# Pain and Stiffness in Partial-Thickness Rotator Cuff Tears

Harry C. Brownlow, FRCS (Orth), Chris Smith, MRCS, Tony Corner, MRCS, Dan Neen, MRCS, and Richard Pennington, MRCS


## Abstract

**To evaluate the null hypothesis of no difference in degree of pain or stiffness between patients with partial- and full-thickness tears of the rotator cuff, we measured pain and stiffness in a cohort of consecutive patients who underwent arthroscopy for rotator cuff–related conditions.**

**Pain was measured with a visual analogue scale, and range of motion was measured with a goniometer. Included in the study were 410 shoulders (410 patients), of which 214 had no tear, 66 had articular-sided partial-thickness tears, and 83 had single-tendon full-thickness tears. There was no statistical difference for measurements of pain or stiffness between patients with partial- and full-thickness tears, and hence the null hypothesis was upheld.**

**Neither pain nor stiffness should be used as a diagnostic indicator for differentiation of partial- and full-thickness rotator cuff tears.**


Partial-thickness tears of the rotator cuff have been described as being more painful than full-thickness tears.[1-3] This assessment is ascribed to the fact that, in contrast to full-thickness tears, partial-thickness defects of the cuff give rise to stiffness.[4] This teaching is applied by some clinicians to aid diagnosis and inform management decisions. Evidence for these assertions stems from small, retrospective clinical studies that have used injection bursography, open surgical inspection, and unvalidated outcome measures for pain.[1,3,5,6] The teaching, however, contradicted our clinical impressions.

To evaluate the null hypothesis of no difference in degree of pain or stiffness between patients with partial- and full-thickness tears of the rotator cuff, we measured pain and stiffness in a cohort of consecutive patients who underwent arthroscopy for rotator cuff–related conditions.

Dr. Brownlow is Consultant Orthopaedic Surgeon, and Dr. Smith, Dr. Corner, Dr. Neen, and Dr. Pennington are Orthopaedic Registrars, Department of Orthopaedics, Royal Berkshire Hospital, Reading, Berkshire, United Kingdom.

Address correspondence to: Harry C. Brownlow, FRCS (Orth), Department of Orthopaedics, Royal Berkshire Hospital, Reading, Berkshire, RG1 5AN, United Kingdom (tel, 0118-322-8191; fax, 0118-322-8191; e-mail, harry.brownlow@royalberkshire.nhs.uk).

*Am J Orthop.* 2009;38(7):338-340. 

## Materials and Methods

A prospective observational cohort study was performed of consecutive public sector patients who underwent shoulder arthroscopy for rotator cuff–related conditions. Initial power analysis indicated the need to include 63 partial-thickness tears (assuming 5% type 1 error rate and 20% type 2 error rate).

Outcome scores included the visual analogue scale (VAS) for pain (patients were asked for a "day-to-day average score for shoulder pain") and a score reflecting the worst pain perceived from the shoulder. Active assisted motion of both shoulders was measured with a goniometer for elevation, external rotation, and internal rotation in 90° of abduction; the highest vertebrae reached with the thumb indicated functional internal rotation. Preoperative pain scores and range of motion (ROM) measurements were collected by the authors on the day of surgery.

**"we advocate that neither pain nor stiffness be used as a diagnostic indicator for differentiation of partial- and full-thickness rotator cuff tears."**

All patients underwent shoulder arthroscopy and bursoscopy with careful attention to the rotator cuff. A partial-thickness tear was considered to be a definite disruption of fibers of the tendon and not simply fraying, roughening, or softening of the surface.[2] We made no attempt to grade the degree of partial tendon tearing. Number of tendons involved was recorded.

Exclusion criteria were conditions not principally affecting the rotator cuff (eg, frozen shoulder, glenohumeral arthropathy, glenohumeral instability, previous major trauma), calcific tendonitis, inability to understand the VAS, revision procedures, and abnormal contralateral shoulder motion.

Potential confounding factors (eg, age, handedness, side of operation, number of tendons involved, underlying diabetes or thyroid disease) were recorded.

Statistical analyses were performed with SPSS (version 12; SPSS Inc, Chicago, Ill).

**Table. Results**

| | No Tear | Articular-Sided Partial-Thickness Tear | Single-Tendon Full-Thickness Tear |
|---|---|---|---|
| n | 214 | 66 | 83 |
| Mean age, years (SD) | 48.5 (11.1) | 57.4 (10.8) | 63.2 (9.7) |
| Sex, % male | 46 | 64 | 65 |
| Operation on dominant side, % | 59 | 67 | 63 |
| Diabetes or thyroid disease, % | 7 | 12 | 5 |
| Mean "average" visual analogue scale score (SD) | 4.51 (1.95) | 4.67 (1.51) | 4.98 (2.11) |
| Mean elevation, degrees (SD) | 144.5 (14.6) | 142.3 (16.3) | 141.0 (16.3) |
| Mean external rotation, degrees (SD) | 57.9 (14.6) | 50.9 (13.6) | 54.8 (14.0) |
| Mean internal rotation in 90° abduction, degrees (SD) | 51.9 (19.1) | 49.3 (21.2) | 45.4 (20.5) |
| Mean functional internal rotation | Thoracic vertebrae 7/8 | Thoracic vertebrae 9/10 | Thoracic vertebrae 9/10 |

## Results

Four hundred twenty-two consecutive shoulder arthroscopies were performed. Twelve shoulders were excluded because of either unexpected glenohumeral arthropathy (11 shoulders) or evidence of instability (1 shoulder). Therefore, 410 shoulders (410 patients) were enrolled in the study of which 214 shoulders (214 patients) had no rotator cuff tear.

There were 86 partial-thickness rotator cuff tears, of which 66 were articular-sided and 20 were bursal-sided; all involved only a single tendon. There were 110 shoulders (110 patients) with full-thickness tears, of which 83 involved a single tendon and 27 involved more than one tendon. Given the relatively small number of tears involving more than 1 tendon and the relative infrequency of bursal-sided partial tears, statistical analysis was applied only to tears involving single tendons and to joint-side partial-thickness tears.

The demographics and results of patients included in the statistical analyses are listed in the Table. There was a strong correlation ($P<.0001$) between age and rotator cuff group (no tear, partial-thickness tear, full-thickness tear), but the factors of sex, handedness, side of operation, number of tendons involved, and underlying diabetes or thyroid disease did not correlate ($P = .115$) with group.

The results of the "worst pain" VAS were plotted as a histogram and noted to be skewed to the right. The "average" VAS showed normal distribution and was therefore used as a more discriminatory indicator of pain. Ordinal regression analysis demonstrated no significant difference (coefficient, –0.102, $P = .06$) in "average" VAS scores between the rotator cuff groups (no tear, partial-thickness tear, full-thickness tear). Logistic regression analysis, comparing 1-tendon partial- and full-thickness tears, again demonstrated no relationship ($P>.05$).

Logistic regression demonstrated that, for each of the 4 planes of motion, there was no statistical significance in ROM between 1-tendon partial- and full-thickness rotator cuff tears (elevation coefficient, 0.005, $P = .605$; external rotation coefficient, –0.021, $P = .9$; internal rotation in abduction coefficient, 0.009, $P = .250$; functional internal rotation coefficient, –0.009, $P = .928$).

## Discussion

The results of this study uphold the null hypothesis that there is no difference in degree of pain or stiffness between patients with partial- and full-thickness tears of the rotator cuff. This finding is contrary to that of previous reports but in keeping with our clinical impression.

The key advantages of our study over previous studies are use of arthroscopy rather than open surgery to identify cuff tears, use of VAS pain scores, and the large number of included patients.

Our study is limited in that bias may have been introduced in the surgeon-observer's selection of patients. As it is not ethical to perform surgery on patients who do not require it, the outcome of this work is necessarily from a select group of patients, and therefore the results may not translate to the entire population.

Lack of magnetic resonance imaging (MRI) or ultrasound scanning for most patients before surgery led to underreporting of intrasubstance tears. However, sensitivity and specificity for the diagnosis of all partial-thickness tears are under 90% for both MRI and ultrasound,[7] and currently arthroscopy remains the gold standard for diagnosis of rotator cuff tears. The diagnosis of intrasubstance tears on MRI and ultrasound remains difficult and contentious because of difficulty in distinguishing chronic tendinopathy and small full-thickness or partial-thickness tears.

ROM measurement with a goniometer and the patient awake and in the standing position is not the most accurate technique for ascertaining stiffness. However, we wanted to identify restricted ROM in the same manner as would be applied in the typical clinic setting so that our study results could be applied in the outpatient setting.

Assessment of pain immediately before surgery may also have introduced bias, but assessment of motion immediately before surgery was important to avoid missing any changes that may have occurred in the variable interval delay between the decision to operate and the actual date of surgery.

Studies using MRI[8] and ultrasonography[9] have established that asymptomatic patients have an age-related incidence of partial- and full-thickness rotator cuff tears. Our study results have confirmed the age-related incidence of partial- and full-thickness rotator cuff tears in a symptomatic cohort of patients and have shown that there is no

significant difference between these cuff tear groups in terms of pain or stiffness.

As the null hypothesis has been upheld, we advocate that neither pain nor stiffness be used as a diagnostic indicator for differentiation of partial- and full-thickness rotator cuff tears.

## Authors' Disclosure Statement and Acknowledgments

The authors report no actual or potential conflict of interest in relation to this article.

The authors thank Dr. David Bonniface (Health Behaviour Unit, Department of Epidemiology and Public Health, University College of London) for advising and performing the statistical analyses.

## References

1. Fukuda H. Partial-thickness rotator cuff tears: a modern view on Codman's classic. *J Shoulder Elbow Surg*. 2000;9(2):163-168.
2. Fukuda H. The management of partial-thickness tears of the rotator cuff. *J Bone Joint Surg Br*. 2003;85(1):3-11.
3. Gschwend N, Ivosevic-Radovanovic D, Patte D. Rotator cuff tear—relationship between clinical and anatomopathological findings. *Arch Orthop Trauma Surg*. 1988;107(1):7-15.
4. Matsen FA 3rd, Arntz CT, Lippitt SB. Rotator cuff. In: Rockwood CA Jr, Matsen FA 3rd, eds. *The Shoulder*. Philadelphia, PA: Saunders; 1998:755-839.
5. Fukuda H, Hamada K, Nakajima T, Yamada N, Tomonaga A, Goto M. Partial-thickness tears of the rotator cuff. A clinicopathological review based on 66 surgically verified cases. *Int Orthop*. 1996;20(4):257-265.
6. Gotoh M, Hamada K, Yamakawa H, Inoue A, Fukuda H. Increased substance P in subacromial bursa and shoulder pain in rotator cuff diseases. *J Orthop Res*. 1998;16(5):618-621.
7. Teefey SA, Rubin DA, Middleton WD, Hildebolt CF, Leibold RA, Yamaguchi K. Detection and quantification of rotator cuff tears. Comparison of ultrasonographic, magnetic resonance imaging, and arthroscopic findings in seventy-one consecutive cases. *J Bone Joint Surg Am*. 2004;86(4):708-716.
8. Sher JS, Uribe JW, Posada A, Murphy BJ, Zlatkin MB. Abnormal findings on magnetic resonance images of asymptomatic shoulders. *J Bone Joint Surg Am*. 1995;77(1):10-15.
9. Milgrom C, Schaffler M, Gilbert S, van Holsbeeck M. Rotator-cuff changes in asymptomatic adults. The effect of age, hand dominance and gender. *J Bone Joint Surg Br*. 1995;77(2):296-298.