial or complete cuff tears).[4,5] Subacromial disorders account for up to 85% of shoulder conditions seen in primary care.[6] Their management ranges from corticosteroid injections, image-guided procedures, and physiotherapy to surgical intervention.[7-10] Accurate diagnosis is essential for appropriate treatment.[11] SIS results from repetitive contact between the rotator cuff and surrounding structures, leading to progressive degeneration.[12] As noted by Neer and Birtane et al, this condition progresses from edema to fibrosis and finally to tendon rupture.[4,13] Due to complex anatomy and overlapping symptoms, diagnosis based on PE alone is challenging. Nonetheless, PE remains a critical tool for evaluating shoulder pain and weakness.[14] Magnetic resonance imaging (MRI), on the other hand, is widely accepted as a reliable, non-invasive diagnostic modality for shoulder pathologies, offering high sensitivity and detailed soft tissue visualization.[15] Various studies have evaluated PE tests against MRI as the reference standard.[15,16] MRI provides detailed imaging, including acromion morphology and supraspinatus evaluation, aiding early diagnosis and treatment planning.[17,18] However, discrepancies between PE and MRI findings underscore the need for a combined approach. Ultimately, integrating both modalities ensures a more accurate and comprehensive diagnosis. Henceforth, this study aimed to evaluate the diagnostic accuracy of physical examination for SIS in comparison with MRI findings.

METHODS

This cross-sectional study was conducted from May 2022 to May 2024 at the Department of Orthopaedics, Era's Lucknow Medical College and Hospital, Lucknow, and included 38 patients who presented with shoulder pain to the orthopaedic outpatient department. Ethical clearance was obtained from the institutional ethics committee, and informed written consent was taken from all participants prior to inclusion in the study. Patients of both genders aged 18 years and above, who reported shoulder pain and underwent MRI within five days of physical examination, were included. Individuals with a history of shoulder trauma or surgery, inflammatory rheumatic conditions, painful cervical motion, other musculoskeletal disorders of the upper limb, MRI contraindications, delayed MRI beyond five days, age below 18 years, or who were unwilling to participate were excluded.

Demographic details such as age, gender, and date of onset of symptoms were recorded. Each patient underwent a detailed physical examination that assessed both active and passive range of motion. Specific manoeuvres used to evaluate subacromial impingement syndrome included Passive abduction, Neer, Hawkins, Yocum, Jobe, Patte, Gerber, and resisted abduction tests. MRI of the symptomatic shoulder was performed within five days of the physical examination. All MRI scans were interpreted by a radiologist who was blinded to the patient's clinical history and examination findings. The diagnostic performance of each physical examination test was assessed by calculating sensitivity, specificity, positive predictive value, negative predictive value, and overall accuracy using MRI findings as the reference standard.

Statistical analysis

Data were entered in Microsoft Excel and analyzed using statistical software SPSS version 26 (SPSS Inc., Chicago, IL, USA). The continuous variables were evaluated by mean (standard deviation) or range value when required. Diagnostic accuracy was calculated. A p value of <0.05 was considered statistically significant.

RESULTS

The study included 38 participants, with the majority (44.74%) in the 41-50 age group, followed by 28.95% aged 31-40, 15.79% aged 51-60, and 10.53% aged 18-30. The mean age was 48.6 years (Figure 1). Most participants were male (63.16%), (Figure 2) and the predominant socioeconomic group was the lower middle class (34.21%) (Figure 3).

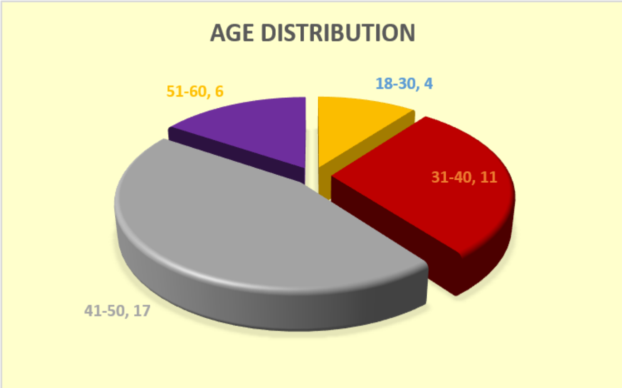

Figure 1: Age distribution of the enrolled patients.

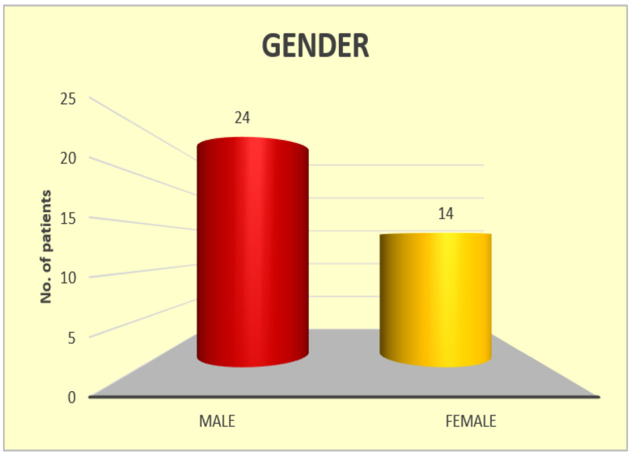

Figure 2: Gender distribution of the enrolled patients.

Physical examination findings showed that the Hawkins and Jobe tests were most frequently positive (73.68%), followed by Yocum (71.05%), Neer (65.79%), Passive abduction (60.53%), Gerber and Resisted abduction (55.26% each), and Patte (44.74%) (Figure 4).

MRI confirmed SIS in 21 participants (55.26%), while 17 (44.74%) had negative MRI findings (Figure 5). Among the tests compared to MRI, the Passive abduction test had the highest diagnostic performance with a sensitivity of 72.00%, specificity of 61.54%, PPV of 78.26%, NPV of 53.33%, and an overall accuracy of 68.42%. It was also the only test with a statistically significant p value (0.0448), indicating reliable association with MRI findings. Other tests showed lower diagnostic reliability.

Table 1: Comparison matrix of physical examination tests against MRI in detecting subacromial impingement.

Physical examination test	TP	FP	FN	TN	P value
Neer	16	9	9	4	0.7471
Passive abduction	18	5	7	8	0.0448*
Hawkins	18	9	7	4	0.8583
Yocum	19	9	6	4	0.6530
Jobe	18	11	7	2	0.3855
Patte	15	11	10	2	0.1215
Gerber	15	6	10	7	0.4154
Resisted abduction	14	9	11	4	0.4286

*p<0.05.

Table 2: Diagnostic performance of physical examination tests against MRI in detecting subacromial impingement.

Physical examination test	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
Neer	64.00	30.77	64.00	30.77	52.63
Passive abduction	72.00	61.54	78.26	53.33	68.42
Hawkins	72.00	30.77	66.67	36.36	57.89
Yocum	76.00	30.77	67.86	40.00	60.53
Jobe	72.00	15.38	62.07	22.22	52.63
Patte	60.00	15.38	57.69	16.67	44.74
Gerber	60.00	53.85	71.43	41.18	57.89
Resisted abduction	56.00	30.77	60.87	26.67	47.37

Note: TP=True positive; FP=False positive; FN=False negative; TN=True negative; PPV=Positive predictive value; NPV=Negative predictive value.

The Hawkins test had 72.00% sensitivity but only 30.77% specificity (accuracy 57.89%, p=0.8583), while the Yocum test had 76.00% sensitivity, 30.77% specificity, and 60.53% accuracy (p=0.6530).

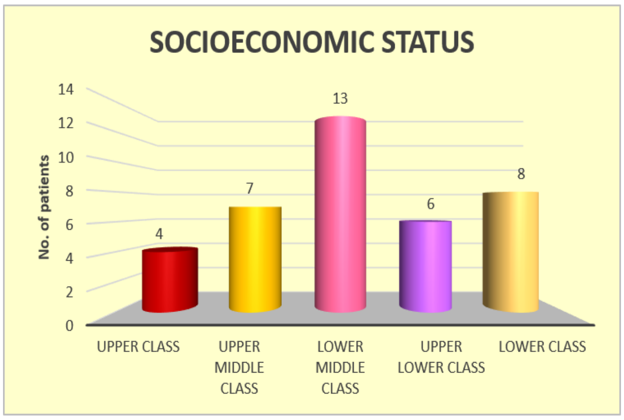

Figure 3: Socioeconomic status of the enrolled patients.

The Neer test showed 64.00% sensitivity and low specificity of 30.77% (accuracy 52.63%, p=0.7471). The Jobe test had 72.00% sensitivity, 15.38% specificity, and 52.63% accuracy (p=0.3855). The Patte test showed the lowest accuracy (44.74%) with 60.00% sensitivity and 15.38% specificity (p=0.1215). The Gerber test had moderate performance with 60.00% sensitivity, 53.85% specificity, and 57.89% accuracy (p=0.4154).

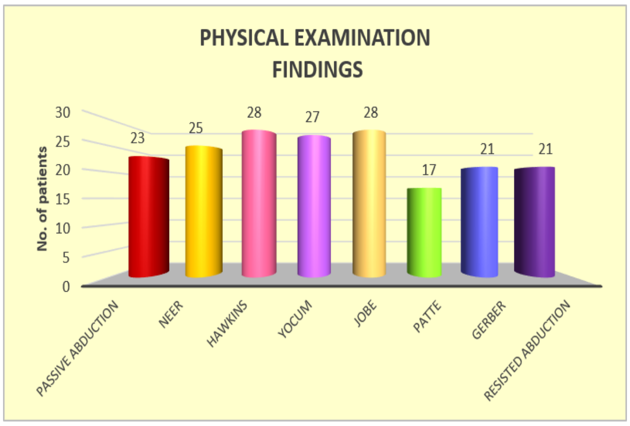

Figure 4: Physical examination findings of the enrolled patients.

The Resisted abduction test showed 56.00% sensitivity, 30.77% specificity, and 47.37% accuracy (p=0.4286). (Table 1 and Table 2). In a nutshell, the Passive abduction test was the most reliable in diagnosing SIS, followed by Gerber, Yocum, Hawkins, Neer, Jobe, Resisted abduction, and Patte, though most tests showed limited specificity.

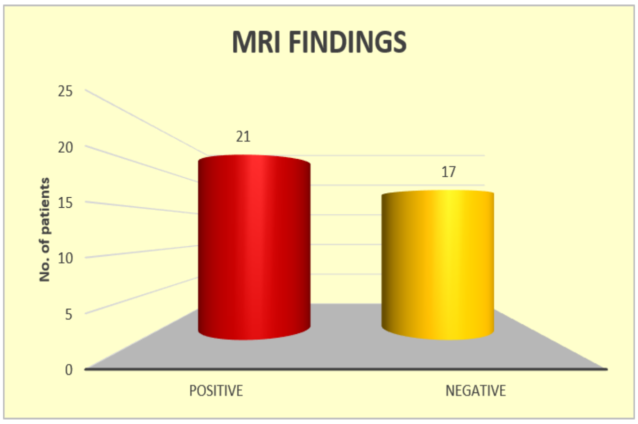

Figure 5: MRI findings of the enrolled patients.

DISCUSSION

Shoulder disorders are common and often present with overlapping symptoms, complicating diagnosis especially in older adults with multiple conditions.[2] Physical examination is useful but often insufficient.[19] MRI use has grown due to its superior soft tissue contrast.[20] SIS results from tissue compression between the humeral head and structures like the acromion, leading to rotator cuff and bursa damage.[21] Neer described it as pain during arm elevation with a fixed scapula, aiming to compress the supraspinatus tendon.[22,23] Advanced stages involve tendon degeneration or rupture.[24] Clinical tests often miss the varied causes of SIS.[22]

In our study, most patients were in the 41-50-year age group, followed by 31-40 and 51-60 years, with the fewest in the 18-30 group. The mean age was 48.6 years, similar to Birtane et al, (51.6 years), Christiansen et al, (47 years), Nanda et al, (51.5 years), and Çalış et al, (51.5 years).[13,25,26,19] Kvalvaag et al, also reported a mean age of 47 years.[27] Males comprised 63.16% and females 36.84% of our sample.[24,14] This male predominance aligns with Nanda et al, but contrasts with Birtane et al, and others suggesting demographic and regional variation.[26,13,19,27] In terms of socioeconomic status, the majority of participants belonged to the lower middle class (34.21%), followed by the lower class (21.05%), upper middle class (18.42%), upper lower class (15.79%), and upper class (10.53%), indicating a diverse economic background within the study population. Among the 38 participants with SIS, the Hawkins and Jobe tests showed the highest positivity rates, followed by Yocum, Neer, Passive abduction, Gerber, and Resisted abduction tests. The Patte test had the lowest positivity rate. MRI confirmed SIS in 21 participants, while 17 had negative results. The Neer test showed moderate sensitivity (64.00%) but low specificity (30.77%) compared to MRI.

Its PPV and NPV were 64.00% and 30.77%, with an overall accuracy of 52.63% and a non-significant p value of 0.7471. Çalış et al, reported higher sensitivity (88.7%) and similar specificity (30.5%), with PPV of 75.9% and NPV of 52.3%.[19] Leroux et al, noted a sensitivity of 89%, and 46% sensitivity with 66% specificity in stage 2 SIS using arthroscopy.[15] MacDonald et al found Neer's sign had 75% sensitivity for subacromial bursitis and 85% for rotator cuff tears.[28] Calis et al, also supported the diagnostic value of Neer, along with Hawkins and horizontal adduction tests.[19] The Passive abduction test demonstrated good diagnostic reliability for subacromial impingement syndrome, with 72.00% sensitivity, 61.54% specificity, 78.26% PPV, 53.33% NPV, and 68.42% overall accuracy. Silva et al, 2008 reported similar sensitivity (73.7%) but lower specificity (10%) and overall accuracy (51.7%).[16] In our study, the Hawkins test showed a sensitivity of 72.00%, indicating good ability to detect SIS, but had low specificity at 30.77%, limiting its accuracy in ruling out negative cases. Similar findings were reported by Çalış et al, with sensitivity and specificity of 92.1% and 25.0%, respectively, and PPV and NPV of 75.2% and 56.2%.[19] Leroux et al, reported 87% sensitivity.[15] MacDonald et al, found a sensitivity of 92%.[28]

These findings support that while Hawkins is sensitive for SIS, its specificity remains limited. The Yocum test in our study showed a sensitivity of 76.00% and a low specificity of 30.77%, indicating good ability to detect SIS but limited accuracy in ruling out negatives. Leroux et al, reported a similar sensitivity of 78%, while Silva et al, found a sensitivity of 79% and a PPV of 71.4%, slightly higher than our study's 67.86%.[15,16] However, the NPV in our study was lower compared to Silva's findings. The Jobe test showed 72.00% sensitivity and 15.38% specificity, indicating good detection but poor exclusion of SIS. PPV was 62.07%, NPV 22.22%, and overall accuracy 52.63%. Silva L et al, reported similar sensitivity (73.7%) with double the specificity, and matching PPV and NPV.[16]

Nanda et al, found 86% sensitivity and 5% specificity.[26] Gillooly JJ et al, reported 81% sensitivity, 89% specificity, and 91% PPV, supporting its clinical value.[29] The Patte test showed 60.00% sensitivity, 15.38% specificity, PPV of 57.69%, NPV of 16.67%, and 44.74% accuracy. Silva et al, found 57.9% sensitivity, 60% specificity, 73.3% PPV, and 42.9% NPV.[16] The Gerber test showed moderate diagnostic value with 60.00% sensitivity, 53.85% specificity, 71.43% PPV, 41.18% NPV, and 57.89% overall accuracy. Similarly, Silva et al, reported 68.4% sensitivity, 50% specificity, 72.2% PPV, and 45.5% NPV.[16]

A meta-analysis by Alqunaee et al, demonstrated the highest diagnostic utility (LR+16.47) with pooled specificity of 0.97 and sensitivity of 0.42, indicating the lift-off test is effective for ruling in SIS.[30] However, wide 95% CI and prediction regions suggest variability across studies. The Resisted abduction test showed limited diagnostic value with 56.00% sensitivity, 30.77% specificity, 60.87% PPV, 26.67% NPV, and 47.37% overall accuracy. A p value of 0.4286 indicates no significant association with MRI findings. Similarly, Silva et al, reported 57.9% sensitivity, 20% specificity, 59.9% PPV, and 20.00% NPV.[16] Neer and Hawkins signs are commonly used for SIS diagnosis and were the focus in studies by MacDonald et al, and others.[28,31,32] MacDonald et al, reported sensitivities of 75% for Neer and 92% for Hawkins in diagnosing subacromial bursitis via arthroscopy, though their specificity and PPV were not significantly high.[28]

Limitations

This study had a relatively small sample size and was conducted at a single center, which may limit the generalizability of the findings and introduce location-specific biases. The low specificity of several physical examination tests and the variable specificity of MRI could affect diagnostic accuracy. Future research should include larger, multi-center studies with standardized examiner training and consider using MRI as a complementary tool in complex or inconclusive cases.

CONCLUSION

The Passive abduction test demonstrated the highest combined sensitivity and specificity, making it the most reliable test overall. The Gerber test followed, showing moderate reliability. The Yocum and Hawkins tests also demonstrated reasonable sensitivity but had lower specificity. The Neer, Jobe, and Resisted abduction tests showed limited reliability due to lower specificity. The Patte test had the lowest combined sensitivity and specificity, making it the least reliable test for diagnosing SIS.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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