Clinical Tests Diagnostic for Rotator Cuff Tear

Judie Walton, PhD and George A. C. Murrell, MD, DPhil

Abstract: This clinical outcomes study aimed to determine the commonly used shoulder tests predictive for rotator cuff tear (RCT). The study was carried out in 2 parts involving 400 patients who attended the senior author’s practice (n = 100/group). Part I compared patients with isolated RCTs and a “No-RCT” group. Part II compared RCT patients (some with isolated RCTs, others with RCTs and combined pathology) and No-RCT patients. Patients were imaged, preoperatively examined with clinical shoulder tests, and given presurgical diagnostic arthroscopy if warranted by their shoulder injury. Part I revealed 4 clinically diagnosed features significantly more common in patients with isolated RCTs than in No-RCT patients. Part II validated the findings, showing remarkably similar results. The drop arm sign (10% sensitivity, 100% specificity) affected a small proportion of subjects but where present was a strong indicator for RCT. Three other diagnostic features [supraspinatus weakness, weakness in external rotation, and impingement (SERI)] tests were highly predictive of RCT when all were positive in a subject (likelihood ratio = 12:1). If all SERI tests were negative, RCT was unlikely to be present (likelihood ratio = 0.06:1). The predictive power of this clinical test combination compares favorably with predictive powers reported for magnetic resonance imaging and ultrasound.

Key Words: shoulder, rotator cuff tear, diagnosis, clinical examination, supraspinatus, impingement, external rotation, drop arm sign, tendon aging, likelihood ratio

This study consists of 2 parts based on more than 400 consecutive patients, of the senior author’s practice, who had a variety of shoulder disorders that warrant arthroscopic examination.

Subsets

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METHODS

Subjects

This study consists of 2 parts based on more than 400 consecutive patients, of the senior author’s practice, who had a variety of shoulder disorders that warrant arthroscopic examination.

(1) Part I commenced with 100 subjects who had a RCT and lacked any other type of shoulder pathology (designated “RCT-I”). The control group consisted of the first 100 consecutive patients who had an operable shoulder condition other than RCT. In this no-tear group, 31% had shoulder instability as their main cause of disability, 15% had adhesive capsulitis, 15% had impingement, 20% had osteoarthritis, 18% had damage to the glenoid labrum, and 1 had a fracture.

(2) Part II included 100 subjects with RCT regardless of additional pathology. This group was designated as “RCT-II.” Eighty-four patients had isolated RCTs and the remaining 16 patients had RCT together with additional major shoulder pathologies: adhesive capsulitis (7), labral lesions (4), osteoarthritis (3), clavicular nonunion (1), and a greater tuberosity avulsion fracture (1). The control group consisted of 100 additional patients with an operable shoulder condition other than RCT. In this group, 25% had instability as their main cause of disability, 19% had adhesive capsulitis, 19% had impingement syndrome, 15% had labral lesions, 14% had osteoarthritis, 3% had calcific tendonitis, 3% had calcific nonunion, one had a tumor, and another had a fracture.

Preoperative Clinical Examination

The patients were requested to bring ultrasound or magnetic resonance imaging (MRI) results to their initial consultation. Their clinical history was taken, a clinical examination was given, the patient completed a pain-and-function questionnaire, his/her imaging was reviewed or taken, and a presumptive diagnosis was made. If surgical repair of the lesion was deemed appropriate, and the patient consented the patient came to surgery. The first step of the surgical procedure was diagnostic arthroscopy to evaluate the glenohumeral joint, followed by the appropriate repair. All subjects were given a systematic clinical shoulder examination comprised of the 23 shoulder tests that formed the basis of this study. The examiners were blind to imaging results. Each subject was examined for: wasting of the supraspinatus, infraspinatus, and the deltoid muscle; tenderness of the sternoclavicular joint,
acromioclavicular joint, subacromial region, and biceps region; range of motion during forward flexion, abduction, internal rotation, and external rotation (measured actively and passively).

Using manual muscle tests, strength was assessed on a scale of 0 to 5, with an additional value of 4.5 to record minimal loss of strength. Shoulder strength was tested during internal rotation, external rotation, supraspinatus strength with the arm held at 45 degrees from the midline, and lift-off (subscapularis) strength with the arm in a hand-behind-back position with the palm facing outward.

Tests were also given for certain signs: O’Brien sign, which is helpful in detecting superior labral detachment; Hawkins test for impingement during internal rotation and impingement in external rotation. This was tested with the arm ab ducted to 90 degrees, placed in full external rotation in the scapular plane, and actively moved by the examiner to the end of its range of motion with pain indicating a positive test sign. To test for the drop arm sign, the affected arm was elevated above the patient’s head by the examiner. The patient was then asked to gradually lower the arm in the coronal plane. A positive test was considered one where the subject could not control the rate of adduction between 130 and 90 degrees.

Surgical Evaluation

A diagnostic arthroscopic examination, carried out under regional anesthesia, determined the nature of the shoulder disorder and complications. If required, the diagnostic arthroscopy was followed by open surgery. All arthroscopic results were interpreted and recorded by a surgeon (G.M.), using a standard form. When a tear was present, the surgeon noted its location, size, shape, and other features on the form using anatomic landmarks as axes.

Statistical Analyses

The clinical test results were analyzed for statistical significance with SPSS and SigmaStat software (SPSS Inc. and Systat Software Inc., Chicago, IL). Preoperative findings for the RCT group scores were compared with those from the No-RCT group scores using χ² tests and Mann-Whitney rank sum tests with the significance level set at P < 0.05. The pretest probability, pretest odds, likelihood ratios, posttest odds, posttest probabilities, and confidence intervals were calculated according to Sackett et al. Likelihood ratios (sensitivity/1 – specificity) indicate how useful a test is for diagnosing a given condition. For example, a likelihood ratio ≥ 10:1 is sufficiently high to rule in a condition, 5:1 is intermediate high, 1:1 is indeterminate, 0.4:1 is intermediate low, and 0.08 is sufficiently low to rule out a condition.

In order to assess how helpful specific combinations of the predictive tests would be for diagnosing RCTs, we calculated the sensitivities, specificities, and likelihood ratios for the RCT and the No-RCT groups, based on the number of subjects who were positive for all of the predictive tests, and for 1, 2, or none of them.

When the combined test results were evaluated, supraspinatus strength and strength in external rotation were defined as less than normal if they were assessed at 4.5 or lower using manual muscle tests, providing that there was no concomitant loss of strength during internal rotation. The purpose of this restricted definition was to distinguish subjects in each group with specific weaknesses from those with general shoulder weakness. Also, impingement was considered as a single diagnostic feature, regardless of whether it was observed during internal rotation, in external rotation, or with both tests.

Magnetic resonance imaging and ultrasound likelihood ratios were based on sensitivities and specificities reported in the literature.

RESULTS

The total population of subjects in the groups designated RCT-I, No-RCT-I, RCT-II, and No-RCT-II included 219 males and 181 females. The 400 subjects ranged in age from 15 to 83 years with a mean (± SD) age of 54 ± 18 years. There were more males (55%) than females in both the RCT groups and the No-RCT groups.

The mean age of the No-RCT subjects was 44 ± 17 years whereas the mean age of the RCT subjects was 63 ± 12 years. This difference was because of a specific age-associated linear increase in percentages of RCT subjects who attended the clinic (Fig. 1).

Arthroscopic Diagnostic Findings

One hundred seventy-nine (90%) of the 200 RCT subjects had full thickness tears and 21 (10%) had either partial thickness tears or laminated tears. As for location, 127 (63.5%) tears were in the supraspinatus tendon alone; 45 (22.5%) were in the supraspinatus and the subscapularis tendons; 8 (4.0%) were in the supraspinatus and infraspinatus; 11 (5.5%) tears involved the supraspinatus, infraspinatus, and subscapularis tendons; 4 (2%) were in the infraspinatus tendon alone, 3 (1.5%) involved the supraspinatus, infraspinatus, and teres minor tendons; whereas 2 (1%) subjects each had 2 separate tears in rotator cuff tendons. Twenty-eight (14%) of the 200 RCT subjects had small tears (1 cm² or less), 116 (58%) had medium tears (from 1 up to 5 cm²), 24 (12%) had large tears (from 5 up to 9 cm²), and 32 (16%) had massive tears (>9 cm²).

Clinical Findings: Part 1

Nineteen of the 23 (83%) clinical tests produced results in the RCT-I and No-RCT-I groups that lacked significant difference and were therefore unpredictable for RCT (Table 1). These were the tests for: wasting (supraspinatus, infraspinatus, deltoid); tenderness (sternoacromial joint, acromioclavicular joint, subacromial region, biceps region); strength (for internal rotation, subscapularis); and range of motion—forward flexion, abduction, external rotation, and internal rotation.

FIGURE 1. The proportion of subjects with rotator cuff tear (RCT) increases with increasing age. Reproduced from Murrell and Walton with permission from Elsevier.
The O'Brien test was also unpredictable for RCT.

Four (17%) clinical tests (illustrated and described in Figs. 2A–D) were positive in significantly more RCT-I subjects than in No-RCT-I subjects ($P \leq 0.001$) and were therefore predictive for RCT. These tests were for (1) supraspinatus strength; (2) strength in external rotation; (3) impingement, either in internal rotation, external rotation, or both directions, and (4) the drop arm test. The percentages of affected patients in each group, differences between the groups, and confidence intervals are shown in Table 1 for the significant results.

The test for supraspinatus weakness had a sensitivity of 71%, a specificity of 83%, and a likelihood ratio of 4:1. The test for weakness in external rotation had a sensitivity of 39%, a specificity of 92%, and a likelihood ratio of 5:1. The impingement signs, when performed in internal rotation or external rotation, had similar sensitivities (73% vs. 77%), specificities (59% vs. 61%), and likelihood ratios (2:1) for predicting a RCT. If any of these tests are considered on their own they are not highly predictive. However, when combined, the likelihood ratio for these 3 tests rises to 12:1.

SERI Test Combination

The combined presence of supraspinatus weakness, weakness in external rotation, and impingement in 1 or both directions occurred much more often in RCT-I subjects than in the No-RCT-I subjects. Any 2 of these signs were at least 5 times more likely to occur in RCT-I subjects than in No-RCT-I subjects, and any single sign was almost equally likely to occur in both groups. Conversely, absence of all 3 signs was 0.06 times as likely to occur in RCT-I subjects as in No-RCT-I subjects.

The Drop Arm Sign

The test for drop arm sign, when positive, was also a good indicator of RCT as a result of its 100% specificity. However, as 89% of RCT-I subjects were able to control their rate of adduction from 130 to 90 degrees (ie, not exhibiting the drop arm sign), some RCTs are undetected by this test.

Clinical Findings: Part 2

Four clinical tests were found to be positive in significantly more RCT-II subjects than in the No-RCT-II subjects ($P \leq 0.001$), regardless of additional pathology in the former group. These 4 clinical tests were identified as predictive in both parts of this study. The differences between groups, and confidence intervals, are shown in Table 1. Hence, the results of part 2 of this study validated those of part 1.

Posttest Probability for Rotator Cuff Tears

The importance of age on RCT prevalence is such that it must be taken into account when evaluating the probability that a particular patient will have a RCT. Table 2 lists the

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**Table 1. Comparison of Clinical Findings in Patients With and Without Rotator Cuff Tears**

<table>
<thead>
<tr>
<th>Test</th>
<th>No-RCT</th>
<th>RCT</th>
<th>Difference</th>
<th>No-RCT</th>
<th>RCT</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wasting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supraspinatus</td>
<td>8</td>
<td>2</td>
<td>NS</td>
<td>3</td>
<td>9</td>
<td>NS</td>
</tr>
<tr>
<td>Infraspinatus</td>
<td>4</td>
<td>2</td>
<td>NS</td>
<td>5</td>
<td>5</td>
<td>NS</td>
</tr>
<tr>
<td>Deltoide</td>
<td>3</td>
<td>2</td>
<td>NS</td>
<td>9</td>
<td>8</td>
<td>NS</td>
</tr>
<tr>
<td>Tenderness</td>
<td>% Affected</td>
<td>Difference</td>
<td>% Affected</td>
<td>Difference</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sterno-clavicular joint</td>
<td>8</td>
<td>2</td>
<td>NS</td>
<td>1</td>
<td>2</td>
<td>NS</td>
</tr>
<tr>
<td>Acromioclavicular joint</td>
<td>18</td>
<td>11</td>
<td>NS</td>
<td>8</td>
<td>11</td>
<td>NS</td>
</tr>
<tr>
<td>Subacromial</td>
<td>24</td>
<td>13</td>
<td>NS</td>
<td>14</td>
<td>21</td>
<td>NS</td>
</tr>
<tr>
<td>Biceps</td>
<td>18</td>
<td>8</td>
<td>NS</td>
<td>13</td>
<td>14</td>
<td>NS</td>
</tr>
<tr>
<td>Range of motion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forward flexion-active</td>
<td>131</td>
<td>112</td>
<td>NS</td>
<td>125</td>
<td>114</td>
<td>NS</td>
</tr>
<tr>
<td>Forward flexion-passive</td>
<td>134</td>
<td>141</td>
<td>NS</td>
<td>132</td>
<td>131</td>
<td>NS</td>
</tr>
<tr>
<td>Abduction-active</td>
<td>118</td>
<td>99</td>
<td>NS</td>
<td>126</td>
<td>108</td>
<td>NS</td>
</tr>
<tr>
<td>Abduction-passive</td>
<td>121</td>
<td>132</td>
<td>NS</td>
<td>118</td>
<td>123</td>
<td>NS</td>
</tr>
<tr>
<td>External rotation-active</td>
<td>34</td>
<td>36</td>
<td>NS</td>
<td>37</td>
<td>37</td>
<td>NS</td>
</tr>
<tr>
<td>External rotation-passive</td>
<td>39</td>
<td>46</td>
<td>NS</td>
<td>38</td>
<td>39</td>
<td>NS</td>
</tr>
<tr>
<td>Vertebral Level</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal rotation-active</td>
<td>T9</td>
<td>T11</td>
<td>NS</td>
<td>T12</td>
<td>T13</td>
<td>NS</td>
</tr>
<tr>
<td>Internal rotation-passive</td>
<td>T11</td>
<td>T12</td>
<td>NS</td>
<td>T13</td>
<td>T13</td>
<td>NS</td>
</tr>
<tr>
<td>Strength (0-5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal rotation</td>
<td>5</td>
<td>5</td>
<td>NS</td>
<td>11</td>
<td>11</td>
<td>NS</td>
</tr>
<tr>
<td>External rotation</td>
<td>8</td>
<td>39</td>
<td>31% (20%-42%)</td>
<td>13</td>
<td>46</td>
<td>33% (21%-45%)</td>
</tr>
<tr>
<td>Subscapularis (lift off)</td>
<td>8</td>
<td>11</td>
<td>NS</td>
<td>13</td>
<td>23</td>
<td>NS</td>
</tr>
<tr>
<td>Supraspinatus (elevation)</td>
<td>17</td>
<td>71</td>
<td>54% (43%-66%)</td>
<td>17</td>
<td>69</td>
<td>52% (40%-64%)</td>
</tr>
<tr>
<td>Signs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drop arm</td>
<td>0</td>
<td>11</td>
<td>11% (5%-17%)</td>
<td>0</td>
<td>8</td>
<td>8% (2%-13%)</td>
</tr>
<tr>
<td>Impingement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal rotation</td>
<td>41</td>
<td>73</td>
<td>32% (19%-45%)</td>
<td>34</td>
<td>76</td>
<td>42% (29-54%)</td>
</tr>
<tr>
<td>External rotation</td>
<td>39</td>
<td>77</td>
<td>38% (25%-51%)</td>
<td>43</td>
<td>71</td>
<td>28% (15%-41%)</td>
</tr>
<tr>
<td>O’Brien sign</td>
<td>30</td>
<td>28</td>
<td>NS</td>
<td>19</td>
<td>22</td>
<td>NS</td>
</tr>
</tbody>
</table>

*1 = Mann-Whitney rank sum test; 2 = $\chi^2$ test.
CI indicates confidence interval; NS, not significant; RCT, rotator cuff tear.
As evident from Table 2, the posttest probability of RCT increased with age. For example, a 55-year-old subject who tests positive for 2 of the diagnostic features would have a 64% posttest probability of RCT whereas the posttest probability for a 70-year-old subject testing positive for 2 diagnostic features would be 98%.

Age-based Substudy

We next considered how age difference affected the test results. For this, we compared the test results from all subjects between the ages of 50 and 65 years in both RCT groups (n = 73) versus No-RCT groups (n = 50). The remaining subjects were either younger than 50 years or older than 64 years (Table 3).

Test results based on this subset correlated with subject age. For the RCT group, 63% had supraspinatus weakness, 38% had weakness in external rotation, and 90% had impingement. For the No-RCT control group, 25% had supraspinatus weakness, 15% had weakness in external rotation, and 68% had impingement. The differences between these 2 groups were all significant with \( P \leq 0.001 \) with \( \alpha \) set at 0.05. Combinations of the predictive tests were also analyzed for the age-based subset. Positive likelihood ratios for RCT subjects versus No-RCT subjects were sufficiently high to rule in RCT where all 3 of the SERI predictive tests were positive, 4.3:1 for positive results in any 2 tests, 0.67:1 for a positive result in only 1 test, and 0.094:1 for negative results in all tests.

DISCUSSION

Our main findings from this study are that 4 clinical shoulder tests we routinely use are predictive for RCT: the combination of tests for supraspinatus strength, strength in external rotation, and the test for impingement sign (in either external rotation or internal rotation) and the test for drop arm sign on its own.

Clinical testing is used for diagnosing RCTs yet relatively few studies have evaluated the predictive power of clinical tests for this common disorder. Norwood et al15 reviewed 103 patients with surgically confirmed RCTs and 64 patients with arthograms negative for a RCT and found a highly significant decrease in abduction strength in the subgroup with multiple rotator cuff tendon tears. Lyons and Tomlinson16 evaluated 6 patients without RCT and 36 patients with RCT who came for surgery. Preoperatively, they attempted to estimate the presence and size of RCTs by palpating the humeral head while the arm was held in internal and external rotation and then hyperextended. These authors reported that the sensitivity and specificity of this technique were 91% and 75%, respectively.

Hertel et al17 evaluated 100 patients who had operations for unilateral subacromial impingement syndrome. Of these,
subject. Gerber and Krushell have described and validated these techniques in the infraspinatus and the teres minor. This condition can be found both in scans, they found both of these tests to be sensitive and specific. Using computed tomography and “hornblower’s sign” and the “dropping sign” in full external rotation with the arm at the side had a sensitivity of 97% and 100%, respectively. The drop sign had a relatively low specificity of 100% but was very specific (100%) for a full thickness RCT.

Walch et al. studied 54 patients operated on for combined supraspinatus and infraspinatus RCTs and evaluated for the “hornblower’s sign” and the “dropping sign” in full external rotation with the arm at the side. Using computed tomography scans, they found both of these tests to be sensitive (100%:100%) and specific (93%:100%) for fatty degeneration of the infraspinatus and the teres minor. This condition can correlate both with the age of a RCT and with the age of the subject. Gerber and Krushell have described and validated the lift-off test for isolated subscapularis tears.

In our studies, we regarded the tests for supraspinatus weakness, weakness in external rotation, and impingement to be more generally useful than the test for the drop arm sign because of their greater sensitivity, particularly when combined. Nevertheless, 4 of the 200 subjects in the RCT groups scored 0 for all 3 diagnostic features. We found that 3 of the 4 subjects who scored 0 had supraspinatus weakness and weakness in external rotation also had weakness in internal rotation and therefore did not fit our restricted definition for loss of strength. The other RCT subject who had a score of 0 for all 3 diagnostic signs had a small partial tear together with adhesive capsulitis.

The clinician’s ability to perform strength testing improves with experience. More recently, a hand-held dynamometer has become available for this purpose.

In addition to clinical tests, MRI and ultrasound have been widely used in the diagnosis of RCTs. On the basis of sensitivities and specificities reported in the literature for a large number of these image-based diagnostic studies, we calculated their predictive powers with respect to their likelihood ratios. For ultrasound, the likelihood ratios ranged from 1:1 to 33:1 with a mean ± SD of 11.6:1 (± 12.5). The likelihood ratios for MRI ranged from 3:1 to 27:1 with a mean ± SD of 11.8:1 (± 8.7). These likelihood ratios are similar to the likelihood ratio calculated for SERI clinical tests (12:1) in which RCT subjects were positive for all 3 diagnostic features (supraspinatus weakness, weakness in external rotation, and impingement) or for 2 SERI tests in a subject aged 60 years or older.

### Table 2. Posttest Probabilities for RCT in Different Age Groups

<table>
<thead>
<tr>
<th>No. Positive Diagnostic Features</th>
<th>Subject Age Groups</th>
<th>Subjects With RCT</th>
<th>Subjects With No-RCT</th>
<th>Posttest probability</th>
<th>95% Confidence Interval*</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Any</td>
<td>48 (24%)</td>
<td>1 (0.5%)</td>
<td>0.98</td>
<td>0.89-1.00</td>
</tr>
<tr>
<td>2</td>
<td>&lt;60</td>
<td>26 (13%)</td>
<td>14 (7%)</td>
<td>0.64</td>
<td>0.47-0.79</td>
</tr>
<tr>
<td>2</td>
<td>≥60</td>
<td>48 (24%)</td>
<td>1 (0.5%)</td>
<td>0.98</td>
<td>0.89-1.00</td>
</tr>
<tr>
<td>1</td>
<td>&lt;40</td>
<td>3 (1.5%)</td>
<td>22 (4%)</td>
<td>0.12</td>
<td>0.025-0.31</td>
</tr>
<tr>
<td>1</td>
<td>40-69</td>
<td>52 (26%)</td>
<td>60 (30%)</td>
<td>0.45</td>
<td>0.36-0.55</td>
</tr>
<tr>
<td>1</td>
<td>≥70</td>
<td>22 (11%)</td>
<td>6 (3%)</td>
<td>0.76</td>
<td>0.56-0.90</td>
</tr>
<tr>
<td>0</td>
<td>Any</td>
<td>1 (0.5%)</td>
<td>96 (48%)</td>
<td>0.05</td>
<td>0.017-0.11</td>
</tr>
</tbody>
</table>

*Approximation based on a fixed total count, then using the F-distribution. Adapted from Murrell and Walton with permission from Elsevier.

RCT indicates rotator cuff tear.

### Table 3. Test Results for RCT and No-RCT Subjects Aged 50 to 65 Years

<table>
<thead>
<tr>
<th>Features</th>
<th>Among All RCT Subjects n = 73</th>
<th>Among All No-RCT Subjects n = 50</th>
<th>Likelihood Ratios</th>
<th>Confidence Intervals</th>
</tr>
</thead>
<tbody>
<tr>
<td>All 3</td>
<td>17</td>
<td>0</td>
<td>47:1</td>
<td>1.42:1 to 374:1*</td>
</tr>
<tr>
<td>Any 2</td>
<td>25</td>
<td>4</td>
<td>4.3:1</td>
<td>1.60:1 to 11.6:1</td>
</tr>
<tr>
<td>Any 1</td>
<td>29</td>
<td>30</td>
<td>0.67:1</td>
<td>0.47:1 to 0.96:1</td>
</tr>
<tr>
<td>None</td>
<td>2</td>
<td>16</td>
<td>0.094:1</td>
<td>0.024:1 to 0.37:1</td>
</tr>
</tbody>
</table>

*Calculated by adding 0.5 to each cell entry in the 2 × 2 table, as for the odds ratio. RCT indicates rotator cuff tear.

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**CONCLUSIONS**

The practical implications of our study are that if a clinician wants to assess whether or not a subject has a RCT, tests for 4 of the diagnostic features we examined are predictive. Firstly, there is the drop arm sign. Three other tests have a higher sensitivity than the drop arm sign and are therefore more useful. These are the SERI tests for: (1) supraspinatus weakness; (2) weakness in external rotation; and (3) impingement. A 60-year-old with positive results for 2 of these 3 diagnostic features has a 98% chance of having a RCT. If he/she has only 1 positive result for the 3 diagnostic features, the chance of a RCT is close to 50%, and therefore indeterminate. Conversely, if he/she tests negative for all 3 diagnostic features, and negative for the drop arm sign, the chance of a RCT is sufficiently low that expensive diagnostic imaging and unnecessary surgery for evaluating the rotator cuff can be deferred.

The implications of this are that subjects who score “0” for all 3 of the SERI tests, and fail to exhibit the drop arm sign, are sufficiently unlikely to have a RCT that they should not need an arthroscopy, an MRI, or an ultrasound examination unless further trauma and pathology occur. If subjects have a positive result for only one of the SERI tests, or for 2 and are younger than 60 years of age, RCT cannot be ruled in or ruled out and imaging should be considered. The predictive power of all 3 SERI tests, or for 2 in subjects aged 60 years or older, is 12:1, comparing favorably with the predictive power of
ultrasound (11:1) and MRI (12:1) for diagnosis of RCT. A
target disorder can be ruled in at odds $\geq 10:1$ (11). In addition,
to the high predictability of this clinical test combination for
diagnosing RCT, SERI tests also have the advantage that they
are easily and conveniently performed by a medical practi-
tioner or other primary health care provider.

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REFERENCES

2. Hawkins RJ, Bokor DJ. Clinical evaluation of shoulder problems. In:
Rockwood JCA, Matsen IFA, eds. The Shoulder. Volume 1. 1st ed.
4. Jobe FW, Tomlinson JE. Clinical diagnosis of tears of the
7. Welch G, Boulahia A, Calderone S, et al. The “dropping” and
“hornblower’s” signs in evaluation of rotator-cuff tears. J Bone Joint
8. Gerber C, Kruhell RJ. Isolated rupture of the tendon of the sub-
A new and effective test for diagnosing labral tears and acromio-
A Basic Science for Clinical Medicine. 2nd ed. Boston, MA: Little,
13. Leemis LM, Trivedi KS. A comparison of approximate interval esti-
14. Kotz S, Johnson NL, Read CB, eds. Odds ratio estimates. Encyclo-
15. Norwood LA. Barrack R, Jacobson KE. Clinical presentation of
499–505.
16. Lyons AR, Tomlinson JE. Clinical diagnosis of tears of the
tests for shoulder impingement syndrome. Rev Rhum, Engl Ed.
18. Itoi E, Kido T, Sano A, et al. Which is more useful, the “full can test”
or the “empty can test,” in detecting the torn supraspinatus tendon? Am
19. Chiu HI, Hsu CC, Chou YH, et al. Sonographic signs of complete
20. Read JW, Perko M. Shoulder ultrasound: diagnostic accuracy for
impingement syndrome, rotator cuff tear and biceps tendon pathology.
21. Crass MR, Craig EV, Feinberg SB. Ultrasonography of rotator cuff
16:313–327.
22. Taboury J. Ultrasonography of the tendons of the rotator cuffs of the
23. Soble MG, Kaye AD, Guay RC. Rotator cuff tear: clinical experience
24. Brandt TD, Cardone BW, Grant TH, et al. Rotator cuff sonography:
ultrasonography and arthrography in evaluation of the rotator cuff. Clin
27. Alasaraela E, Leppilaiti J, Hakala M. Ultrasound and operative eval-
28. Yeu K, Jiang CC, Shih TT. Correlation between MRI and operative
29. Wang YM, Shih TT, Jiang CC, et al. Magnetic resonance imaging of
30. Patten RM, Spear RP, Richardson ML. Diagnostic performance of
magnetic resonance imaging for the diagnosis of rotator cuff tears
using supplemental images in the oblique sagittal plane. Invest Radiol.
32. Blanchard TK, Bearcroft PW, Constant CR, et al. Diagnostic and
therapeutic impact of MRI and arthrography in the investigation of
33. Robertson PL, Schweitzer ME, Mitchel DG, et al. Rotator cuff disor-
ders: interobserver and intraobserver variation in diagnosis with MR
34. Needell SD, Zlatkin MB. Comparison of fat-saturation fast spin echo
versus conventional spin-echo MRI in the detection of rotator cuff
cuff lesions: comparison of US and MRI on 38 joint specimens. Eur
cuff tendon: interobserver agreement and analysis of interpretive
imaging of the shoulder. Sensitivity, specificity, and predictive value.