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COMPARISON OF EMPTY CAN TEST VERSUS FULL CAN TEST FOR DIAGNOSIS OF SUPRASPINATUS TEAR

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Abstract

Background: *Rotator cuff injuries, particularly supraspinatus tendon tears, are a prevalent cause of shoulder pain and dysfunction. Clinical diagnostic maneuvers such as the Empty Can Test (ECT) and Full Can Test (FCT) are commonly used to assess supraspinatus integrity, especially where imaging access is limited. However, their diagnostic accuracy, interobserver reliability, and patient tolerability remain variably reported.*

Operational Definitions: *The **Empty Can Test (ECT)** and **Full Can Test (FCT)** are considered positive if they reproduce shoulder pain or weakness during resisted abduction in the scapular plane. **Patient discomfort** was recorded using the **Visual Analogue Scale (VAS)**, ranging from 0 (no pain) to 10 (worst pain imaginable).*

Methodology: *This prospective diagnostic accuracy study included 60 adult patients with suspected rotator cuff pathology undergoing MRI. Each participant was assessed using both the ECT and FCT by two independent orthopedic examiners blinded to each other's findings and MRI results. The tests were evaluated for sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and interobserver reliability (Cohen's kappa). Patient-reported discomfort during each test was measured using the Visual Analogue Scale (VAS).*

Results: *MRI confirmed supraspinatus tears in 65% of patients. The ECT demonstrated higher sensitivity (82.1%) but lower specificity (66.7%) compared to the FCT (sensitivity: 74.4%; specificity: 81.0%). Both tests had identical overall diagnostic accuracy (76.7%). Interobserver reliability was higher for the FCT (κ = 0.80) than the ECT (κ = 0.63). Patient-reported pain was significantly lower during the FCT (VAS: 4.1 ± 1.2) compared to the ECT (VAS: 5.9 ± 1.3, $p < 0.001$).*

Conclusion: *Although both tests show comparable diagnostic accuracy for*

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detecting supraspinatus tears, the Full Can Test is superior in terms of specificity, interobserver reliability, and patient comfort. These findings support the use of the Empty Can Test as a sensitive screening tool and the Full Can Test as a more specific and patient-friendly confirmatory method. When used together and interpreted alongside imaging, they can enhance clinical assessment of rotator cuff pathology.

INTRODUCTION

The most often torn part of the rotator cuff complex is the supraspinatus tendon, making rotator cuff injuries one of the most common musculoskeletal conditions affecting the shoulder. Particularly in people who engage in repetitive overhead activities or in older populations with degenerative changes, these rips are a major source of pain, weakness, and limited shoulder mobility [1]. To prevent persistent dysfunction and to inform choices about conservative versus surgical treatment, a prompt and precise identification of supraspinatus disease is crucial [2].

In situations when there is limited quick access to imaging, physical examination is crucial to the initial assessment of shoulder pathology. Clinical tests designed to isolate supraspinatus function need to be exact enough to minimize false positives from overlapping shoulder issues while also being sensitive enough to identify actual pathology. Two popular provocative procedures, the Empty Can Test and the Full Can Test, are intended to evaluate the integrity of the supraspinatus by causing discomfort or weakness during resisted abduction in the scapular plane [3,4].

A common diagnostic tool for supraspinatus involvement is the Empty Can Test, which is executed with the thumb pointed downward and the shoulder internally rotated. Subacromial impingement, which could cause pain unrelated to true tendon pathology and worse test specificity, could result from this position [5]. The Full Can Test, on the other hand, is thought to reduce impingement and provide better diagnostic accuracy while increasing patient comfort by keeping the shoulder in external rotation with the thumb pointed upward [6].

There is still a lot of variation in the reported sensitivity and specificity values for both tests, even with their extensive clinical use. While some recent studies contend that the Empty Can Test may more effectively elicit pain in cases with mild or partial tears, others contend that the Full Can Test has higher specificity and interobserver reliability [7, 8]. Furthermore, a significant but little-studied element that could affect the usefulness and acceptability of either technique in standard practice is patient-reported discomfort during testing.

Physical examination tests can be validated with the help of magnetic resonance imaging (MRI), which is currently the gold standard for diagnosing rotator cuff pathology. However, in many healthcare systems, access to MRI may be restricted or delayed, highlighting the ongoing need for accurate and repeatable bedside diagnostic techniques [9]. Additionally, recent research has highlighted the significance of interobserver agreement in musculoskeletal assessment, emphasizing that in clinical practice, repeatability is just as crucial as accuracy [10].

In light of this, a comparison of the Empty Can and Full Can tests side by side, compared to MRI and enhanced by patient-reported results, is both pertinent and timely from a clinical standpoint. In order to provide evidence to support best practices in the clinical assessment of supraspinatus tears, this study was undertaken to analyse each test's diagnostic accuracy as well as interobserver reliability and patient comfort.

This study's main goal was to compare the diagnostic accuracy of the Empty Can Test and the Full Can Test in identifying MRI-confirmed supraspinatus tears in terms of sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV). Determining the degree of discomfort that patients described throughout each movement, analyzing the association between clinical test results and MRI results, and evaluating interobserver reliability were secondary goals.

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Materials and methods:

Study Design and Setting

Over the course of eight months, this prospective diagnosis accuracy study was carried out in the orthopedic department of tertiary care hospital Rawalpindi. Following the presentation of shoulder pain indicative of rotator cuff pathology, 60 adult patients were enrolled one after the other.

Study Population and Inclusion Criteria

Inclusion criteria comprised adults aged between 18 and 70 years who were clinically suspected to have rotator cuff involvement and were scheduled for MRI of the shoulder as part of their routine diagnostic workup.

Exclusion Criteria

Patients with prior shoulder surgery, recent shoulder trauma, adhesive capsulitis, significant passive motion restriction, known inflammatory arthritis, neurological deficits involving the shoulder, or contraindications to MRI were excluded from the study.

Ethical Considerations

Ethical approval was obtained from the Institutional Review Board, and informed consent was secured from all participants prior to inclusion.

Clinical Assessment

The Empty Can and Full Can tests were part of a standardized clinical evaluation that was performed on all eligible patients. Two orthopedic examiners conducted these tests separately while being blind to the MRI results and each other's conclusions. To lessen bias, the testing order was randomized. If a test replicated discomfort and/or showed weakness during resisted shoulder elevation in the scapular plane, it was deemed positive. A visual analogue scale (VAS), with 0 representing no pain and 10 representing the worst pain possible, was used to rate the patient's discomfort during each procedure.

Radiological Assessment

Within two weeks of the clinical assessment, all subjects had an MRI of the afflicted shoulder. A 1.5 Tesla machine was used for the MRI scans, which followed typical shoulder protocols such as axial, sagittal, and coronal sequences. Based on the MRI data provided by a musculoskeletal radiologist who was blind to the clinical findings, the existence or absence of a supraspinatus tear—categorized as full-thickness, partial-thickness, or intact—was noted.

Data Collection and Statistical Analysis

Using MRI results as the gold standard, diagnostic performance parameters such as sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were computed for every test. Cohen's kappa coefficient was used to evaluate the interobserver reliability between the two examiners. The tolerability of each test was assessed using patient-reported VAS scores. Clinical and demographic data were summarized using descriptive statistics. Whereas categorical data like test results and MRI findings were presented as frequencies and percentages, continuous variables like age and VAS ratings were represented as means with standard deviations. IBM SPSS version 26.0 was used for all statistical analyses, and a p-value of less than 0.05 was deemed statistically significant.

Results:

Sixty patients in all fulfilled the requirements for inclusion and finished the research. The male-to-female ratio was 37:23, and the participants' average age was 52.4 ± 9.6 years. In 39 cases, the dominant arm was impacted (65%). The mean duration of shoulder pain before presentation was 5.3 ± 2.1 months, and most patients reported subtle start of symptoms.

39 patients (65%) had supraspinatus tendon tears confirmed by MRI; 22 (56.4%) had full-thickness rips and 17 (43.6%) had partial-thickness tears. The remaining 21 patients (35%) had subacromial bursitis or tendinosis in addition to intact supraspinatus tendons.

36 patients (60%) had positive results from the Empty Can Test, whereas 33 patients (55%) had good results from the Full Can Test. The Empty Can Test showed a sensitivity of 82.1% and specificity of 66.7% when compared to MRI results. On the other hand, the Full Can Test exhibited a higher specificity of 81.0% but a slightly lower sensitivity of 74.4%. Overall diagnosis accuracy was similar for both tests (Empty Can: 76.7%; Full Can: 76.7%).

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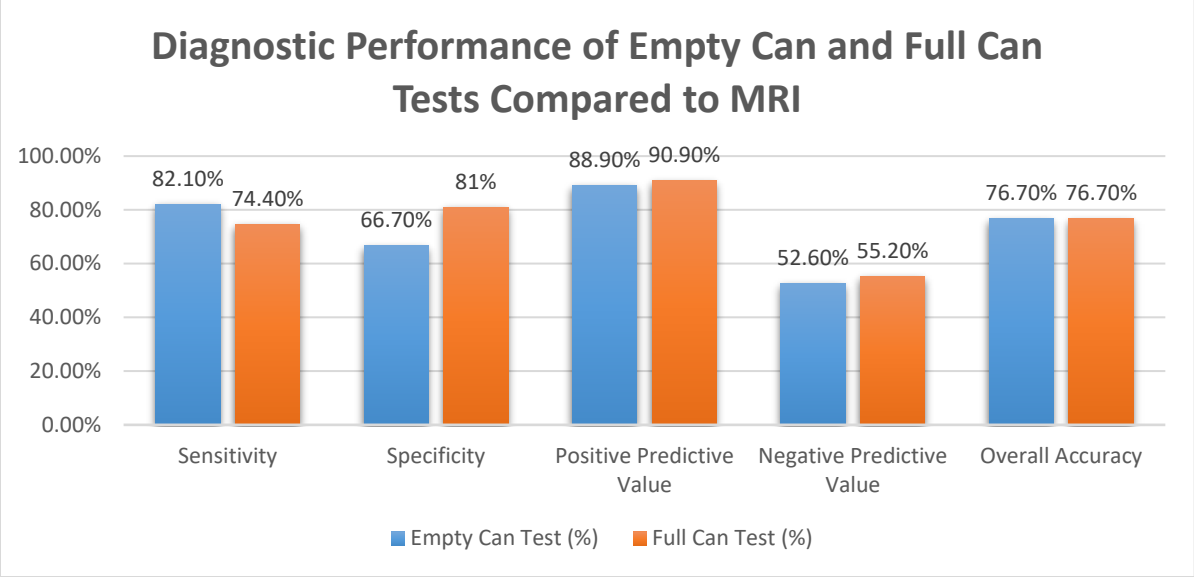

Figure 1: Diagnostic Performance of Empty Can and Full Can Tests Compared to MRI

Subgroup analysis revealed that both tests had higher sensitivity in full-thickness tear instances (Empty Can: 86.4%; Full Can: 81.8%) than in partial-thickness tear cases (Empty Can: 76.5%; Full Can: 64.7%). The Full Can Test, however, continued to have a better specificity for both types of tears. The two tests' interobserver reliability was also contrasted. With a Cohen's kappa value of 0.80, which indicates substantial agreement, the Full Can Test demonstrated a higher level of inter-rater agreement. With a kappa value of 0.63, the Empty Can Test showed moderate agreement. With a mean score of 5.9 ± 1.3 on the Visual Analogue Scale (VAS), patient-reported pain was substantially higher during the Empty Can Test than it was during the Full Can Test ($p < 0.001$). This implies that patients tolerated the Full Can Test better.

Table 2: Interobserver Reliability and Patient-Reported Pain

Test Type	Cohen's Kappa (κ)	Mean VAS Score ± SD
Empty Can Test	0.63	5.9 ± 1.3
Full Can Test	0.80	4.1 ± 1.2

Overall, while both clinical tests demonstrated comparable diagnostic accuracy, the Full Can Test outperformed the Empty Can Test in terms of specificity, interobserver reliability, and patient comfort.

Discussion:

With MRI acting as the gold standard reference, this study offers a thorough comparison of the Full Can Test (FCT) and the Empty Can Test (ECT) for the diagnosis of supraspinatus tears. Although the overall diagnostic accuracy of both tests was 76.7%, there were significant differences between them in a number of clinically significant dimensions, such as sensitivity, specificity, interobserver reliability, and patient-reported pain levels. These factors have a significant impact on the tests' usefulness and application in a variety of clinical settings [11]. Optimizing shoulder examination techniques is significantly impacted by the subtle differences between these two widely used clinical tests. Patients with actual supraspinatus tears were more accurately identified by the ECT, which had a higher sensitivity (82.1%) than the FCT (74.4%). This is consistent with previous research by Yakobellis et al., who proposed that the ECT's internal rotation

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location promotes subacromial compression and more consistently elicits symptoms in injured tendons [12]. As demonstrated in this study, the same placement may also make the test more likely to irritate nearby non-pathological tissues like the long head of the biceps tendon or the subacromial bursa, which would result in a larger false-positive rate and a comparatively lower specificity (66.7%) [13]. This decreased specificity raises questions about the possibility of misclassification in patients with widespread subacromial pain, which, if used alone, can make clinical decision-making more difficult.

Conversely, the FCT showed a higher specificity (81.0%) but a lower sensitivity, which was consistent with findings from Bodor et al. and Narasimhan et al., who ascribed this to the FCT's outward rotation posture. Because this position lessens mechanical impingement, non-supraspinatus structures cause less pain, and the test is better able to appropriately rule out false positives [14,15]. The FCT's balanced diagnostic profile and clinical dependability were further supported by its superior performance over the ECT in terms of both positive predictive value (90.9% versus 88.9%) and negative predictive value (55.2% against 52.6%) [16]. Together, these findings imply that the FCT may be preferred as a confirmatory test because of its higher specificity, even though the ECT may be better suited for initial screening.

Additionally, subgroup analysis showed that both tests performed better in diagnosing full-thickness supraspinatus tears, with the FCT obtaining a sensitivity of 81.8% and the ECT achieving 86.4%. This is probably because full-thickness tears have more structural damage, which results in more noticeable and detectable clinical signs [17]. The difficulties clinicians encounter in recognizing less extensive tendon pathology are highlighted by the significant loss in sensitivity in partial-thickness tears, especially for the FCT (64.7%). These results highlight the value of supplementary imaging techniques, including magnetic resonance imaging (MRI), when clinical examination findings are unclear or partial rips are suspected.

This study's distinction in interobserver reliability between the two tests was one of its most important findings. Compared to the ECT, which showed moderate inter-rater agreement (kappa = 0.63), the FCT showed strong agreement (Cohen's kappa = 0.80) [18]. This is in line with Wu et al.'s findings, which highlighted how the FCT's ease of use and simplicity allow for more consistent examiner interpretation. In clinical settings with several practitioners, such teaching hospitals and multidisciplinary teams, where diagnostic consistency has a direct impact on patient treatment and training results, high interobserver reliability is essential. Therefore, beyond its inherent diagnostic accuracy, the FCT's clinical utility is increased by its reproducibility.

Another crucial factor to take into account is the patient's experience throughout testing. In this investigation, the ECT elicited a statistically and clinically significant increase in pain (mean VAS 5.9 ± 1.3) in comparison to the FCT (4.1 ± 1.2) [19]. A patient's participation may be hampered by excessive discomfort during physical testing, which could distort test results and make follow-up exams more difficult. Therefore, the FCT is a more patient-friendly approach due to its more bearable nature, especially for those with inflammatory diseases or low pain thresholds.

The findings points to a complimentary role for these two manoeuvres in the clinical assessment of suspected supraspinatus disease from a practical perspective. Because of its increased sensitivity, the ECT might be best used as a screening test to identify as many prospective instances as feasible. However, positive results should ideally be validated with further specific tests or imaging examinations due to its poor specificity and the discomfort it can cause. In contrast, where diagnostic certainty is crucial, the FCT may work better as a confirmatory procedure or as a component of an improved clinical protocol because to its higher specificity, superior interobserver reliability, and increased patient comfort [20].

Even while MRI is still the gold standard for diagnosing supraspinatus tears, its restricted accessibility, high expense, and lengthy wait times in many healthcare systems underscore the continued significance of trustworthy physical examination methods. When carefully combined with imaging and clinical judgment, the FCT proves to be a very useful clinical tool, providing a reproducible and

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patient-friendly substitute without compromising diagnostic accuracy [21].

However, there are a few restrictions to take into account. The results may not be as broadly applicable as they could be due to the study's single-center design and limited sample size. Furthermore, although while MRI is commonly considered the gold standard, it may not pick up on minute microstructural tendon alterations that can only be seen by arthroscopy, which could result in an underestimation of the actual frequency of partial-thickness tears. Lastly, the complete range of clinical responses is not captured by the binary positive/negative classification of test results, which may provide more complex diagnostic insights in subsequent studies.

Conclusion:

In conclusion, when compared to MRI, the Empty Can Test and Full Can Test show similar overall diagnostic accuracy for identifying supraspinatus tears; nevertheless, they differ in important clinical characteristics. Although the Empty Can Test has a higher sensitivity, which makes it a good first screening technique, its diagnostic accuracy and tolerance may be limited by its lower specificity and increased patient discomfort. On the other hand, the Full Can Test supports its function as a confirmatory test in clinical practice by offering greater specificity, interobserver reliability, and patient comfort. Given these results, the Full Can Test is a more patient-friendly and well-rounded choice for evaluating supraspinatus, especially in instances when reproducibility and diagnostic accuracy are crucial. In contrast, the Empty Can Test might be saved for circumstances where sensitivity is the top priority. These tests work well together and, when paired with imaging, can improve the precision of diagnosing supraspinatus tears and help determine the best course of treatment.

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