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Two-Year Outcomes After Arthroscopic Rotator Cuff Repair in Recreational Athletes Older Than 70 Years

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Background: Outcomes after arthroscopic rotator cuff repair in recreational athletes older than 70 years are not widely reported.

Purpose: To evaluate clinical outcomes after arthroscopic repair of full-thickness rotator cuff tears in recreational athletes aged 70 years or older.

Study Design: Case series; Level of evidence, 4.

Methods: Institutional review board approval was obtained before initiation of this study. Data were collected prospectively and were retrospectively reviewed. From December 2005 to August 2012, patients who were at least 70 years of age, who described themselves as recreational athletes, and who underwent a primary or revision arthroscopic repair of full-thickness supraspinatus tears by a single surgeon were identified from a surgical registry. Demographic data, surgical data, and the following pre- and postoperative clinical outcomes scores were collected: American Shoulder and Elbow Surgeons (ASES), Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH), Short Form–12 Physical Component Summary (SF-12 PCS), and Single Assessment Numeric Evaluation (SANE). Acromiohumeral distance and Goutallier classifications were recorded. Patient satisfaction (range, 1-10, 10 = best) and reasons for activity modification were collected at final follow-up.

Results: Forty-nine shoulders (44 patients) were included. The mean age was 73 years (range, 70-82 years). There were 33 men and 11 women (5 bilateral). The mean preoperative acromiohumeral distance was 9.2 mm (range, 3.0-15.9 mm). All patients had Goutallier classifications of 0, 1, or 2. Mean follow-up was 3.6 years (range, 2.0-6.9 years) in 43 of 49 (88%) shoulders. No rotator cuff repairs were revised, however, 1 patient had surgical treatment for stiffness. All postoperative outcomes measures demonstrated significant improvements when compared with their preoperative baselines. The mean ASES score was 90.3 (range, 60-100), the mean SANE score was 85.1 (range, 29-100), the mean QuickDASH score was 11.3 (0-50), and the mean SF-12 PCS score was 51.6 (range, 38-58) with a median patient satisfaction of 10 (range, 1-10). Patients who modified their recreational activities due to postoperative weakness were significantly less satisfied ($P = .018$). In this study, 24 of 31 (77%) who responded were able to return to their sport at a similar level of intensity.

Conclusion: Arthroscopic rotator cuff repair was highly effective at reducing pain, improving function, and returning patients to sport in recreational athletes 70 years of age and older.

Keywords: rotator cuff; treatment; athletes; elderly; outcomes

Rotator cuff tears are a common cause of shoulder dysfunction, especially in patients older than 70 years of age. The prevalence of full-thickness rotator cuff tears increases with age, with a report indicating that they may occur in up to 22% of all patients over 65 years of age.[4] Elderly individuals have shown an increasing desire to remain physically active. These expectations often warrant surgical treatment of rotator cuff tears in this population after failure of nonoperative management. However, controversy exists regarding surgical indications as well as the optimal operative technique.

Older individuals have a number of factors that work against obtaining good results after surgery. For example, patients older than 60 years are 3 times more likely to experience massive rotator cuff tears compared with younger patients.[9] Bone quality also decreases with age and

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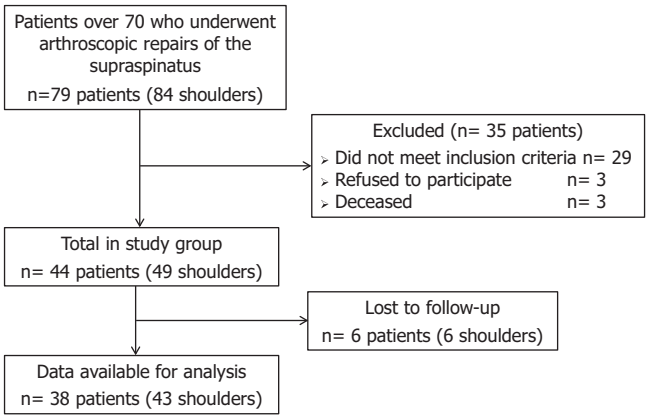

Figure 1. Patient grouping flow diagram.

may complicate suture anchor fixation. Lamellar dissection and fatty infiltration are more common in elderly individuals.[11] Healing may be impaired by poor blood supply, as histologic examination of rotator cuff tendon tissue has shown decreased vascularity in older patients.[2] Furthermore, comorbid conditions such as diabetes, rheumatoid arthritis, and renal disease are more prevalent in older individuals. All of the aforementioned factors can make rotator cuff repair more challenging and clinical outcomes less predictable.

Rotator cuff repair has shown superior results when compared with debridement alone in patients over 70 years old.[5] Historically, favorable clinical outcomes have been reported for open and mini-open rotator cuff repairs[8,10,23] and more recently for arthroscopic repairs in the general elderly population.[14,15,17,21] This study aims to evaluate clinical outcomes in recreational athletes 70 years of age or older.

METHODS

Study Design

Institutional review board approval was obtained before the initiation of this study. Between December 2005 and August 2012, all patients who had full-thickness supraspinatus tears (with or without infraspinatus or subscapularis tendon involvement) repaired arthroscopically by the senior surgeon (P.J.M.), who were 70 years of age or older, and who described themselves as recreational athletes on an activity level scale of "not an athlete," "recreational athlete," "collegiate athlete," or "professional athlete" were included in the study. Patients who refused to participate, died before time of final follow-up, had fractures, had acromioclavicular joint injuries, or underwent previous total shoulder arthroplasty were excluded (Figure 1).

Data Collection

All data were prospectively collected, stored in a registry, and retrospectively reviewed. Data included demographic information (age, sex, dominant shoulder, affected shoulder), characteristics of injury (mechanism, duration of symptoms), occupation or retirement status, prior surgeries, treatment history, additional injuries, adjuvant treatments, and operative complications. Patient-centered outcomes scores were collected preoperatively and included American Shoulder and Elbow Surgeons (ASES), Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH), Short Form–12 Physical Component Summary (SF-12 PCS), and Single Assessment Numeric Evaluation (SANE) scores.

Acromiohumeral distance measurements were made on anteroposterior radiographs, and information regarding Goutallier classification of fatty infiltration was determined from sagittal plane magnetic resonance images (MRI).[6] The same patient-centered outcomes scores collected preoperatively were also collected at a minimum of 2 years postoperatively. In addition, specific questions were asked regarding the level of pain associated with activities such as recreational athletics, work, and activities of daily living (ADLs). At the time of final follow-up, patients were asked questions regarding satisfaction with surgical outcomes, degree of activity modification, and the need for additional surgeries.

Surgical Technique

All patients were medically cleared for surgical intervention. Operations were performed using general anesthesia with additional interscalene nerve blocks. The patients were positioned in the beach-chair position. The operative extremity was placed in a pneumatic arm holder, and the shoulder was prepared and draped using sterile technique. Diagnostic arthroscopy was performed, and treatable intra-articular lesions were addressed. After articular lesions were addressed, an acromioplasty was performed creating a Bigliani type 1 acromion if indicated, particularly when subacromial spurs or impingement lesions were found.[19]

Attention was then turned to the rotator cuff (Figures 2 and 3). The rotator cuff footprint on the greater tuberosity was debrided to a bleeding surface, preserving the cortical surface. Intra- and extra-articular releases were performed if the margins of the full-thickness tear lacked adequate mobility. Thirty-four shoulders underwent repair using a linked arthroscopic double row technique, which has been described elsewhere (SpeedBridge, Arthrex Inc).[19] Briefly, bioabsorbable anchors were inserted 1 mm lateral to the articular margin. Once the anchors were placed, a shuttling device was used to shuttle the suture limbs through the rotator cuff tendon lateral to the musculotendinous junction. The 2 lateral anchors were then placed 5 to 10 mm lateral to the lateral edge of the greater tuberosity. The anterolateral anchor was placed first, with care being taken to properly tension the suture limbs from the medial row before fixation. The posterolateral anchor was secured in a similar fashion. Although this technique typically uses 4 knotless suture anchors, the number of anchors may vary according to tear size, configuration, and mobility. Eight shoulders (16%) were repaired with a standard double-row construct (SutureBridge, Arthrex Inc). Seven shoulders (14%) underwent repair of the rotator cuff using a standard single-row repair.

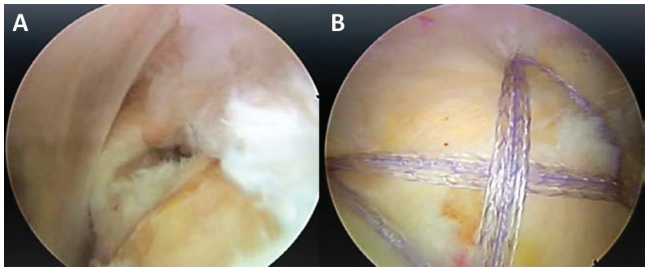

Figure 2. A 73-year-old man who skis approximately 100 days per year, with a chronic (A) delaminated crescent-shaped supraspinatus tear that was repaired with (B) a double-row repair.

Five of the 7 (71%) single-row repairs were performed for massive rotator cuff tears.

Forty-three shoulders (87%) had significant injury of the long head of the biceps. In these cases, the long head of the biceps tendon was released arthroscopically. Thirty-six (84%) of the 43 shoulders with biceps injury underwent a subpectoral biceps tenodesis. A 2.5-cm incision was created in the axillary crease and sharply taken down to the fascia of the short head of the biceps. The fascia between the pectoralis major and the short head of the biceps was incised, and the long head of the biceps was identified, extracted, and whipstitched. A hole was drilled in the bicipital groove, and the biceps tendon was secured using a polyetheretherketone (PEEK) tenodesis screw, typically 7 × 10 mm or 8 × 12 mm (Arthrex Inc). Three tenodesis procedures were performed arthroscopically, and 4 biceps tendons were treated with tenotomy only.

Postoperatively, all shoulders were immediately immobilized in a sling. Patients were allowed early pendulum and passive range of motion exercises, with full passive range of motion starting immediately. Active and active assisted motion was begun 4 to 6 weeks after surgery, and strengthening was delayed until at least 6 to 8 weeks after surgery. Full, unrestricted activities were typically permitted between 12 and 16 weeks postoperatively according to patient tolerance and kinematic progress.

Statistical Analysis

Statistical analyses were performed using SPSS version 11.0 (SPSS Inc). Univariate analyses were performed using an independent *t* test for normally distributed variables. Mann-Whitney or Kruskal-Wallis tests were performed for data that were not normally distributed. Bivariates were analyzed with a chi-square test. The paired Student *t* test or Wilcoxon signed ranks test were used to detect differences between pre- and postoperative outcomes scores. *P* values less than .05 indicated statistical significance.

RESULTS

Forty-nine shoulders (44 patients) underwent arthroscopic rotator cuff repair and were included in the study. The mean age of the patient cohort at the time of surgery was 73 years (range, 70-82 years; SD, 3.2). There were 33 men and 11 women. Five patients underwent bilateral surgery. Primary recreational activities are summarized in Table 1. The average time of onset of symptoms to surgery was 1.1 years (range, 1 day to 13.3 years). Four shoulders (8%) underwent revision of a prior rotator cuff repair.

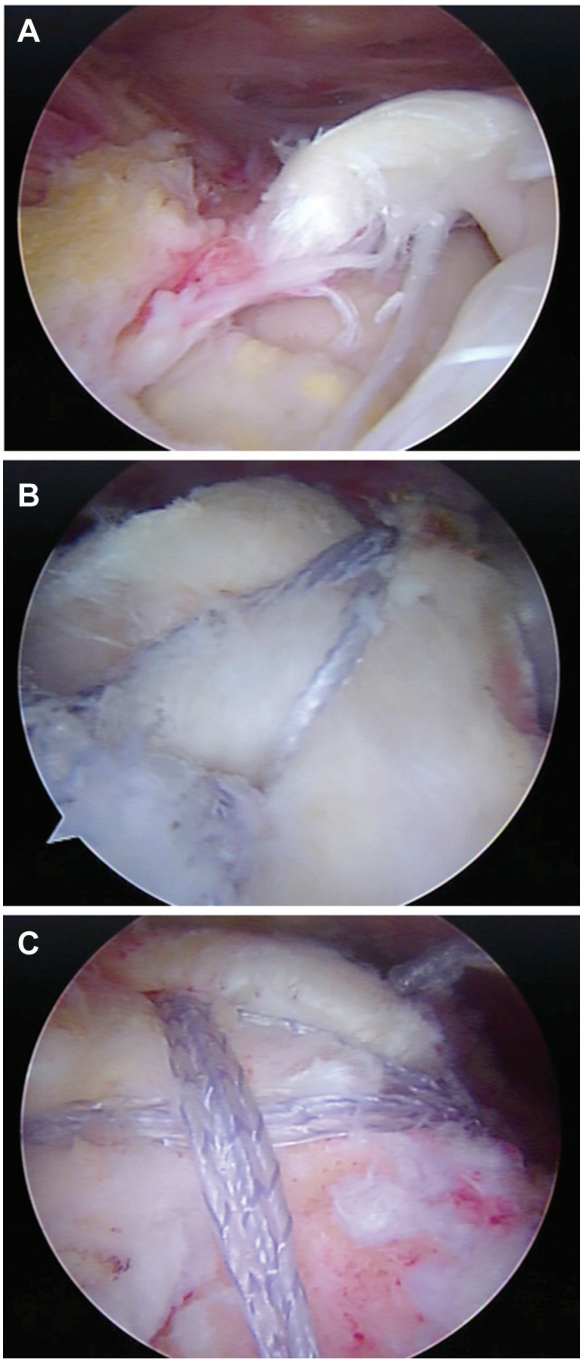

Figure 3. A 78-year-old man who suffered a fall while riding his bike. (A) Acute U-shaped massive cuff tear with delaminated infraspinatus portion visible. (B) A margin convergence repair was incorporated into a (C) double-row cuff repair.

TABLE 1
Summary of Recreational Sports in Which Patients Participated

Sporting Activity Indicated	No. of Patients
Alpine skiing	11
Baseball	2
Cycling	2
Golf	10
Hockey	2
Horseback riding	3
Other sports (yoga, fitness, swimming)	12
Track and field (javelin, pole vaulting)	2

Twelve injuries (24%) were the result of significant trauma. Twenty-four shoulders (49%) had a Goutallier classification of fatty infiltration of grade 0, 21 (42%) had grade 1, and 4 (8%) had grade 2. The mean preoperative acromiohumeral distance was 9.2 mm (range, 3.0-15.9 mm). Two patients (5%) had diabetes mellitus and 6 patients (14%) were active smokers.

Twenty-two shoulders (45%) had full-thickness tears of the supraspinatus and infraspinatus, 6 shoulders (12%) had full-thickness tears of the supraspinatus and subscapularis, and 1 shoulder (2%) had full-thickness tears of the supraspinatus, infraspinatus, and subscapularis.[7] Biceps lesions were noted and treated with a tenodesis or tenotomy in 43 of 49 shoulders (88%). Previous rupture of the long head of the biceps tendon occurred in 2 of the remaining 6 shoulders. Thirty-seven shoulders (76%) had labral lesions in addition to the rotator cuff tears. Twelve shoulders (25%) had osteoarthritis with Outerbridge criteria of 3 or 4. Two shoulders (4%) received microfracture treatment. Forty-two shoulders (86%) underwent double-row rotator cuff repair, and 7 shoulders (14%) had a single-row repair. No patients went on to receive a revision rotator cuff repair. One patient underwent surgical treatment for stiffness within 4 months from initial surgery.

Minimum 2-year follow-up data were collected for 43 of 49 shoulders (88%). The mean follow-up was 3.6 years (range, 2.0-7.9 years). All outcomes scores significantly improved when compared with preoperative values (Table 2). Mean postoperative ASES scores were 90.3. Satisfaction with outcomes of surgery at the time of final follow-up was high, with a median of 10 out of 10 (range, 1-10). However, for the 39 patients who responded, 12 (31%) had a satisfaction score of 6 or lower. Patients who required postoperative activity modification as a result of weakness were less satisfied with their outcomes (6 vs 10; $P = .018$). Patients who had to modify activities because of weakness were more likely to have full-thickness tears of both the supraspinatus and infraspinatus versus supraspinatus only (36% vs 5%; $P = .028$).

There was significant improvement in the effect of pain influencing ADLs ($P < .001$), recreational sporting activities ($P < .001$), and sleep ($P < .001$) (Table 3). Patients also showed improvement in painless, reasonably strong activities ($P < .001$), with 24 of 35 patients (69%) reporting pain-free, reasonably strong use of their arm for overhead activities. Of the 31 patients who responded, 24 (77%) were able to return to sporting levels at or near their preinjury level. No other surgical or demographic variables were significantly associated with outcomes scores or patient satisfaction.

DISCUSSION

In this study, arthroscopic rotator cuff repair in self-described recreational athletes aged 70 years or older resulted in decreased pain, improved function, and a high rate of return to recreational activities with a median satisfaction of 10 out of 10. The mean ASES score, a validated method to measure rotator cuff function,[12] was 90.3 and is comparable with age-matched individuals with normal shoulder function.[1,18] Significant improvements in the effect of pain influencing ADLs ($P < .001$), recreational sporting activities ($P < .001$), and sleep ($P < .001$) were also demonstrated. Eighty-eight percent of patients in the cohort (43/48) had lesions of the long head of the biceps tendon.

Patients over the age of 70 with rotator cuff injury are increasingly expressing a desire to remain physically active in both sport and occupation. However, elderly individuals with rotator cuff tears sometimes have various biological challenges, as previously noted. Given these obstacles, many patients over the age of 70 with rotator cuff tears have been treated nonoperatively or with simple debridement procedures.[21] Although shoulder debridement procedures frequently improve pain for a short period of time, many patients are disappointed by their inability to regain shoulder function.[8]

Disappointment in the inability to regain shoulder function is likely to be more pronounced in active elderly individuals, particularly in self-described recreational athletes. In recent years, improvements in minimally invasive arthroscopic surgical techniques combined with patients' high functional demands have led surgeons to attempt arthroscopic rotator cuff repair in active patients over the age of 70 years who wish to regain shoulder function. Thus far, arthroscopic repair of rotator cuff tears in this population appears to be superior to debridement.[21]

Other investigators have reported outcomes of arthroscopic rotator cuff repair in the general elderly population. Verma and colleagues,[21] in a retrospective review of 44 patients over the age of 70 years who underwent arthroscopic rotator cuff repair, noted significant improvement in ASES score, Simple Shoulder Test score, visual analog pain score, and forward elevation after a mean follow-up period of 36 months. In that report, mean ASES score improved from 45.8 to 87.5 at final follow-up, comparable to the improvement in score noted in our study. Similarly, Robinson et al,[17] in a review of 68 patients over the age of 70 years who underwent arthroscopic rotator cuff repair, noted that the Constant-Murley score significantly increased after surgery and that men had improved functional scores at 1 year postoperatively. Interestingly, the authors also noted that rotator cuff retears were detected in 32% of patients at 1 year postoperatively on follow-up ultrasound. Most of these retears occurred in patients who had massive (>5 cm) rotator cuff tears.[17]

Rhee et al[16] examined clinical and radiographic outcomes of 191 patients aged 60 to 69 years who underwent

TABLE 2
Summary of Minimum 2-Year Outcome Scores[a]

Outcomes	Preoperative	Postoperative	*P* Values
ASES (0-100, 100 = best)	56.0 (12-80)	90.3 (60-100)	<.001[b]
SANE (0-100, 100 = best)	63.1 (25-90)	85.1 (29-100)	.034[b]
QuickDASH (0-100, 0 = best)	34.1 (14-77)	11.3 (0-50)	.001[b]
SF-12 PCS	43.0 (30-58)	51.6 (38-58)	<.001[b]
Satisfaction (1 = unsatisfied, 10 = completely satisfied)	—	10 (1-10)	—

[a]Data are presented as mean (range) except for satisfaction outcomes, which are presented as median (range). ASES, American Shoulder and Elbow Surgeons; QuickDASH, Quick Disabilities of the Arm, Shoulder and Hand; SANE, Single Assessment Numeric Evaluation; SF-12 PCS, Short Form–12 Physical Component Summary.
[b]Statistically significant difference between groups ($P < .05$).

TABLE 3
Summary of Improvements in Pain Scores[a]

Outcomes	Preoperative	Postoperative	*P* Values
Pain with activities of daily living	Moderate (none-severe)	None (none-moderate)	<.001[b]
Pain with recreational sport	Moderate (mild-severe)	None (none-severe)	<.001[b]
Pain with sleep	Moderate (mild-severe)	None (none-moderate)	<.001[b]

[a]Data are presented as median (range).
[b]Statistically significant difference between groups ($P < .05$).

open rotator cuff repair compared with 47 patients over 70 years of age who underwent the same procedure. The authors noted that mean visual analog scores, UCLA shoulder scores, and Constant-Murley scores improved significantly in both groups with no significant difference between the 2 groups.[16] Additionally, there was no significant difference in the retear rate of 39.8% for patients in their 60s and 51.1% for patients in their 70s on follow-up MRI. Although open rotator cuff repair results in more deltoid morbidity than arthroscopic rotator cuff repair, others have noted comparable findings.

The current study isolated the outcomes of arthroscopic rotator cuff repair in an elderly recreationally athletic population with a high follow-up rate of 88%. Previous reports on rotator cuff repair in elderly people have described improved outcomes but have not limited their analysis to athletic individuals.[15,23] It is plausible that the high postoperative outcome scores observed in this cohort may be attributed to participation in recreational sporting activities that likely resulted in improved bone and tendon quality within the shoulder relative to elderly individuals who are not athletic. This theory is corroborated by Deranlot and colleagues,[3] who noted that the best outcomes of arthroscopic rotator cuff repair in elderly people occur in individuals who remain very active. However, the bone quality of the recreational athletes included in this study was likely diminished relative to elderly recreational athletes without rotator cuff tears, as the detached rotator cuff tendon does not provide stimulus for bone remodeling.[22] It is possible that a high degree of preoperative athletic function in this cohort resulted in elevated postoperative functional expectations on the part of the patient with regard to return to sports.

Although satisfaction with surgical outcomes at the time of final follow-up was high, 12 of 39 patients (31%) had a satisfaction score of 6 or lower. Patients who modified their activities after surgery because of persistent weakness were significantly less satisfied with their outcomes (6 vs 10; $P = .018$). Furthermore, these patients were more likely to have larger tears of the rotator cuff ($P = .028$).

The most noteworthy limitation in this investigation is the lack of postoperative imaging. This did not allow for stratification of outcomes based on repair integrity at a minimum of 2 years postoperatively, nor did it allow for assessment of change in Goutallier grade postoperatively. In addition, 2 different rotator cuff repair constructs were used. Although 42 shoulders had their rotator cuff repaired with a double-row technique, 7 shoulders were repaired with a single-row construct. A recent meta-analysis did not find a difference in clinical outcomes measures between patients who received a single-row repair and those who received a double-row repair, although the authors did note a lower retear rate in patients who had a double-row repair.[13] It is plausible that the favorable biomechanics and decreased retear rate of the double-row repair improved clinical outcomes in those patients.[13,20] However, the present study is underpowered to compare outcomes between single-row and double-row repairs. The senior author's (P.J.M.) preference is for double-row linked anatomic repair when the tear is greater than 1 cm and there is sufficient tendon quality.

CONCLUSION

Arthroscopic rotator cuff repair was highly effective at reducing pain, improving function, and returning patients

to sport in high-demand elderly individuals over 70 years of age.

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