Systematic Review With Video Illustration

The Role of Subacromial Decompression in Patients Undergoing Arthroscopic Repair of Full-Thickness Tears of the Rotator Cuff: A Systematic Review and Meta-analysis

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Purpose: The purpose of this study was to determine the efficacy of arthroscopic repair of full-thickness rotator cuff tears with and without subacromial decompression. **Methods:** We searched the Cochrane Central Register of Controlled Trials (third quarter of 2011), Medline (1948 to week 1 of September 2011), and Embase (1980 to week 37 of 2011) for eligible randomized controlled trials. Two reviewers selected studies for inclusion, assessed methodologic quality, and extracted data. Pooled analyses were performed by use of a random effects and relative risk model with computation of 95% confidence intervals. **Results:** We included 4 randomized trials and 373 patients. Methodologic quality was variable as assessed by the CLEAR NPT (Checklist to Evaluate a Report of a Non-pharmacological Trial) tool. One trial showed that there was no difference in disease-specific quality of life (Western Ontario Rotator Cuff questionnaire) between the 2 treatment groups. A meta-analysis of shoulder-specific outcome measures (American Shoulder and Elbow Surgeons or Constant scores) or the rate of reoperation between patients treated with subacromial decompression and those treated without it also showed no statistically significant differences. **Conclusions:** On the basis of the currently available literature, there is no statistically significant difference in subjective outcome after arthroscopic rotator cuff repair with or without acromioplasty at intermediate follow-up. **Level of Evidence:** Level I, systematic review of Level I studies.

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Since originally described by Neer in 1972,[1] acromioplasties have become 1 of the most commonly performed procedures in orthopaedic surgery.[2] They are usually performed as part of a formal subacromial decompression (SAD), which involves an anteroinferior acromioplasty, coracoacromial ligament release, and subacromial bursectomy. In a population study by Vitale et al.,[2] the volume of acromioplasties (isolated and combined with other procedures) in New York State increased by 254.4% over an 11-year period (1996 to 2006). Similarly, the mean number of arthroscopic acromioplasties increased by 142.3% among candidates eligible for part 2 of their orthopaedic surgery board certification examination over a 10-year period (1999 to 2008). The most common indication for an SAD remains subacromial impingement with or without a concomitant rotator cuff tear.

The rationale for performing an acromioplasty in the setting of rotator cuff repair (RCR) is historically anchored to the theory of extrinsic subacromial impingement, which has been popularized by Neer[1] and Bigliani et al.[3] This theory is grounded on the principle that acromial morphology is the initiating factor leading to dysfunction of the rotator cuff and eventual tearing.[4] The influence of this theory on the practice of shoulder surgery has been profound because several authors have advocated that acromioplasty is an integral part of RCR.[5-8] However, proponents of the intrinsic theory of rotator cuff failure purport that abnormalities of the rotator cuff occur when eccentric tensile overload occurs at a rate greater than the ability of the cuff to repair itself.[4] According to the intrinsic theory, acromioplasty fails to address the primary problem of intratendinous degeneration or tendinosis. Potential benefits of acromioplasty include improved visualization for arthroscopic technique, as well as access to bleeding in the subacromial space, which may improve healing potential. Potential disadvantages of routine SAD include violation of the soft-tissue envelope during arthroscopy leading to intraoperative soft-tissue swelling, weakening of the deltoid origin by detachment of some of its anterior fibers, anterosuperior instability in the presence of a failed rotator cuff or irreparable tear, and the formation of adhesions between the raw exposed bone on the undersurface of the acromion and the underlying tendon, which in turn can limit smoothness, motion, comfort, and range of motion.[9] There is also uncertainty as to whether acromioplasty can prevent the progression of rotator cuff failure.[9]

On the basis of the framework proposed by the intrinsic theory of rotator cuff degeneration, several investigators have challenged whether SAD needs to be performed concomitantly with rotator cuff surgery. Budoff et al.[4] reported good and excellent results in 81% of cases at long-term follow-up (minimum of 5 years) in patients undergoing debridement alone for partial-thickness rotator cuff tears without simultaneous SAD. Matsen and colleagues[10] also reported significant improvements in health-related quality of life and Simple Shoulder Test scores in 96 consecutive repairs of full-thickness tears of the rotator cuff without SAD. Both of the aforementioned studies did not have a control group, and hence direct comparisons could not be made.

At this time, there is ongoing debate as to whether acromioplasty results in improved outcomes in patients undergoing repair of full-thickness rotator cuff tears. To our knowledge, there is no systematic review published in the literature that has addressed this controversy. The objective of this systematic review was to identify and summarize the available Level I evidence to compare the efficacy of performing acromioplasty in patients undergoing repair of full-thickness tears of the rotator cuff. We hypothesized that there would be no difference in outcome among patients who did receive an acromioplasty and those who did not during arthroscopic repair of full-thickness rotator cuff tears.

METHODS

Inclusion Criteria

Types of Studies and Interventions

Randomized or quasi-randomized controlled trials that compared the role of SAD versus no SAD in patients undergoing repair of full-thickness rotator cuff tears were included. Minimum 1-year follow-up was also required for inclusion. Our preferred technique of arthroscopic double-row RCR is illustrated in Video 1 (available at www.arthroscopyjournal.org).

Types of Participants

Participants were patients aged older than 18 years who were diagnosed with a full-thickness tear of at least 1 rotator cuff tendon.

Outcomes

The primary outcome of interest was disease-specific quality of life as measured by the Western Ontario Rotator Cuff (WORC) index (continuous variable). Secondary outcomes of interest (when available) included (1) shoulder joint–specific patient-reported outcome measures including Disabilities of the Arm, Shoulder and Hand questionnaire,[11,12] University of California, Los Angeles outcome score,[13] Constant-Murley outcome score,[14] Pennsylvania Shoulder Score,[15] American Shoulder and Elbow Surgeons (ASES) outcome score,[16] Simple Shoulder Test,[17] L'Insalata scoring system,[18] visual analog scale (VAS) for pain; (2) postoperative range of motion; and (3) rate of reoperation.

Search Strategy

We used a text-search strategy using the terms "(subacromial decompression OR acromioplasty) AND rotator cuff" under the limit "randomized controlled trials." Specifically, we searched the Cochrane

Central Register of Controlled Trials (third quarter of 2011), Medline (1948 to week 1 of September 2011), Embase (1980 to week 37 of 2011), and www.clinicaltrials.gov for completed and ongoing randomized controlled trials. We also assessed the bibliographies of identified studies to seek additional articles. We did not restrict our search or inclusion by language. Meeting archives and abstract proceedings were searched from the American Association of Orthopedic Surgeons and American Orthopaedic Society for Sports Medicine from 2009 to 2011. In the event where a trial was published in abstract form only, the study authors were contacted for access to a complete study manuscript. The final list of eligible studies was reviewed with content experts to ensure that there were no missing trials.

Study Selection

The primary author parsed through all citations and abstracts generated by the literature search and applied selection criteria with a tendency toward inclusion. Abstracts were excluded if they were published over 10 years ago (without a subsequent peer-reviewed publication) to avoid the effect of time-lag bias. Identified randomized controlled trials were subsequently assessed by 2 reviewers for inclusion. Each investigator independently assessed each full report to determine whether it met the inclusion criteria. Disagreements were resolved by discussion and consensus. Titles of journals and names of authors or supporting institutions were not masked at any stage.

Data Extraction and Management

Data were extracted independently from included studies by 2 reviewers on data abstraction forms. All extracted data were entered into RevMan version 5.1 (The Cochrane Collaboration; www.cochrane.org) for statistical analysis.

Assessment of Risk of Bias in Included Studies

The CLEAR NPT (Checklist to Evaluate a Report of a Non-pharmacological Trial) is a previously validated tool and was used to evaluate the methodologic quality of included studies.[19-21] Methodologic quality was assessed by 2 reviewers.

Analysis

For binary outcomes, the pooled risk ratio was calculated. For continuous outcomes, the mean difference was calculated. Ninety-five percent confidence intervals (CIs) were calculated for all point estimates. The I^2 statistic[19] was used to quantify heterogeneity, whereas the Cochran χ^2 test of homogeneity (i.e., Q test, $P < .10$) was used to test for heterogeneity.

Data from eligible studies were pooled by use of a random effects model because of the anticipated heterogeneity among study populations, surgical treatment protocols, and differences in lengths of immobilization and physical therapy. Heterogeneity was planned to be explored by subgroup analysis of results (age, gender, Workers' Compensation, acromion type). A sensitivity analysis was used by removing 1 study at a time from the pooled analysis for recurrent shoulder instability to test the robustness of our results.

RESULTS

General Study Characteristics

The results of the search, the study selection log, and the number of studies are reported in Fig 1. Four Level I randomized controlled trials were included in this review,[22-25] and their baseline characteristics are reported in Table 1. One randomized trial was excluded because it was published in the form of an abstract more than 10 years ago without subsequent publication in a peer-reviewed journal.[26] Of the 4 included studies, 2 of the trials were published,[22,24] 1 was in press in a peer-reviewed journal,[23] and 1 was a preliminary report of interim results in abstract form.[25] The mean follow-up across these 4 trials ranged from 12 to 24 months. In total, the 4 trials had a total enrollment of 373 patients, of whom 226 (60.66%) were men. Complete follow-up was reported in 217 of 373 patients, with an overall follow-up rate of 58.2% (including the preliminary results presented by Tetteh et al.[25]). The mean age of the participants across all trials was 58.6 years. One study published results on disease-specific quality of life as measured by the WORC.[23] The most commonly reported shoulder-specific outcome measures used across studies were the ASES score (3 of 4 trials[22,23,25]) and the total Constant score (2 of 4 trials[24,25]).

All 4 of the included trials looked at arthroscopic repair of full-thickness rotator cuff tears. In 1 of the studies, patients were only enrolled if they had an isolated tear of the supraspinatus and a type II acromion.[22] The remainder of the studies included full-thickness tears of 1 to 4 tendons. The study by Milano et al.[24] enrolled patients with a type II or III acromion only, whereas the studies by MacDonald et al.[23] and

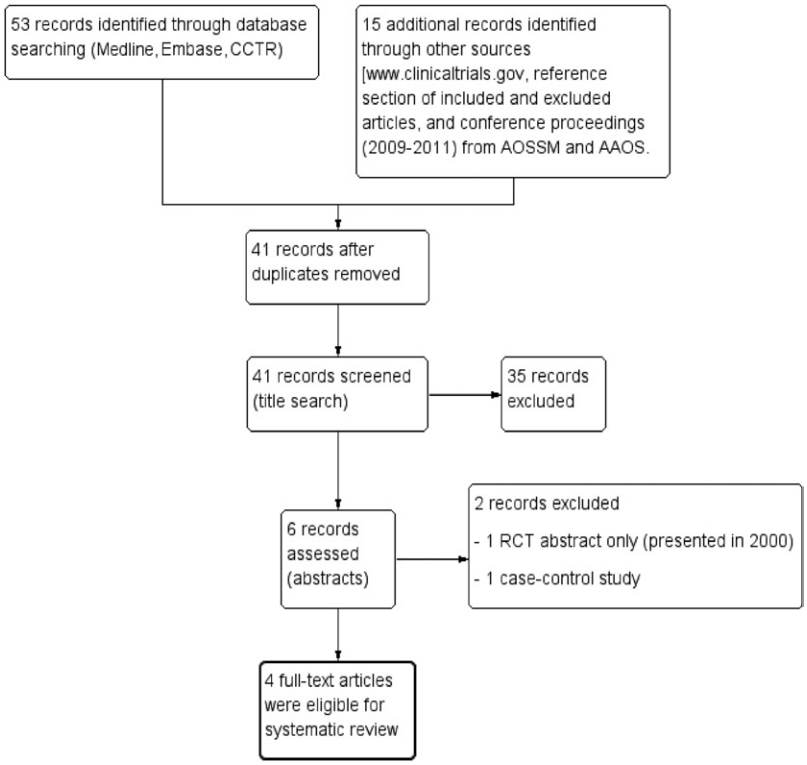

Figure 1. Search strategy results. (AAOS, American Academy of Orthopaedic Surgeons; AOSSM, American Orthopaedic Society for Sports Medicine; CCTR, Cochrane Controlled Trials Register; RCT, randomized controlled trial.)

Tetteh et al.[25] enrolled patients with a type I, II, or III acromion. It is also important to note that Workers' Compensation patients were excluded in all trials except for the study conducted by Tetteh et al.

The results of the methodologic quality assessment of included studies using the CLEAR NPT tool are presented in Table 2. Sequence generation was adequately reported and allocation was concealed in all 4 included studies. However, the experience and/or skill level of the care providers (surgeons) was appropriate in 2 of the trials[23,25] and was unclear based on the manuscripts in the 2 remaining studies.[22,24] With regard to the rehabilitation phase of treatment, participant compliance was not assessed quantitatively in any of the 4 included studies. Given the nature of the interventions, treating surgeons could not be blinded to treatment allocation in all 4 of the trials. Clinical outcome assessors were definitely blinded in 1 of 4 trials[23]; blinding of outcome assessors did not take place in 1 trial[25]; and in the other 2 studies, it was unclear whether such blinding took place. Finally, it was not stated whether an intention-to-treat analysis would have been performed in any of the included studies should the need have arisen for a patient without acromioplasty to undergo revision surgery for impingement. Publication bias could not be assessed because of the small number of studies.

Effects of Interventions

Primary Outcome

Disease-Specific Quality of Life: MacDonald et al.[23] showed that there were no differences in WORC scores between patients treated with SAD and those not treated with SAD. This study also found no differences in WORC scores related to acromion type, and there was no interaction between treatment group and acromion type.

Secondary Outcomes

Shoulder-Specific Outcomes Measures: A meta-analysis of 2 trials showed that there was no difference in age- and gender-normalized total Constant scores in patients treated with or without SAD (mean difference, 4.40; 95% CI, −1.96 to 10.75; $P = .18$)[24,25] (Fig 2A). A meta-analysis of 3 of the included studies also showed no difference in ASES scores between patients treated with SAD and those treated without it (mean difference, 1.91; 95% CI, −2.00 to 5.83; $P = .34$) (Fig 2B). No differences in the aforementioned results were seen whether a fixed or random effects

Table 1. *Characteristics of Included Studies*

Study	Study Design	Inclusion Criteria*	Details of Surgery	Sample Size (% Male)	Mean Age (yr)	Follow-Up Rate (%)	Follow-Up (Range) (mo)	Outcome Measures
Gartsman and O'Connor,[22] 2004	Level I randomized	Isolated full-thickness repairable supraspinatus tears Type II acromion	Arthroscopic repair Suture anchors Single row	93 (55)	59.7	100	15.6 (12.3-18.9)	ASES
Milano et al.,[24] 2007	Level I randomized	Full-thickness tear in ≥1 tendons Type II or III acromion	Arthroscopic repair Suture anchors Single row	80 (55)	60.4	88.75	24	Constant DASH Work-DASH
MacDonald et al.,[23] 2011	Level I randomized	Full-thickness tear ≤4 cm in ≥1 tendons Type I, II, or III acromion	Arthroscopic repair Suture anchors Single row	86 (65)	56.8	79.1	24	WORC ASES
Tetteh et al.,[25] 2011	Level I randomized	Full-thickness tear of ≥1 tendons Type I, II, or III acromion Workers' Compensation patients not excluded	Arthroscopic repair Suture anchors Single row or double row	114 (66)	57.8	33.3	12	Constant ASES SST Visual analog scale for pain Range of motion

Abbreviations: DASH, Disabilities of the Arm, Shoulder and Hand; SST, Simple Shoulder Test.
*Workers' Compensation patients excluded in all trials except for that of Tetteh et al.

model was used because there was no significant statistical heterogeneity in these comparisons (I^2 = 0%). Furthermore, a sensitivity analysis was performed by removing 1 study at a time from the aforementioned meta-analyses: no difference in the direction of the conclusions was observed, indicating that the observed results are statistically robust.

Although a formal meta-analysis could not be performed because of heterogeneity in outcome measures used and reporting of data, 2 of the 4 studies reported that acromion type did not have a significant effect on postoperative WORC, ASES, and age- and gender-normalized Constant scores.[23,24]

Postoperative Range of Motion: Tetteh et al.[25] reported preliminary results on postoperative range of motion. In the 29 patients who were available for physical examination at 1-year follow-up, there were no statistically significant differences in forward flexion, internal rotation, or abduction between the 2 treatment groups. However, at 1-year follow-up, patients treated with an SAD averaged 56° of external rotation compared with 67° in patients not treated with SAD (P = .0455).

Rate of Reoperation: Of the 4 included studies, 2 reported on the need for repeat surgery.[23,25] MacDonald et al.[23] reported that 4 of 45 patients (9%) in the group not treated with SAD were offered repeat surgery over a 2-year follow-up period compared with 0 patients in the decompression group (P = .05). Of these 4 patients, 2 had a repeat rotator cuff tear that was repaired, and 3 of the 4 had an acromioplasty. One patient declined surgery. Of the 4 patients who were offered repeat surgery, 3 had a type III acromion.

In the trial by Tetteh et al.,[25] 6 of 114 patients (3 in the SAD group and 3 in the non–SAD group) have undergone repeat surgery, 2 of whom had a type III acromion. Among patients treated with SAD in this latter study, 1 patient underwent revision RCR, 1 patient had a total shoulder replacement, and another had a capsular release and revision decompression. In the group treated without SAD, 2 patients required a revision RCR and 1 patient had a capsular release.

A meta-analysis of the need for repeat surgery shows that there is no difference in reoperation rates between patients treated with SAD and those treated without it among patients undergoing repair of full-thickness tears of the rotator cuff (risk ratio, 0.46; 95% CI, 0.08 to 2.69: P = .39) (Fig 2C).

TABLE 2. *Assessment of Methodologic Quality of Included Trials Using CLEAR NPT Tool*

Checklist of Items to Assess Quality of Randomized Controlled Trials of Non-Pharmacologic Treatment (N = 4 Trials)	Gartsman and O'Connor,[22] 2004	Milano et al.,[24] 2007	MacDonald et al.,[23] 2011	Tetteh et al.,[25] 2011
1. Was the generation of allocation sequences adequate?	Yes	Yes	Yes	Yes
2. Was treatment allocation concealed?	Yes	Yes	Yes	Yes
3. Were the details of the intervention administered to each group made available?	No	Yes	Yes	Yes
4. Was the experience/skills of the care providers in each arm appropriate?	Unclear	Unclear	Yes	Yes
5. Was participant adherence assessed quantitatively?	No	No	No	No
6. Were participants adequately blinded?	Yes	Unclear	Yes	No
7.1. Were surgeons adequately blinded?	No	No	No	No
7.2. Were rehabilitation staff adequately blinded?	Unclear	Unclear	Unclear	No
8. Were all other treatments and care (i.e., co-interventions) the same in each randomized group?	Yes	Yes	Yes	Yes
9. Were the number of patients who dropped out and those lost to follow-up the same in each randomized group?	Yes	Yes	Yes	Yes
10. Were clinical outcome assessors adequately blinded to assess the primary outcomes?	Unclear	Unclear	Yes	No
11. If outcome assessors were not adequately blinded, were specific methods used to avoid ascertainment bias?	No	No	NA	Unclear
12. Was the follow-up schedule the same in each group?	Yes	Yes	Yes	Yes
13. Were the main outcomes analyzed according to the intention-to-treat principle?	Unclear	Unclear	Unclear	Unclear

Abbreviation: NA, not applicable.

DISCUSSION

The objective of this systematic review was to identify, summarize, and combine the available Level I evidence related to concomitant acromioplasty with repair of full-thickness rotator cuff tears. This systematic review and meta-analysis showed no significant difference in disease-specific quality of life, shoulder-specific outcome measures, and rate of reoperation in the short-term period (1 to 2 years) in patients treated with SAD and those treated without it when undergoing concomitant arthroscopic repair of full-thickness rotator cuff tears.

The findings in this study support the view of Codman,[27] who stated that "acromioplasty has an important duty and should not be thoughtlessly divided at any operation." Rotator cuff tears likely arise from intrinsic degeneration, and as such, routine decompression may not be required. The theoretic disadvantages of routine SAD include weakening of the deltoid origin, anterosuperior instability, and the formation of adhesions between exposed bone on the undersurface of the acromion and the underlying rotator cuff tendon, which in turn can limit smoothness, motion, comfort, and range of motion.[9] Although the effect of acromioplasty on strength and anterosuperior escape was not evaluated in the included studies, the preliminary results in 1 of the studies indicate that there may be a decrease in postoperative external rotation in the affected shoulder at 1-year follow-up in patients treated with SAD.[25] Whether acromioplasty facilitates the healing of a repaired rotator cuff, prevents the progression of rotator cuff tears, or protects the integrity of RCR also cannot be elucidated. Confirming or disputing such possibilities requires postoperative imaging and long-term follow-up.

The generalizability of the results in this review requires careful consideration in specific patient subpopulations. First, the role of acromioplasty in Workers' Compensation patients undergoing RCR requires further evaluation. Only 1 of the studies in this systematic review included Workers' Compensation patients, and the final results for this study are pending.[25] The importance of not generalizing the aforementioned results to the Workers' Compensation population is supported by literature that has shown decreased health-related quality of life and upper extremity function after rotator cuff surgery when compared with patients without Workers' Compensation claims.[28] Next, although acromion type did not have an effect on WORC, ASES, or Constant scores in the included studies, it is notable that 5 of the 10 revision surgeries in 2 of the studies were in individ-

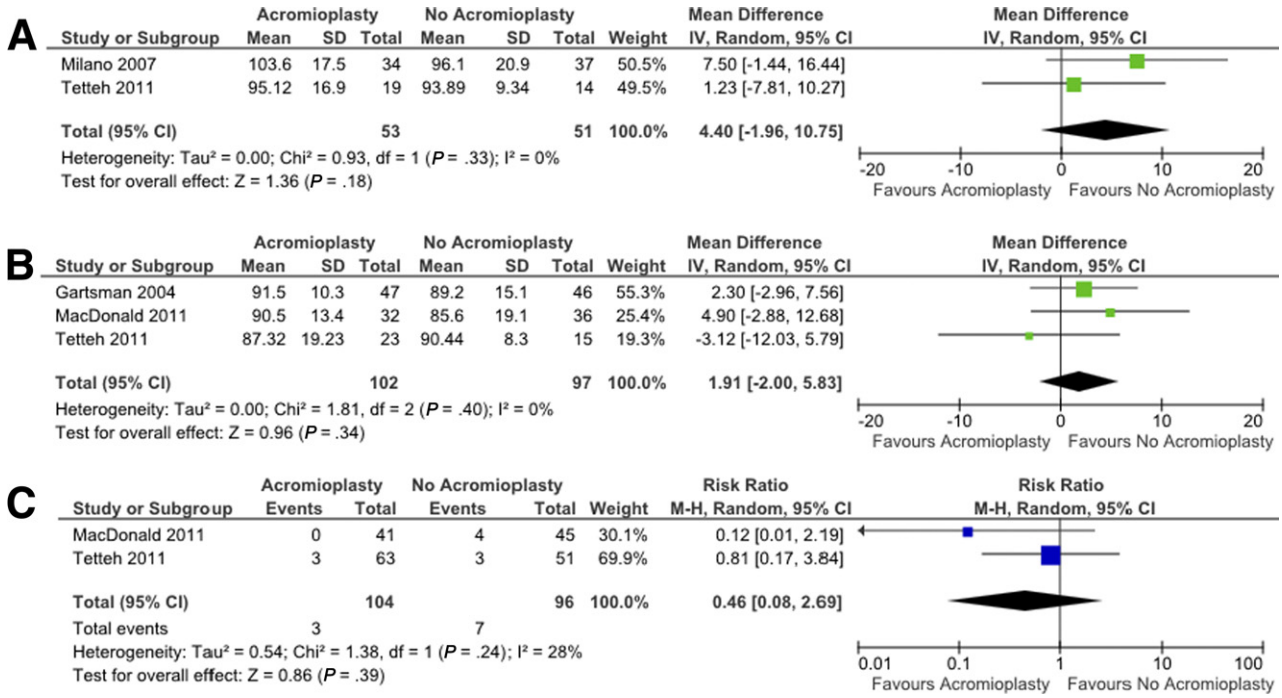

FIGURE 2. Forest plots showing results of meta-analysis for shoulder-specific outcome measures and rate of repeat surgery in patients undergoing acromioplasty versus no acromioplasty during arthroscopic repair of full-thickness rotator cuff tears. No statistically significant difference was observed in age- and gender-normalized Constant scores (A), ASES scores (B), or rate of repeat surgery (C) between the 2 treatment groups. (IV, inverse variance; MH, Mantel-Haenszel.)

uals with a type III acromion. Although it is possible that the ongoing pain and rotator cuff retear occurred as a result of unaltered acromial morphology (4 of these 5 cases) of a type III acromion, other factors such as a failure of tendon healing, tendon fibrosis, and reinjury cannot be excluded as reasons for ongoing pain. Longer-term follow-up studies looking at patient-reported outcome measures, imaging, and the rate of repeat surgery are required to definitively address the effect of acromial morphology on the rate of reoperation.

One of the strengths of this systematic review is that it is composed of 4 Level 1 randomized controlled trials that have used adequate allocation concealment and random sequence generation methods. This helps to reduce the systematic error that is inherently present in retrospective and sometimes prospective cohort studies. Another strength is that there is little clinical heterogeneity across the 4 included trials in pertinent variables including the eligibility criteria, arthroscopic repair techniques, and fixation techniques, as well as patient demographics (age and gender composition).

There are also some limitations. First, 1 of the 4 included trials has reported preliminary results in abstract form.[25] Although enrollment is complete in this study, patient follow-up is ongoing—at this time, the effective follow-up rate for this meta-analysis is 58.2% because of this process. Next, outcome assessors were definitely blinded in only 1 of the 4 included studies[23]—a sensitivity analysis to evaluate the possible effect of bias could not be evaluated because of the small number of studies. Furthermore, the clinical follow-up period in these studies ranges from 1 to 2 years. Long-term follow-up will be required to corroborate the reported findings. Another weakness included the variability in functional outcome measures reported across trials, which made a pooled analysis possible for only ASES and Constant scores. Finally, because no good evidence is available for rehabilitation after RCR, the variation in postoperative rehabilitation protocols among the 4 studies could impact the study outcomes.

Available evidence suggests that there are no differences in patient-reported outcomes or the rate of reoperation in patients treated with SAD and those treated without it when undergoing RCR in the short-term follow-up period. Long-term follow-up with stratification for acromion type and Workers' Com-

pensation status is required. Outcome measures of interest should be uniformly reported and include a disease-specific quality-of-life measure (WORC), a generic patient-reported outcome measure (Disabilities of the Arm, Shoulder and Hand, ASES, or Constant score), objective deltoid strength measurement, and postoperative imaging to evaluate acromial morphology, rotator cuff healing, and the presence of anterosuperior escape in the setting of failed or new rotator cuff tears.

CONCLUSIONS

On the basis of the currently available literature, there is no statistically significant difference in subjective outcome after arthroscopic RCR with or without acromioplasty at intermediate follow-up.

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