



# Rotator cuff crepitus: could Codman really feel a cuff tear?

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**Background:** The objective of this study was to assess the accuracy of palpating crepitus to diagnose rotator cuff tears.

**Methods:** Seventy consecutive consenting patients who presented with shoulder pain and no previous imaging or surgery on the affected shoulder were prospectively enrolled during a 10-month period. A standardized patient history and examination, including the crepitus test, were recorded in addition to obtaining standard radiographs. Additional imaging after initial evaluation was performed with magnetic resonance imaging and interpreted by a musculoskeletal radiologist blinded to the examination findings. Statistical analysis was used to determine sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of the crepitus test in the clinical diagnosis of a rotator cuff tear.

**Results:** Sixty-three patients had histories, examinations, and imaging studies available for analysis. The crepitus test had a sensitivity of 67%, specificity of 80%, PPV of 91%, and NPV of 43% for all types of rotator cuff tears. The sensitivity and specificity for full-thickness or high-grade partial tears was 82% and 73%, respectively; the PPV and NPV were 77% and 79%. Increasing age improved accuracy as the presence of crepitus in patients older than 55 years had a sensitivity of 76%, specificity of 100%, PPV of 100%, and NPV of 38%.

**Conclusion:** The crepitus test has a favorable sensitivity, specificity, PPV, and NPV to assess the integrity of the rotator cuff and may be a useful examination in the clinical diagnosis of a rotator cuff tear.

**Level of evidence:** Level I, Diagnostic Study.

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**Keywords:** Rotator cuff tear; physical examination; crepitus test; palpation

Rotator cuff tears are a common source of shoulder pain. The presurgical diagnosis of rotator cuff disease is based on history, physical examination, and imaging studies. Common features in the history of rotator cuff tears include

increasing age, pain with overhead activity, and night pain.<sup>3,14</sup> However, history alone may be a poor predictor. Magnetic resonance imaging (MRI), computed tomography arthrography, and ultrasound are common imaging modalities used to assess for rotator cuff tears with excellent testing profiles.<sup>11,24,26</sup> However, several authors have expressed concern with overreliance on these studies.<sup>7,8,11,14,16-18,20,22,24,26</sup> The physical examination remains an essential component in the diagnosis of rotator cuff tears.

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Numerous physical examination tests have been described to diagnose rotator cuff disease.<sup>3,5-8,10,14,16,17,20,22,25,27,28</sup> Frequently used examination tests or signs to help diagnose rotator cuff tears include painful arc, supraspinatus strength, infraspinatus strength, drop-arm, external rotation lag, hornblower's, bear-hug, belly-press, lift-off, and Napoleon.<sup>1,3,6-8,10,14,17,20,22,27</sup> Sensitivity and specificity values have ranged widely, depending on the examination technique and author, with ranges of 25% to 90% and 12% to 100%, respectively.<sup>8,15</sup>

There are several potential reasons for the variable specificity and sensitivity of rotator cuff examination tests. One factor is that many of these tests require active patient participation, which may be limited by pain or secondary gain. Pain may be lessened with selective analgesic injections, and secondary gain may be identified through effort testing. However, such steps require additional time and resources. Ideally, a physical examination test to identify a rotator cuff tear would be simple to perform, not require maximal patient effort, and have exceptional accuracy. An examination technique that is relatively simple to learn, largely bypasses patient effort, and has excellent reported specificity and sensitivity is direct palpation of the rotator cuff.<sup>4,16,19,28</sup>

The crepitus test was first described by Codman in his 1934 treatise on shoulder disease.<sup>4</sup> He described the ability of an examiner to locate a tender point by palpation. This point, deep to the deltoid, is the gap between the torn tendon ends felt just anterior to the anterior acromion when the shoulder is extended. In addition to elicitation of pain, Codman described the sensation of "soft crepitus," which is more "velvety and gristly" in contrast to the crepitus of fractures. Others have described the transdeltoid palpation of a torn rotator cuff tendon sulcus as the examiner rotates it beneath the fingers. These authors referred to this test as the rent test.<sup>28</sup> Despite its early reference, testing of the accuracy of direct palpation of the rotator cuff has only twice been described in the American literature.<sup>16,28</sup> Lyons and Tomlinson<sup>16</sup> in 1992 described this test in conjunction with supraspinatus and infraspinatus strength testing and not as an independent examination in 45 patients. Palpation with resistance testing demonstrated a sensitivity of 91% and a specificity of 75%.<sup>16</sup> Wolf and Agrawal<sup>28</sup> in 2001 evaluated the accuracy of cuff palpation and compared findings with MRI and surgical results. In 109 patients preselected with a diagnosis of impingement or rotator cuff tear, rotator cuff palpation had a specificity of 97% and sensitivity of 96% for full-thickness tears. Despite benefits of this noninvasive test with reported accuracy similar to that of MRI, the results of that study have not been reproduced. The familiarity of this test is low, and its inclusion as a diagnostic technique to help diagnose rotator cuff tears is sporadic in textbooks that describe the physical examination of the shoulder.<sup>9,12,13,23</sup> The purpose of this study was to evaluate the sensitivity, specificity, positive predictive value (PPV), and negative predictive value

(NPV) of palpation of shoulder crepitus (i.e., the crepitus test) as an independent examination test to diagnose both full- and partial-thickness rotator cuff tears. We hypothesized that compared with other rotator cuff examination techniques, the crepitus test will have a favorable specificity, sensitivity, PPV, and NPV and may help in the clinical diagnosis of relevant rotator cuff tears.

## Methods

Patients presenting with shoulder pain between October 2010 and August 2011 were prospectively enrolled. A standardized history, which included gender, height, weight, calculated body mass index, and age, was recorded. Further information was gathered about the patient's shoulder pain, including catching sensation during movement, loss of strength or motion, night pain, pain with overhead movement, and duration of symptoms. In addition, a standardized physical examination that included cuff palpation was performed. On the basis of the history, examination, and review of four radiographs of the shoulder (anteroposterior in external rotation, anteroposterior in internal rotation, outlet, and axillary), an initial diagnosis was made. Patients with a history of ipsilateral shoulder surgery or who had preexisting advanced imaging or evidence of glenohumeral arthritis of the affected shoulder were excluded from participation. This left 70 patients eligible for participation. These 70 patients underwent advanced imaging by MRI with a 1.5T magnet with the exception of 2 cases, in which a low-field, open magnet was used. A standard shoulder protocol consisting of multiplanar and multisequence imaging was used in all cases. Magnetic resonance arthrography was not routinely used unless there was a specific concern for labral disease. A trial of conservative treatment consisting of a combination of anti-inflammatories, physical therapy, or injections was attempted in most cases. All physical examinations and patient histories were conducted by a shoulder fellowship-trained surgeon (B.A.P.). Imaging studies were interpreted by a single musculoskeletal radiologist blinded to the examination findings. The radiologist classified the tear as full-thickness tear, high-grade (>50%) partial-thickness tear, low-grade ( $\leq$ 50%) partial-thickness tear, or no tear.

## Examination description

With the patient in a seated position, the examiner stands alongside the patient as demonstrated in [Figure 1](#). Using the hand farthest away from the patient, the examiner grasps the patient's flexed elbow and gently manipulates the affected shoulder through the desired range of motion. The examiner's other hand palpates the anterior superior aspect of the shoulder principally with the index and long fingers. The attempted area of direct palpation is deep to the anterolateral deltoid just inferior to the anterolateral acromion. This corresponds to the anterior greater tuberosity and the supraspinatus and is referred to as Codman's point. The relaxed shoulder is held in neutral to slight abduction during the examination, and a combination of extension with passive internal and external rotation is used to identify any palpable crepitus. Rotation may help not only to identify crepitus but also to clarify the location of the biceps and lesser tuberosity. As a general rule

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