Editorial Commentary

Partial rotator cuff tears: algorithmic approach to treatment

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Keywords: Acromioplasty; magnetic resonance imaging (MRI); partial rotator cuff tear

Received: 08 November 2022; Accepted: 22 May 2023; Published online: 12 June 2023.

doi: 10.21037/aoj-22-38

View this article at: https://dx.doi.org/10.21037/aoj-22-38

Codman was the first to describe the pathology associated with tears of the rotator cuff (1). Codman and Akerson specifically described partial-thickness tears as "rim rents" (1). Before the advent of magnetic resonance imaging (MRI) and arthroscopy, the diagnosis of partial rotator cuff tear was challenging. Arthrograms inconsistently diagnosed partial rotator cuff tear on the articular side only if contrast could be visualized entering the rotator cuff insertion. Arthrograms were of no value in diagnosing bursal-side tears. Bursagrams were used by some to identify superficial, incomplete tears, but they were difficult to interpret (2).

Neer defined his algorithm for management of impingement by stages: stage 2, fibrosis and tendinitis; and stage 3, tears of the rotator cuff, biceps tendon ruptures, and bone changes (2). In stage 3, he included both incomplete and complete tears of the rotator cuff. Whereas he recommended nonoperative management for stage 2 impingement, stage 3 impingement was thought to be irreversible and to require surgical management. Neer believed that all full-thickness tears required an associated acromioplasty, but he was less clear on partial-thickness tears.

With the introduction of MRI scans, partial-thickness tears became more commonly diagnosed. Andrews *et al.* (3) were the first to publish on arthroscopic treatment of partial-thickness rotator cuff tears, suggesting that simple debridement would resolve symptoms in 85% of cases. That study and others like it that combined debridement with acromioplasty described the accepted treatment for the next decade of shoulder surgery (4).

Harvey Ellman was the first surgeon to raise concerns about this approach. In his seminal 1990 article, he divided partial rotator cuff tears into articular-side and bursal-side tears (5). On the other hand, lower-grade tears (Ellman class I and II) could successfully be treated with debridement and acromioplasty, tears greater than 50% of the substance of the tendon (Ellman class III) he felt required open repair of the tendon. Ellman suggested that arthroscopic observation of the rotator cuff enabled accurate diagnosis of articular-side rotator cuff tears but did not provide specifics on how to estimate the depth of the tear.

The work of the senior author SCW echoed that of Ellman, describing a high failure rate with debridement and acromioplasty for high-grade, partial-thickness rotator cuff tears (6). In that study, the location and depth of the tear was best assessed by using a marking suture of PDS (polydioxanone) passed through the articular rotator cuff tear to enable localization of the damage from the bursal side of the cuff (6). Curtis *et al.* (7) made the measurement of the depth of articular-side, partial-thickness tears more accurate by understanding that the percentage of tear can be accurately determined by measuring the amount of uncovered rotator cuff footprint compared with the normal 12-mm footprint as a whole. These concepts have stood the test of time, with multiple review articles supporting repair over debridement for high-grade, partial-thickness tears (8-10). Even for lower-grade partial tears, progression to full-thickness tears over the long term has been shown in nearly half of patients, despite debridement and acromioplasty (11).

Despite frequent presentation to the shoulder clinician, partial rotator cuff tears lack a definitive treatment algorithm. This article highlights the clinical needs, focuses, and main concerns regarding management of partial-

thickness rotator cuff tears. The proposed treatment algorithm provides a reproducible approach to successfully manage these injuries.

Neer (2) described the classic physical examination findings associated with impingement, which are common to all partial- and full-thickness rotator cuff tears. History and examination alone do not enable discrimination between stage 1, 2, and early stage 3 disease. Pain with abduction and forward flexion, along with a positive Neer impingement test, are consistent with all three stages. Weakness overhead is not normally present. Neer's lidocaine impingement test is pathognomonic for rotator cuff pathology in general and is a critical piece of the diagnostic puzzle (2).

Bursagrams are inconsistent in the diagnosis of partial-thickness rotator cuff tears (2). MRI supplanted bursography in the early 1990s. Although an improvement, MRI diagnosis of partial-thickness tears remains inconsistent. The senior author's work showed a disturbing number of false-positive and false-negative MRI scans (12). In that study, 80 patients with an MRI diagnosis of partial tear or possible partial tear had subsequent confirmatory arthroscopy. Although sensitivity was reasonable (83%), specificity was poor (35%), and accuracy was also poor (43%). Only 28% of the scans could be definitively interpreted. These results were echoed by those of Brockmeyer *et al.* (13). For this reason, MRI scanning should be reserved for patients for whom the diagnosis of a complete rotator cuff tear would lead to early operative repair. MRI evidence of a partial rotator cuff tear or "possible" partial rotator cuff tear is not an indication for surgery.

Nonoperative management remains the initial treatment option for partial rotator cuff tears. Oral medication, physical therapy, and cessation of the causal activity for a period of months is important. The use of steroid injections is controversial; however, limited injections can help calm the inflamed shoulder. Temporary pain relief after subacromial lidocaine injection, along with a subsequent negative Neer impingement test after injection, can help determine the diagnosis (2). Nonoperative management is important, in part because of the high number of false-positive MRI scans, leading to inappropriately aggressive surgical treatment. Research continues to show that many patients experience improvement without surgery (14), and that delay in treatment does not affect the final outcome (15). Nakhaei Amroodi and Salariyeh (16) listed risk factors for failure of nonoperative management for partial rotator cuff tears.

Surgical treatment is the best option for patients with symptomatic, partial-thickness tears for whom nonoperative treatment has failed. As noted, debridement of Ellman class I and II tears of less than 50% of the substance of the rotator cuff remains a reasonable treatment option (5). The senior author's research is the only comparative investigation of debridement versus repair, and it and confirmed Ellman's philosophy, supporting the need for repair in higher-grade, partial-thickness tears (6). The depth of the tear is easily visually assessed for bursal-side tears. For articular-side tears, Curtis *et al.* (7) showed that if more than 6 mm of the rotator cuff footprint is uncovered when viewed from below the tendon insertion, then a high-grade, partial-thickness tear is present and repair of articular-side tears is indicated.

Controversy remains regarding (I) *in situ* repair versus completing the tear for articular-side tears, and (II) single-row versus double-row repair of partial-thickness tears. Theoretical concerns have been raised regarding completing the tear in terms of restoration of tendon length and increasing the risk of a full-thickness failure. The senior author's work showed that completing the tear appeared technically easier and produced good results (17). Subsequently, several comparative studies have shown little difference in the outcome between the two techniques (18,19).

As with repair of full-thickness rotator cuff tears, concomitant acromioplasty has been used in most series despite the lack of solid evidence of benefit, more commonly in bursal-side than articular-side tears (10,20). In the senior author's series, acromioplasty was recommend only in patients with substantial evidence of impingement on bursoscopy (17). No studies are currently available comparing the outcome of partial rotator cuff tears treated with or without associated acromioplasty. Biologic augmentation of partial-thickness tears has also been recommended (21). These implants, however, are expensive and may not contribute to the already good results expected with arthroscopic repair.

Provided the guidelines initially proposed by Ellman are followed, the outcome of surgical repair of partial-thickness rotator cuff tears remains excellent, consistent with the outcome expected of surgical repair of small rotator cuff tears in general. For individuals who are not overhead throwing athletes, studies have shown low complication rates and good to excellent results in most cases (9,17,18,20).

Successful treatment of partial-thickness rotator cuff tears in the high-demand overhead throwing athlete remains elusive. Despite good initial results with isolated debridement (3,4), a more recent study found that return to

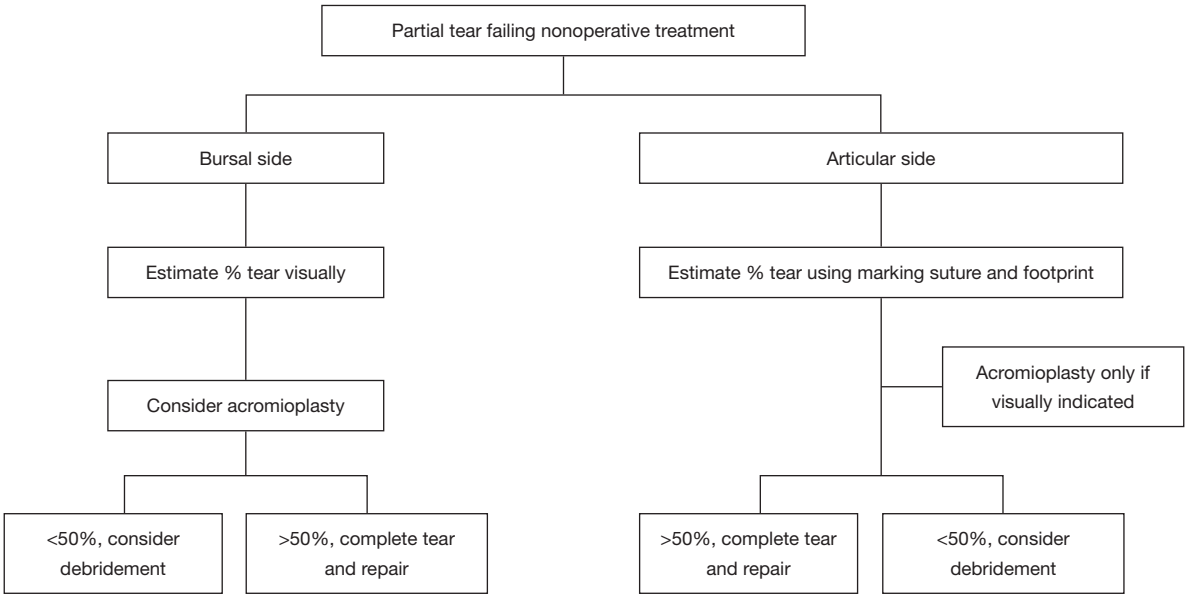

Figure 1 Algorithm for surgical management of partial rotator cuff tears.

sport may not be predictable (22). At least one author group who previously recommended debridement has suggested that more aggressive treatment than simple debridement is usually indicated (23). These data are further confounded by studies that show a high incidence of partial tears on MRI in otherwise asymptomatic throwing athletes (24). An early report on the repair of full-thickness tears in the overhead throwing athlete was discouraging (25). For this reason, less aggressive treatment of partial-thickness tears has been recommended (23). As no current treatment offers a high degree of success, nonoperative management is required in the treatment of these athletes, along with a realistic discussion of the outcome of surgery.

Current evidence suggests a fairly simple algorithm for the management of partial rotator cuff tears (*Figure 1*): Symptomatic, high-grade partial-thickness (greater than 50%) rotator cuff tears for which nonoperative treatment has failed continue to be best managed by repair, either arthroscopic or mini-open repair, with good results. Although it has been challenging to determine whether acromioplasty improves the results of full-thickness tear repair, bursal-side tears seem to show better outcomes with concomitant acromioplasty (10,20).

Partial-thickness rotator cuff tears are encountered frequently in a busy shoulder practice. Although MRI has revolutionized the diagnosis of partial rotator cuff tears, it continues to produce high rates of false-positive and false-negative results. For this reason, initial nonoperative management is recommended. When nonoperative treatment fails, arthroscopic evaluation with debridement of lower-grade tears and repair of tears of more than 50% of the tendon is the current standard. There appears to be little difference between the types of repairs in terms of outcome. Good to excellent results can be anticipated, although high-demand overhead throwing athletes with partial-thickness tears face uncertain return to sport.

Acknowledgments

Funding: None.

Footnote

Provenance and Peer Review: This article was commissioned by the Guest Editor (Prashant Meshram) for the series "Controversies in Shoulder Surgery and Algorithmic Approach to Decision Making" published in *Annals of Joint*. The article has undergone external peer review.

Conflicts of Interest: The authors have completed the ICMJE uniform disclosure form (available at https://aoj.amegroups.com/article/view/10.21037/aoj-22-38/coif). The series "Controversies in Shoulder Surgery and Algorithmic Approach to Decision Making" was commissioned by the

editorial office without any funding or sponsorship. SCW receives consulting fees from NDA Partners and MSquared Associates and is a committee member of AANA, AAOS, ASES, and ISAKOS. EGM declares royalties or licenses from Innomed, receives consulting fees and payment from Stryker Corporation, and is on the editorial boards of *Clinical Orthopaedics and Related Research* and *American Journal of Sports Medicine*. The authors have no other conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

References

1. Codman EA, Akerson IB. The pathology associated with rupture of the supraspinatus tendon. Ann Surg 1931;93:348-59.
2. Neer CS 2nd. Impingement lesions. Clin Orthop Relat Res 1983;(173):70-7.
3. Andrews JR, Broussard TS, Carson WG. Arthroscopy of the shoulder in the management of partial tears of the rotator cuff: a preliminary report. Arthroscopy 1985;1:117-22.
4. Snyder SJ, Pachelli AF, Del Pizzo W, et al. Partial thickness rotator cuff tears: results of arthroscopic treatment. Arthroscopy 1991;7:1-7.
5. Ellman H. Diagnosis and treatment of incomplete rotator cuff tears. Clin Orthop Relat Res 1990;(254):64-74.
6. Weber SC. Arthroscopic debridement and acromioplasty versus mini-open repair in the treatment of significant partial-thickness rotator cuff tears. Arthroscopy 1999;15:126-31.
7. Curtis AS, Burbank KM, Tierney JJ, et al. The insertional footprint of the rotator cuff: an anatomic study. Arthroscopy 2006;22:609.e1.
8. Katthagen JC, Bucci G, Moatshe G, et al. Improved outcomes with arthroscopic repair of partial-thickness rotator cuff tears: a systematic review. Knee Surg Sports Traumatol Arthrosc 2018;26:113-24.
9. Borbas P, Hoy G. Surgical treatment options for partial rotator cuff tears: a re-view of the literature. Int J Orthop 2019;6:1032-8.
10. Zhang Y, Zhai S, Qi C, et al. A comparative study of arthroscopic débridement versus repair for Ellman grade II bursal-side partial-thickness rotator cuff tears. J Shoulder Elbow Surg 2020;29:2072-9.
11. Kartus J, Kartus C, Rostgård-Christensen L, et al. Long-term clinical and ultrasound evaluation after arthroscopic acromioplasty in patients with partial rotator cuff tears. Arthroscopy 2006;22:44-9.
12. Weber S. Magnetic resonance imaging diagnosis of partial-thickness rotator cuff tears: fact or fantasy (SS60). Arthroscopy 2004;20:e28.
13. Brockmeyer M, Schmitt C, Haupert A, et al. Limited diagnostic accuracy of magnetic resonance imaging and clinical tests for detecting partial-thickness tears of the rotator cuff. Arch Orthop Trauma Surg 2017;137:1719-24.
14. Lo IK, Denkers MR, More KD, et al. Partial-thickness rotator cuff tears: clinical and imaging outcomes and prognostic factors of successful nonoperative treatment. Open Access J Sports Med 2018;9:191-7.
15. Kim YS, Lee HJ, Kim JH, et al. When Should We Repair Partial-Thickness Rotator Cuff Tears? Outcome Comparison Between Immediate Surgical Repair Versus Delayed Repair After 6-Month Period of Nonsurgical Treatment. Am J Sports Med 2018;46:1091-6.
16. Nakhaei Amroodi M, Salariyeh M. Predictors of failure after conservative treatment of symptomatic partial-thickness rotator cuff tear. J Shoulder Elbow Surg 2020;29:113-20.
17. Weber SC. Philosophy on Repair In Situ vs Competing and Repair of the Partial Rotator Cuff Tear. In: Imhoff A, Savoie F, editors. Rotator Cuff Across the Life Span: ISAKOS Consensus Book. Berlin, Germany: Springer; 2019: 137-42.
18. Kim KC, Shin HD, Cha SM, et al. Repair integrity and functional outcome after arthroscopic conversion to a full-thickness rotator cuff tear: articular- versus bursal-side partial tears. Am J Sports Med 2014;42:451-6.
19. Shin SJ. A comparison of 2 repair techniques for partial-thickness articular-sided rotator cuff tears. Arthroscopy 2012;28:25-33.
20. Fukushi R, Horigome K, Yamashita T. Clinical outcomes

following arthroscopic repair of articular vs. bursal partial-thickness rotator cuff tears with follow-up of 2 years or more. JSES Int 2020;4:352-6.
21. Schlegel TF, Abrams JS, Bushnell BD, et al. Radiologic and clinical evaluation of a bioabsorbable collagen implant to treat partial-thickness tears: a prospective multicenter study. J Shoulder Elbow Surg 2018;27:242-51.
22. Reynolds SB, Dugas JR, Cain EL, et al. Débridement of small partial-thickness rotator cuff tears in elite overhead throwers. Clin Orthop Relat Res 2008;466:614-21.
23. Andrews JR, Elbayar JH, Jordan SE. Partial-rotator cuff tears in throwing athletes. Oper Tech Sports Med 2021;29:150799.
24. Mihata T, Morikura R, Hasegawa A, et al. Partial-Thickness Rotator Cuff Tear by Itself Does Not Cause Shoulder Pain or Muscle Weakness in Baseball Players. Am J Sports Med 2019;47:3476-82.
25. Mazoué CG, Andrews JR. Repair of full-thickness rotator cuff tears in professional baseball players. Am J Sports Med 2006;34:182-9.

doi: 10.21037/aoj-22-38
Cite this article as: Łukasiewicz P, McFarland EG, Weber SC. Partial rotator cuff tears: algorithmic approach to treatment. Ann Joint 2023;8:21.