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ORIGINAL ARTICLE

Indications for Surgery in Clinical Outcome Studies of Rotator Cuff Repair

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Abstract Full-thickness tears of the rotator cuff are common, but there is no clear consensus regarding indications for rotator cuff surgery. Because some patients with full-thickness rotator cuff tears who are asymptomatic or symptomatic can be successfully treated nonoperatively, clinical outcome studies of rotator cuff repair should describe the subjects in detail to allow appropriate interpretation of the results. However, we hypothesized the indications for surgery are poorly described in outcome studies of rotator cuff surgery. We undertook a detailed literature review over 11 years of six major orthopaedic journals to assess whether the indications for surgery were described adequately in studies of rotator cuff repair. Eighty-six papers fit the criteria for the study and were reviewed. Limitations of activities of daily living (31%), failure of nonoperative treatment (52%), duration of nonoperative treatment (26%), and history of nocturnal pain (16%) were reported in a minority of papers overall. The patients' characteristics and indications for surgery were not described in a majority of clinical outcome studies of rotator cuff repair. It is important for these factors to be considered and reported because, without this information, the reasons for and results of rotator cuff repair are difficult to interpret.
Level of Evidence: Level III, prognostic study. See the Guidelines for Authors for a complete description of levels of evidence.

Introduction

Full-thickness tears of the rotator cuff are common [76, 85, 97], but the indications for rotator cuff surgery have not been clearly described. A recent survey of American Academy of Orthopaedic Surgeons indicated considerable variations in practice patterns relating to the care of patients with rotator cuff tears [22]. Numerous nonoperative therapies are effective, including physical therapy, antiinflammatory medications, and cortisone injections [2, 11, 36, 44, 49, 93]. In 2004, there were an estimated 30,000 inpatient rotator cuff repairs performed in the United States, which represented approximately 20% of the total number of rotator cuff repairs [38]. Therefore, approximately 150,000 rotator cuff repairs were performed in the United States in 2004. This operation generally is judged beneficial for health-related quality of life [21, 61]. Because some patients with full-thickness cuff tears who are asymptomatic or symptomatic can be treated successfully nonoperatively, clinical outcome studies of rotator cuff repair should describe the subjects in detail to allow appropriate interpretation of the results.

Factors generally believed to affect outcome, and therefore the decision to perform elective rotator cuff

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repair, include size of the tear, duration of symptoms, failure of nonoperative treatment, duration of nonoperative treatment, nocturnal pain, history of trauma, and limitations of activities of daily living (ADL), not necessarily in that order [41]. Without detailed knowledge of these factors before surgery, it is difficult to interpret the outcome of the operation.

We hypothesized these factors, and therefore the indications for surgery, frequently are not described in outcome studies of rotator cuff surgery (ie, in less than 50% of papers). We undertook a detailed literature review of six leading orthopaedic journals to ascertain whether the indications for surgery actually are described in outcome studies of rotator cuff surgery.

Materials and Methods

The review was limited in scope to six journals we believed most likely to publish high-quality clinical studies of the outcome of rotator cuff surgery. These journals, *The American Journal of Sports Medicine, Arthroscopy, Clinical Orthopaedics and Related Research, The Journal of Bone and Joint Surgery (American Volume), The Journal of Bone and Joint Surgery (British Volume),* and *The Journal of Shoulder and Elbow Surgery*, were reviewed over an 11-year period to identify articles relating to the rotator cuff. We located 273 papers pertaining to rotator cuff surgery from 1995 through 2005 (inclusive). A manual search of the six journals was performed, and all articles with the term "rotator cuff, supraspinatus, subscapularis, infraspinatus, and teres minor" in the title or abstract were included. We excluded all papers that did not describe the results of rotator cuff repair surgery including those that were technique-focused, biomechanical studies, basic science research, or review articles (Table 1). There were 187 papers on the rotator cuff that were excluded, leaving 86 papers for inclusion in this study.

Two investigators (SKC, PK) independently reviewed the 86 papers, evaluating specific indications for rotator cuff surgery in each paper. The factors studied were history of trauma, limitation of ADL, failure of nonoperative treatment, duration of nonoperative treatment, nocturnal pain, size of the tear, and duration of symptoms. We ascertained whether each of the factors was described, as explained below. Documentation of a history of trauma reported or not reported was recorded for each paper. Papers that mentioned limitation of ADL were recorded. Instances of ADL limitation that were recorded included specific ADL scores presented in the paper or references to difficulties performing routine daily tasks before surgery. We recorded failure of nonoperative treatment, such as nonsteroidal antiinflammatory drugs (NSAIDs), steroid injections, physical therapy, activity modification, rest, and exercise. General references to nonoperative treatment also were recorded. The duration of nonoperative treatment before surgery was recorded, if applicable. Specific mention of whether patients awoke at night as a result of pain was recorded. In addition, any references to patients having pain during the night but not specifically waking at night because of pain were noted. For each paper, the investigators recorded any mention of the size of the rotator cuff tear. This included average size (in centimeters), range of sizes, or another classification for tear size, such as small, medium, large, and massive. The number of tendons involved in the tear was recorded if other size measurements were not reported. The length of symptoms before rotator cuff surgery was recorded.

Table 1. Reasons for exclusion of articles

Explanation	Number of articles excluded (n = 187)
Biomechanical	32
Imaging	26
Technical note	23
Review article	18
Basic science	15
Case report	14
Anatomic study	5
Diagnosis	4
Epidemiologic study	4
Nonoperative care	4
Physical examination	4
Cuff not repaired	3
Tendon transfer	3
Current concepts review	3
Development of outcome measure	3
Not outcomes	3
Database research	2
Débridement	2
Electromyography	2
Postoperative pain management	2
Partial thickness	2
Treatment of infection	2
Finite element analysis	1
Latissimus transfer	2
Not clinical	1
Not cuff tear, only impingement	1
Observation study of anatomy	1
Questionnaire development	1
Reruptures only	1
Reverse total shoulder arthroplasty	1
Study of followup	1
Treatment of complications	1

Results

Of the 86 papers, only 38 (44%) mentioned whether the patients had history of trauma.

Limitations of ADL were described for 27 of the 86 papers (Table 2). Twenty-three papers reported a preoperative score that measures function and activity level (UCLA, Constant-Murley, Simple Shoulder Test, American Shoulder and Elbow Society) but did not specifically mention limitations of ADL (Table 3). Greater than 40% of the papers did not mention any physical limitations before rotator cuff surgery that impaired the patients' ability to perform normal daily functions.

In 37 of the 86 papers, failure of nonoperative treatment for patients was reported and the specific types of nonoperative treatment also were noted. In eight of the papers, failure of nonoperative treatment was mentioned, but no specific treatment types were presented. In 41 papers, nearly ½ of the total, nonoperative treatment was not mentioned (Table 4). In all, 49 papers (57%) did not report the specific method of nonoperative treatment before surgery.

Thirty-seven papers mentioned nonoperative treatment. Physical therapy, steroid injections, and NSAIDs were the most common types of nonoperative treatment (Table 5). Activity modification, rest, and exercise also were listed as nonoperative treatment options.

The duration of nonoperative treatment was reported for only 22 of the 86 papers. Of these papers, the most frequent duration of nonoperative treatment before surgery was a minimum of 3 months (Table 6). Four papers included patients with less than 3 months of nonoperative treatment, whereas four papers cited patients with a minimum of 6 months of nonoperative treatment before rotator cuff surgery. Two papers reported an average duration of nonoperative treatment of 5.5 months (range, 1–24 months) and 34.9 months (range, 1–144 months), respectively.

Only 14 papers of the 86 (16%) made reference to patients with pain at night. None of the papers reported patients waking at night because of pain.

Of the 86 papers included in the study, 49 papers reported the size of rotator cuff tears as small (< 1 cm), medium (1–3 cm), large (3–5 cm), or massive (> 5 cm). Seventeen of the papers reported an average size of the tear, whereas eight reported a range of tear sizes. Nine papers only reported the number of tendons in the tear and four used another sizing scale such as that of Boehm et al. [9] or Ide et al. [42]. Finally, 10 papers did not mention the size of the tear (Table 7).

The duration of symptoms before rotator cuff surgery was reported in 48 papers, whereas 44% (38 papers) did not mention the duration of symptoms.

Table 2. Limitations of ADL

ADL limitations	Number of papers	Percentage of papers	References
ADL limitations reported	27	31%	[7, 15, 18, 21, 23, 32, 33, 39, 40, 45, 50, 54, 58, 59, 61–63, 65, 68, 69, 71, 74, 78, 89–91, 96]
Only ADL or function score reported	23	27%	[1, 6, 13, 27–30, 37, 42, 43, 47, 48, 60, 66, 70, 77, 82–84, 86–88, 92]
No mention of ADL	36	42%	[3–5, 8–10, 12, 14, 16, 17, 19, 20, 24–26, 31, 34, 35, 46, 51–53, 55–57, 64, 67, 72, 73, 75, 79–81, 89, 94, 95, 98]

ADL = activities of daily living.

Table 3. Scoring systems used

Scoring system	Frequency	References
Constant-Murley	26	[3–5, 8–10, 12, 19, 20, 24, 26–30, 32, 39, 48, 50, 51, 58, 59, 65, 72, 73, 89]
American Shoulder and Elbow Society	25	[3–5, 17, 20, 23, 27, 29–31, 39, 48, 59, 63, 64, 66–69, 74, 75, 78, 80, 82, 98]
UCLA	41	[1, 2, 10, 12, 14–17, 25, 29, 30, 34, 35, 39, 40, 42, 43, 45–47, 53–55, 57, 62, 63, 65, 70–73, 75, 77, 82–84, 92, 94–96, 98]
Simple Shoulder Test	8	[13, 33, 60, 73, 78, 79, 90, 91]
Visual analog scale	7	[3–6, 13, 20, 28]
Short Form-36	6	[29, 30, 33, 59–61]
Other validated	7	[7, 25, 29, 30, 33, 42, 43, 51, 52, 59–61, 87]
Nonvalidated	4	[18, 21, 37, 81]
None	2	[56, 86]

Table 4. Failure of nonoperative treatment

Nonoperative treatment	Number of papers	Percentage of papers	References
Specific nonoperative treatment reported	37	43%	[3, 6, 10, 12, 13, 17, 18, 24, 25, 28–30, 37, 39, 45, 50, 51, 54, 58, 59, 61–63, 65, 67–69, 71, 74, 75, 77, 78, 80, 81, 90, 91, 96]
General nonoperative treatment reported	8	9%	[1, 27, 32, 55, 86, 92, 94, 95]
No mention of nonoperative treatment	41	48%	[4, 5, 7–9, 14–16, 19–21, 23, 26, 31, 33–35, 40, 42, 43, 46–48, 52, 53, 56, 57, 60, 64, 66, 70, 72, 73, 79, 82–84, 87–89, 98]

Table 5. Types of nonoperative treatment (includes 37 papers)

Type of nonoperative treatment	Frequency	References
Physical therapy	32	[3, 10, 12, 13, 17, 18, 25, 28–30, 37, 39, 45, 51, 54, 58, 59, 61–63, 65, 67–69, 74, 75, 77, 78, 80, 81, 90, 96]
Steroid injections	26	[3, 10, 12, 18, 28–30, 39, 45, 50, 58, 59, 61–63, 65, 67, 68, 74, 75, 78, 80, 81, 90, 91, 96]
Nonsteroidal antiinflammatory drugs	24	[3, 6, 12, 17, 18, 24, 28–30, 39, 45, 50, 58, 59, 61, 62, 65, 67–69, 71, 74, 75, 78]
Activity modification	10	[24, 29, 30, 37, 39, 45, 61, 62, 71, 91]
Rest	6	[6, 24, 37, 68, 71, 78]
Exercise	4	[6, 24, 71, 92]

Table 6. Distribution of nonoperative treatment duration

Duration of nonoperative treatment	Frequency	References
Less than 3 months	4	[45, 69, 90, 91]
Minimum 3 months	12	[1, 3, 13, 24, 27, 32, 55, 58, 65, 68, 74, 77]
Minimum 6 months	4	[10, 29, 30, 59]
Other (1–144 months)	2	[39, 86]

Table 7. Size of tear

Size of tear	Number of papers	Percentage of papers	References
Reported as small, medium, large, or massive	49	44%	[1, 3, 5, 7, 13, 14, 18, 20, 21, 23, 25, 26, 28, 30, 32, 34, 35, 37, 39, 40, 43, 45–47, 50, 52–55, 58, 59, 61–63, 65–68, 70–72, 75, 77–79, 81, 82, 96, 97]
Average size reported	17	20%	[7, 12, 15, 20, 29, 31, 39, 48, 54–56, 59, 63, 74, 83, 84, 87]
Only number of tendons reported	9	10%	[4, 8, 16, 33, 60, 63, 80, 86, 89]
Size reported in a range	8	9%	[19, 27, 30, 51, 74, 83, 89, 93]
Other size scale reported	4	5%	[9, 10, 42, 69]
Not reported	10	12%	[6, 17, 24, 57, 64, 73, 89–91, 94, 95]

The distribution of symptom duration showed, in 19 of the 48 papers, the patients had an average duration of symptoms between 6 and 12 months (Fig. 1). Eleven papers reported patients with an average duration of symptoms between 12 and 18 months, whereas three papers reported an average duration between 1 and 6 months. Two papers [37, 87] reported the duration of symptoms for two separate groups of study patients. The duration of symptoms was reported as a range in four papers, with a duration greater than 3 months in three papers and greater than 6 months in one. The overall range of symptom duration before surgery was 1 to 244 months.

Discussion

Numerous factors influence the decision to perform elective rotator cuff repair surgery. Although full-thickness

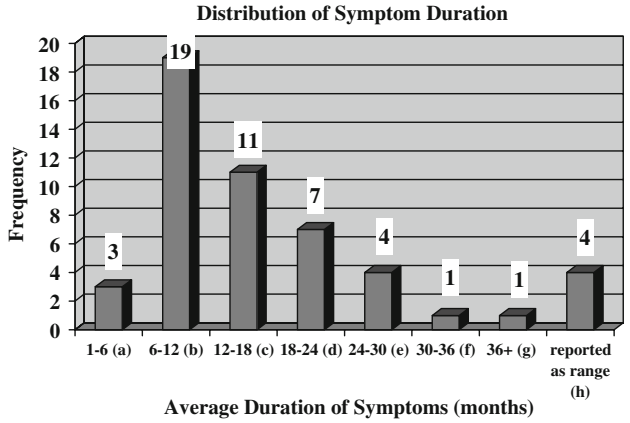

Fig. 1 Distribution of symptom duration is shown (includes 48 papers). (a) References [6, 50, 69]; (b) References [12, 16, 17, 26, 39, 42, 43, 45, 47, 55, 61, 63, 65, 68, 72, 88–90, 92, 96]; (c) References [23, 24, 30, 40, 51, 75, 81, 83, 84, 87, 89]; (d) References [15, 29, 32, 67, 73, 80, 87]; (e) References [10, 18, 37, 66]; (f) Reference [58]; (g) Reference [37]; (h) References [13, 28, 71, 78].

tears of the rotator cuff are common, there seems to be no clear consensus regarding indications for rotator cuff surgery. Because some patients with full-thickness rotator cuff tears who are asymptomatic or symptomatic can be successfully treated nonoperatively, clinical outcome studies of rotator cuff repair should describe the subjects in detail to allow appropriate interpretation of the results. Based on our experience with the literature we hypothesized the indications for surgery are poorly described in outcome studies of rotator cuff surgery.

Limitations of this study include the fact that there may be other potential indicators for surgery that were not evaluated; however, we believe we included the most important factors. Additionally, the research was limited to six journals and was not a systematic review. As stated earlier, we limited our search to attempt to include the highest quality papers in the most frequently read and cited journals that publish studies relating to the rotator cuff.

We intentionally limited the scope of the review to the six journals we believed published the most detailed and comprehensive studies of rotator cuff surgery. Despite this, 44% of the papers did not discuss the duration of symptoms for the patients who underwent surgery. A majority of the papers included in this study did not report if there was a history of trauma or limitations of ADL. These factors, all important for the decision to perform the surgery, have been clearly underreported in outcome studies of rotator cuff surgery.

Nonoperative treatments such as physical therapy, NSAIDs, and steroid injections have beneficial effects for some patients with rotator cuff tears. Therefore, failure of nonoperative treatment is important to consider when evaluating the results of surgery. However, 41 of the 86 papers in this study do not mention nonoperative treatment of the cuff tears before surgery. Additionally, of the 45 papers that reported nonoperative management of rotator cuff tears, only 22 discussed the duration of nonoperative treatment. Although ½ of the papers did not mention whether patients had (with failed results) nonoperative treatment before having rotator cuff surgery, it is possible nonoperative treatment was administered but omitted from the paper. Without attempting nonoperative treatment for appropriate patients, there is the potential for patients whose rotator cuff problems could have been improved with nonoperative treatment to have had unnecessary surgery.

As seen through the analysis of 86 papers in this study, numerous important factors relating to the indications for surgery often are omitted from clinical studies of rotator cuff repair. It is important for all of these factors to be considered and reported because, without this information, the reasons for and the results of rotator cuff repair are difficult to interpret.

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