Clinical Sports Medicine Update

Return to Sport After Arthroscopic Rotator Cuff Repair

Is There a Difference Between the Recreational and the Competitive Athlete?

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Background: Return to sport (RTS) remains an important challenge and measure of success for athletes undergoing arthroscopic rotator cuff repair (RCR).

Purpose: To determine the rate of RTS after RCR and to analyze predictive factors associated with a lower rate of return.

Study Design: Systematic review and meta-analysis.

Methods: A systematic review of the literature was performed following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. The electronic databases of PubMed, MEDLINE, Cochrane, and Google Scholar were used for the literature search. Study quality was evaluated according to the Coleman Methodology Score. Studies in English evaluating RTS after arthroscopic repair of partial- or full-thickness rotator cuff tears among athletes of all levels, ages, and sports were included. Random effects meta-analysis and metaregression were performed to investigate RTS activity rate after arthroscopic RCR and to explore study heterogeneity, respectively.

Results: Fifteen studies were reviewed, including 486 patients (499 shoulders) who were treated with arthroscopic RCR and who had a mean follow-up of 40.1 months (range, 18-74.4 months). Eighteen patients were lost to follow-up, leaving 468 patients with outcome data; 347 identified themselves as athletes (81 competitive, 266 recreational). The most commonly included sports were baseball (n = 45), golf (n = 38), football (n = 23), and tennis (n = 18). RTS specific to the type of athlete was reported for 299 of 347 athletes. According to the meta-analysis, the overall rate of RTS at a similar level of play or higher was 70.2%, with 73.3% of recreational athletes and 61.5% of competitive athletes able to return. A subset of 43 baseball and softball players across 4 studies yielded a 79% rate of RTS; however, only 38% returned to the same level of play or higher. Subgroup meta-analysis revealed no significant difference in the rate of RTS between competitive and recreational athletes. Metaregression analysis revealed that the mean follow-up time and mean age at surgery were not significantly associated with RTS rate.

Conclusion: Most athletes (70.2%) were able to return to a preinjury level of play after arthroscopic RCR. While recreational sports participation (73.3%) was associated with higher return, competitive sports (61.5%) and overhead sports (38%) were associated with lower return. Exactly why all athletes do not return remains uncertain and likely multifactorial.

Keywords: rotator cuff tear; arthroscopic repair; athlete; return to sports

Rotator cuff tears are common and can lead to pain and dysfunction. The prevalence of rotator cuff tears in the general population is reported to be 9.7% among patients ≤20 years old and 62% among patients ≥80 years, demonstrating a profound increase with age.[24] Among competitive collegiate American football players invited to the National Football League Combine, 12% have rotator cuff injuries.[12] Overhead athletes are especially at risk of injury because the repetitive physiological demands put on the shoulder increase microtrauma, while contact and collision athletes have the added risk of acute traumatic tears.[8,13] Chronic degenerative pathology is the most common pathomechanism in the elderly population.[16] While low-demand older patients with chronic attritional tears may be more suited to nonoperative treatment, younger active patients with acute traumatic tears may be better treated with surgical rotator cuff repair (RCR).[1]

The ultimate goal of surgical treatment for athletes is a symptom-free return to sport (RTS) at the same preinjury level of competition. Arthroscopic approaches have become increasingly popular over open approaches, owing to the potential advantages of less soft tissue trauma, decreased scar tissue and adhesions, and increased

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accessibility to treat concomitant injuries simultaneously. This less invasive operation also potentially offers a quicker recovery time as compared with open procedures, which is advantageous for an athlete's RTS.[29] Given the increasing common use of arthroscopic RCR, this review focuses on studies utilizing arthroscopic approaches to provide a detailed analysis of this technique. While some studies focused on the outcomes of RCR among athletes, none analyzed the differences between recreational and competitive athletes after only arthroscopic repair. In this systematic review and meta-analysis, we aim to determine the rate of RTS after arthroscopic RCR between recreational and competitive athletes. We hypothesize that competitive athletes will have a lower rate of RTS than recreational athletes, given the increased physiological demands of their sports and the higher skill sets needed to return to a competitive level and despite the significant financial incentive and high level of prestige of continuing at the same level.

METHODS

The systematic review of the literature was performed per the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines.[17]

Search Strategy

PubMed, MEDLINE, Cochrane Library, and Google Scholar were used to conduct an electronic search of the literature with the keywords "rotator cuff tear/repair," "arthroscopic" associated with "return to sport/to play," and then "return to sport/to play and athletes/player." The final search was performed on February 12, 2018. Two independent reviewers screened all resulting titles and abstracts. After this initial search, the citations of included articles were carefully examined to locate further studies.

Selection Criteria

Studies in English comprising level 1, 2, 3, or 4 evidence that reported RTS after arthroscopic repair of rotator cuff tears among sports-active patients were included without restrictions of age or level/type of sport. There was no restriction on size of tear, and partial- and full-thickness tears were included. Concomitant pathology was included as well, such as shoulder instability and superior labrum anterior and posterior (SLAP) lesions. Excluded were level 5 studies, basic science studies, and case reports. Clinical studies involving open, mini-open, or arthroscopically assisted open repairs or debridements were excluded as well as studies without evaluation of return to play.

Evaluation of the Study Quality

Each study's methodological quality and bias were evaluated with the 10-item Coleman Methodology Score.[7] Its scaled potential score ranges from 0 to 100 (85-100, excellent; 70-84, good; 55-69, fair; <55, poor).

Extraction of Data and Synthesis

Two independent reviewers (B.A., N.A.) separately extracted data from the included studies. Study characteristics, clinical and radiographic follow-up intervals, patient demographics, tear size, and complications were noted with clinical and radiographic outcomes. Clinical outcome measures were variable and included the SF-12 (12-Item Short Form Health Survey), QuickDASH outcome measure (Disabilities of the Arm, Shoulder and Hand), ASES (American Shoulder and Elbow Surgeons), UCLA (University of California–Los Angeles), Constant-Murley, L'Insalata shoulder rating questionnaire, SANE (Single Assessment Numerical Evaluation), WORC (Western Ontario Rotator Cuff), KJOC Overhead Athlete Shoulder and Elbow (Kerlan-Jobe Orthopaedic Clinic), and PSS (Penn Shoulder Score). Retears were included if reported by postoperative imaging (magnetic resonance imaging or ultrasound) or if found postoperatively in conjunction with other pathology. The athletes were grouped as "competitive" or "recreational." The competitive criterion was applied if the athletes were professional, in a regular competitive league, on a high school or collegiate team, or otherwise indicated "competitive."

Quantitative Synthesis

The primary aim of this study was to determine the rate of RTS among patients undergoing arthroscopic RCR, with

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the best available evidence from the literature. All meta-analyses utilized random effects models to allow for increased generalizability of our results beyond the set of included studies.[10] Additionally, using subgroup meta-analysis, we aimed to compare the RTS rate between studies reporting on competitive and recreational athletes. Last, we performed metaregression to test whether mean follow-up time or mean age at surgery was correlated with RTS rates. Parallel analyses were run with any RTS and return to the same or higher level as the outcome metric of interest. Residual heterogeneity was estimated with the DerSimonian-Laird method, reported with the I^2 statistic and presented with 95% CIs. Evidence for publication bias was assessed with funnel plots, and symmetry was tested with the rank correlation test. Model assumptions and fit were assessed via residual diagnostics. The statistical software R (v 3.4.3) was used to produce all analyses and results figures.[19,20,26,28]

RESULTS

Study Selection

Fifteen studies were included for systematic review. Figure 1 summarizes the process for study selection. Literature searches of the Ovid MEDLINE, Cochrane, Google Scholar, and PubMed databases with query of major orthopaedic journals revealed 632 individual titles and abstracts, including duplicates. After initial screening of the title and abstract and removal of duplicates, 606 studies were excluded, leaving 29 articles for full-text review. After a thorough review of these articles and their citations with a repeated search of the literature, 15 studies were included in the systematic review (Table 1). Only arthroscopic studies were used in the review to provide a detailed analysis of the arthroscopic technique, which has become increasingly popular.

Study Characteristics and Quality

Baseline patient characteristics with a focus on sports participation for each study are documented in Table 2. Table 3 depicts surgical techniques and concomitant procedures, as well as complications of each study.

Although the interventions and study aims were similar in the included studies, there were major differences in population characteristics, follow-up interval, tear size, repair type, and outcome measures. Of the included studies, 12 studies[2-6,8,11,14,21-23,25] had an evidence level of 4; 2 studies,[15,27] an evidence level of 3; and 1 study,[9] an evidence level of 1. Eleven studies were retrospective clinical studies. Overall, 7 studies used a consistent technique for all arthroscopic repairs. Azzam et al[4] included 7 of 32 patients with concomitant subscapularis tears who underwent open repair. Only the subscapularis was repaired with an open technique, and if an accompanying infra- or supraspinatus tear was present, it was repaired arthroscopically. Because of the low number of patients with open repair, this study was included as well.

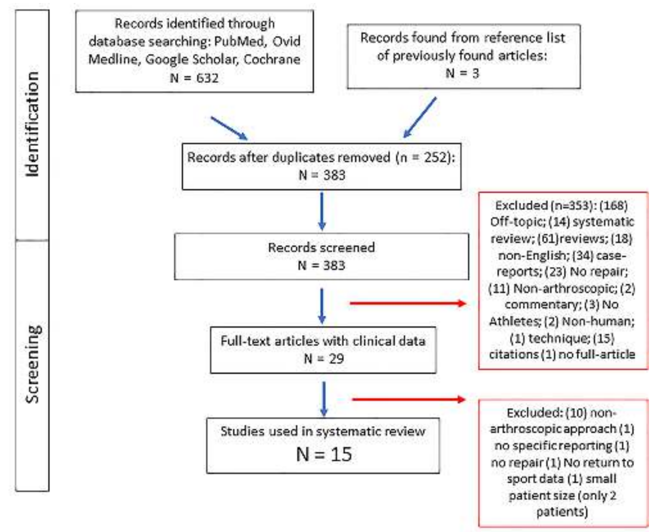

Figure 1. PRISMA (Preferred Reporting Items for Systematic Meta-Analyses) flow diagram.

According to the Coleman Methodology Score, 5 studies were poor (<55); 7 studies, fair (55-69); 2 studies, good (70-84); and 1 study, excellent (85-100). The median Coleman Methodology Score was 65 (range, 37-85) out of a possible 100. The mean follow-up was 40.1 months (range, 18-74.4 months).

Patient Characteristics

A total of 486 patients (499 shoulders) were included in the 15 studies, 330 men and 156 women, with a mean age of 41.6 years (range, 13.2-84 years). Eighteen patients were lost to follow-up, leaving 468 patients for analysis. Of these, 347 (74.1%) patients identified themselves as athletes: 81 competitive athletes and 266 recreational athletes. Six studies reported on arm dominance, and of these, 75.2% of the injured shoulders (152 of 202) involved the dominant arm.[3,4,6,8,11,27]

Tear Type and Treatment

Tear etiology was reported in 7 studies.[4-6,11,14,23,27] Of 237 patients, 124 suffered a traumatic event, of which 50 were classified as sports related. In the 7 studies that reported the duration of symptoms, the mean ± SD time between the injury and surgery was 9.4 ± 5.7 months (range, 1 day–13.3 years).[3,5,6,9,11,14,23] Twelve studies (452 shoulders) described the tear type,[2-6,9,11,14,15,21,22,25] including 167 isolated supraspinatus tendon tears, 18 isolated infraspinatus tears, 9 isolated subscapularis tears, 80 infraspinatus and supraspinatus tendon tears, and 11 massive tears involving the supraspinatus, infraspinatus, and subscapularis. One tear involved the supraspinatus, infraspinatus, and teres minor. A total of 108 partial articular supraspinatus tendon avulsions were reported; 42 tears out of the entire patient cohort had an unspecified tendon; and no bursal-sided partial tears were reported.

TABLE 1
Study Characteristics

Study	Year	Design	Level of Evidence	Follow-up, mo[a]	Coleman Score
Liem[15]	2008	Prospective	3	26 (24-29)	68
Dines[8]	2016	Retrospective	4	67 (23-95)	37
Ide[11]	2005	Prospective	4	39 (25-57)	73
Bhatia[5]	2015	Retrospective	4	43 (24-95)	58
Spencer[22]	2010	Retrospective	4	29 (16-41)	65
Voos[27]	2007	Retrospective	3	32 (24-54)	69
Antoni[3]	2016	Retrospective	4	45 ± 14	67
Tambe[23]	2009	Retrospective	4	18 (12-31)	43
Simon[21]	2017	Retrospective	4	27 (12-72)	51
Krishnan[14]	2008	Retrospective	4	26 (24-29)	65
Burns[6]	2008	Retrospective	4	70 (37-161)	56
Anderson[2]	2006	Prospective	4	30 (24-43)	83
Van Kleunen[25]	2012	Retrospective	4	37 (24-55)	45
Franceschi[9]	2013	Randomized controlled trial	1	38 (29-49)	85
Azzam[4]	2018	Retrospective	4	74 (24-120)	53

[a]Mean (range) or mean ± SD.

Twelve studies[2-6,8,9,14,15,23,25,27] reported concomitant procedures for 341 patients, with the most common being subacromial decompression and acromioplasty (n = 151), subacromial decompression (n = 108), biceps tenotomy (n = 93), biceps tenodesis (n = 59), SLAP repairs (n = 47), and anterior or posterior labral repair (n = 34). Three studies[2,8,15] used a double-row repair; 6 studies,[6,9,11,14,22,25] a single-row repair; and 6 studies,[3-5,21,23,27] both techniques.

RTS and the Level of Play After Return

RTS was evaluated for 347 athletes, with 12 studies (299 athletes)[2-6,8,9,14,21,23,25,27] reporting return to play specific to level of sporting activity. Overall, of 347 patients, 247 (71.2%) returned to a sports activity of similar level or higher; 56 (16.1%) returned to a lower level; 26 (7.5%) were unable to return; and for 18 (5.2%), the level of return was unknown. The most common sports were baseball (n = 45), golf (n = 38), football (n = 23), and tennis (n = 18). Most calculations for sports participation relied on patients involved in ≥1 sports. A total of 179 athletes were confirmed to participate in overhead sports.

Four studies[4,8,11,25] reported RTS for 43 throwing athletes (baseball/softball), of which the majority were competitive athletes. Seventy-nine percent (34 of 43) of these athletes returned to sport; however, only 38% (13 of 34) returned to the same level of play or higher. Dines et al[8] reported that 5 of 6 professional pitchers with RCR involving the dominant arm returned to a lower level of sport. Azzam et al[4] noted that among 14 competitive baseball/softball players with RCR on the dominant arm, 13 returned to the same level, but 9 had to switch positions. Pooling of these data revealed that 70% (14 of 20) of these competitive athletes failed to return to the same level after surgery on the dominant shoulder. Regarding other overhead athletes, the rate of RTS was 35% to 91%.[23,25] Among the studies on recreational athletes, 4 reported RTS rates in this subpopulation of athletes.[2,3,6,21] Antoni et al[3] reported a rate of 88.9% among recreational tennis players and 76.9% among recreational swimmers. Another study reported 80% RTS among recreational overhead athletes.[6] Anderson et al[2] reported 89% for an overhead and contact athletic population that was able to return to its preinjury level. This rate dropped to 42% in a study on climbers.[21] Unfortunately, a comparison between overhead and contact athletes was unable to be completed because of the variety of reporting on contact athletes among studies.

The 12 studies that reported return to play specific to level of competition were used in the meta-analysis. Three studies[11,15,22] did not specify level of return to play broken down by level of sporting activity. In this cohort, the mean time to RTS was reported in only 1 study (4.8 months).[23] The unadjusted overall rate of RTS by meta-analysis according to a random effects model was 85.5% (95% CI, 77.6%-91%). The I^2 value was 40.7% for this model (95% CI, 0%-69.9%). Funnel plot analysis and the rank correlation test did not reveal significant evidence for publication bias (tau = 0.242, P = .311). Subgroup meta-analysis revealed return-to-play rates of 84.8% (95% CI, 63.7%-94.6%) for competitive athletes and 86.4% (95% CI, 77.3%-92.2%) for recreational athletes, which were not significantly different (P = .840) (Figure 2).

The level of play at return was evaluated in 12 studies (299 athletes). In sum, 213 athletes (71.2%) reported that they were able to return to the same level or higher. According to a random effects model in the meta-analysis, the overall rate of RTS at the same level or higher as before the injury was 70.2% (95% CI, 59.2%-79.3%) with high heterogeneity (I^2 = 61.4%; 95% CI, 27.5%-79.4%). The rates of return to play at the same level or higher were 61.5% (95% CI, 29.0%-86.2%) for competitive athletes and 73.3% (95% CI, 63.7%-81.2%) for recreational athletes, which were not significantly different between the groups (P = .458).

TABLE 2
Patient Characteristics[a]

Study	Patients: Shoulders, n	Age,[b] y	Male: Female	Athletes, n	Sport Type	Sport Level
Liem[15,c]	53:53	58.9 (46-68)	34:19	21	Tennis, 11; golf, 5; volleyball, 3; swimming, 2; fencing, 1; handball, 1	Competitive, 9 of 53; Recreational, 12 of 53
Dines[8]	6:6	29.8 (25-37)	6:0	6	Baseball, 6	Professional, 6 of 6
Ide[11,d]	17:17	42 (17-51)	14:3	6	Baseball, 2; badminton, 1; tennis, 1; volleyball, 1	Competitive, 5 of 17; Recreational, 1 of 17
Bhatia[5]	44:49	73 (70-82)	33:11	44	Alpine skiing, 11; baseball, 2; cycling, 2; golf, 10; hockey, 2; horseback riding, 3; other (yoga, fitness, swimming), 12; track/field (javelin, pole vaulting), 2	Recreational, 44 of 44
Spencer[22]	20:20	41 (18-54)	16:4	20	NA	Competitive, 2 of 20; Recreational, 18 of 20
Voos[27,d]	30:30	48 (31-65)	22:8	30	Golf, 7; weight lifting, 4; tennis, 3; skiing, 3; running, 3; rugby, 1; amateur baseball, 1; professional dancing, 1	Recreational. 29 of 30; Professional 1 of 30
Antoni[3]	76:76	57 ± 7.3	39:37	76	Tennis, swimming, golf: 53 of 76; physical exercises, running: 23 of 76	Recreational, 76 of 76
Tambe[23]	11:11	25.7 (19-31)	11:0	11	Rugby, 11 of 11	Professional, 11 of 11
Simon[21]	12:12	55 (28-66)	10:2	12	Rock climbing, 12 of 12	Recreational, 12 of 12
Krishnan[14]	23:23	37 (21-39)	15:8	3	NA	Professional, 3 of 23
Burns[6]	37:41	43.7 (30-49)	24:13	10	Overhead (tennis, ball sports, swimming), 10	Recreational, 10 of 37
Anderson[2,d]	48:52	58.3 (38-84)	30:18	39	Golf, 16; softball, 4; hockey, 4; weight lifting, 4; tennis, 3	Recreational, 39 of 48
Van Kleunen[25]	17:17	19.2 (16.1-22.9)	17:0	17	Baseball, 17	Competitive, 17 of 17
Franceschi[9]	60:60	Group 1: 57.3 (38-71) Group 2: 55.6 (34-69)	Group 1: 18:14 Group 2: 13:15	38	NA	Recreational, 38 of 60
Azzam[4,c]	32:32	16.1 (13.2-17.9)	28:4	32	Football, 23; baseball, 14; basketball, 7; softball, 4; wrestling, 4; motocross, 3; track, 2; volleyball, 2; bull riding, 1; cross-country, 1; mixed martial arts, 1	Competitive, 27 of 27

[a]NA, not available.
[b]Mean (range) or mean ± standard deviation (SD).
[c]Athletes involved in ≥1 sports.
[d]Study did not provide type of sport for every athlete.

The mean follow-up time did not influence the RTS rate ($\beta = -0.0003$; 95% CI, −0.039 to 0.040; $P = .987$) or a return to the same level or higher ($\beta = -0.008$; 95% CI, −0.040 to 0.024; $P = .614$). The mean age did not influence the RTS rate ($\beta = 0.007$; 95% CI, −0.025 to 0.039; $P = .685$) or a return to the same level or higher ($\beta = 0.015$; 95% CI, −0.013 to 0.042; $P = .303$).

Complications and Retears

Twelve studies (394 patients) reported on postoperative complications.[‖] Three studies had no reported complications while the overall rate in others remained low, with

[‖]References 2, 4-6, 8, 9, 11, 14, 15, 22, 23, 27.

TABLE 3
Surgical Procedures[a]

Study	Type of Rotator Cuff Tear	Surgical Technique	Concomitant Procedures	Complications
Liem[15]	53 SSP	Modified Mason-Allen double row	Biceps tenotomy, 4; AC joint resection, 4; subacromial decompression, 21	Retears, 13
Dines[8]	Full thickness: 6 of 6 ISP and/or SSP	Double row	SLAP, 1; posterior labrum debridement, 1	None
Ide[11]	PASTA: 17 of 17	Single row	None	None
Bhatia[5]	Full thickness: 49 of 49 (20 SSP, 22 SSP + ISP, 6 SSP + SSC, 1 SSP + ISP + SSC)	42 double row, 5 standard single row	Subpectoral BT, 36; arthroscopic BT, 3; biceps tenotomy, 4; microfracture, 2	Postoperative stiffness, 1
Spencer[22]	PASTA: 20 of 20	Single row	None	None
Voos[27]	26 full thickness, 4 partial thickness	Single and double row	Bankart, 16; SLAP, 14; subacromial decompression, 30; resection, 3; biceps tenodesis, 2	Retears, 2
Antoni[3]	Full thickness 76 of 76 (31 SSP, 27 SSP + ISP, 10 SSP + ISP + SSC, 6 SSP + SSC, 2 SSC)	69 of 76 double row, 7 of 76 single row	Biceps tenotomy, 68; biceps tenodesis, 8; acromioplasty, 76; lateral clavicle resection, 7	NA
Tambe[23]	Full thickness	7 modified Mason-Allen single row, 2 four-anchor double row, 1 parachute single anchor, or 1 two-anchor double row	Labral, 5; bony Bankart, 1; biceps debridement, 2; biceps tenodesis, 1	Repeat arthroscopy, 1
Simon[21]	7 complete, 5 PASTA	5 single row, 7 double row	NA	NA
Krishnan[14]	18 SSP, 5 SSP + ISP	23 single row	Subacromial bursectomy, 23; subacromial decompression, 22; distal clavicle resection, 13; SLAP, 2; biceps tenodesis, 2; anterior suture capsulolabral reconstruction, 1; capsular release, 1	Superficial wound infection, 1
Burns[6]	6 PASTA, 17 small tears <1 cm, 13 medium tears 1-3 cm, 5 large of massive tears >3 cm	Single row	Biceps debridement, 13; arthroscopic subacromial biceps tenodesis, 4; subpectoral tenodesis, 2; SLAP, 1; arthritis debridement, 2; subacromial decompression, 35; clavicle spur resection, 19; Mumford procedure, 1	Postoperative stiffness, 1
Anderson[2]	Full thickness: 24 SSP + ISP, 24 SSP, 4 SSP + SSC	Double row	Acromioplasty, 52	Retear, 9
Van Kleunen[25]	PASTA, 11 ISP; full thickness, 6 ISP	3 single anchor, 14 PDS sutures	SLAP, 17; posterior capsular release, 11	NA
Franceschi[9]	PASTA: 60 of 60	32 transtendon, 32 single row	Acromioplasty, 23; biceps tenotomy, 17; SLAP, 9	Adhesive capsulitis, 6; retear, 2
Azzam[4]	Partial thickness: 19 of 32 (18 SSP, 1 ISP), full thickness: 5 of 32 (2 SSP, 1 SSP + ISP, 1 SSP + ISP + TM, 1 SSC), bony avulsions: 8 of 32 (1 SSP, 1 SSP + ISP, 6 SSC)	14 single row, 11 double row, 7 open (subscapularis)	Subacromial bursectomy, 26; labral, 10; SLAP, 3; HAGL, 2; biceps tenodesis, 1; rotator interval closure, 1; posterior capsular release, 1	Retear, 2

[a]AC, acromioclavicular; BT, biceps tenodesis; HAGL, humeral avulsion of the glenohumeral ligament; ISP, infraspinatus; NA, not available; PASTA, partial articular supraspinatus tendon avulsion; PDS, polydioxanone; SLAP, superior labrum anterior and posterior; SSC, subscapularis; SSP, supraspinatus; TM, teres minor.

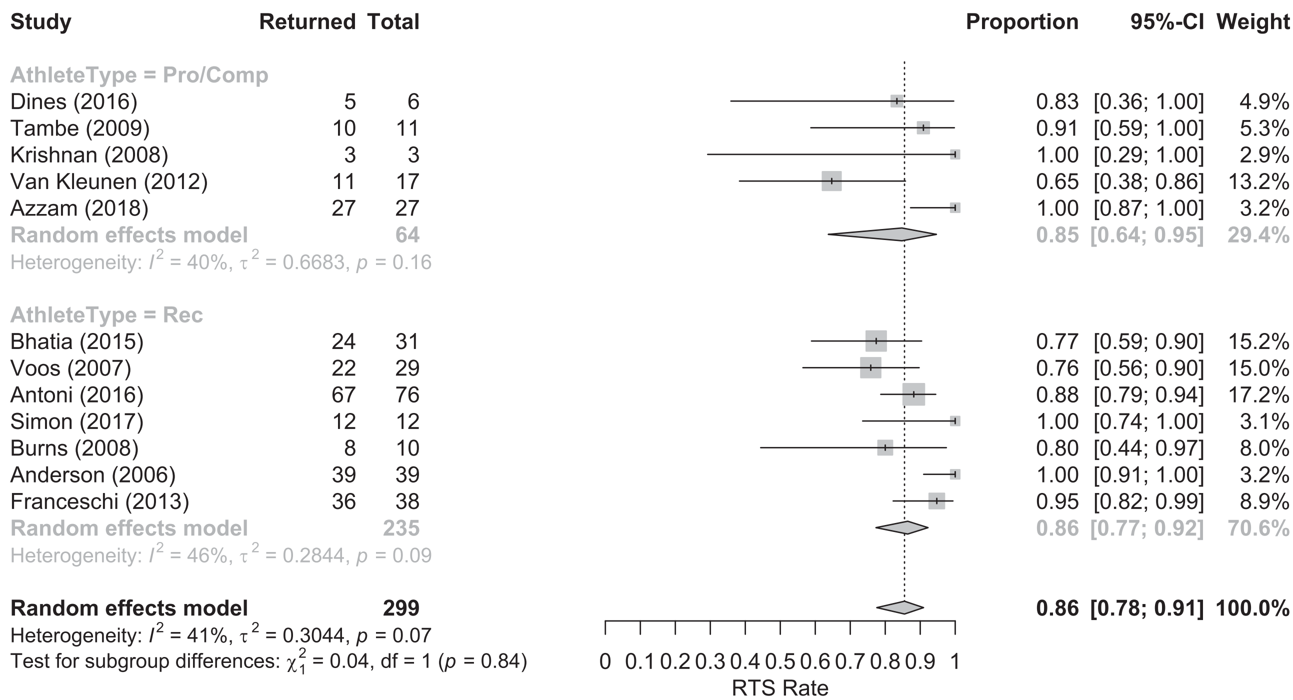

Figure 2. Forest plot of the subgroup meta-analysis comparing return-to-sport (RTS) proportion between recreational and competitive cohorts.

the majority consisting of retears (n = 26) followed by stiffness (n = 8) and infection (n = 1).[2,4,15,27] Of importance, only 6 studies[2,6,9,11,15,23] performed a dedicated structural evaluation with imaging after surgery. Anderson et al[2] determined 9 retears/defects (17%) with postoperative ultrasound. Interestingly, the mean postoperative functional score of those patients with a defect on imaging after repair was 94.3, which was not significantly different from those with an intact repair (91.6). Only 2 of the patients with defects were unable to return to their preinjury activity level. Liem et al[15] identified 5 retears out of 21 athletes (23.8%) and 8 retears in 32 nonathletes (25%), and the difference between groups was not significant. Although the level of sport did not have an effect on the retear rate, 2 patients with the worst RTS results suffered a retear. Thus, the effect of nonhealing or retear on the RTS remains controversial. Owing to the lack of postoperative imaging in the studies with the competitive athletes, a comparison was not possible.

There were 6 reoperations: 2 patients underwent a reoperation for a retorn rotator cuff,[4] and 4 reoperations were performed to treat stiffness.[5,9,23] Of the 7 (57.1%) athletes with retears who were treated nonoperatively, 4 were unable to return to the same level of play, 2 of whom were unable to return to play at all.[2,15]

Patient Satisfaction and Functional Outcome

The rate of patient satisfaction was reported in 6 studies.[3,5,6,14,21,27] Bhatia et al[5] reported a median postoperative satisfaction score of 10 on a scale from 1 to 10. One study[21] indicated 100% satisfaction in everyday activities, and another[6] had a 98% overall satisfaction rate. Two studies[3,27] found that 96.1% and 90% of patients considered the results of surgery to be good to excellent, and 1 study[14] indicated that 95% of patients would undergo the procedure again. Pain according to a visual analog scale was evaluated in 1 study[6] separately from the ASES scale, and it showed improvement from a preoperative score of 4.8 to a postoperative score of 1.3 in activities of daily living. Four other studies[5,9,11,14] reported that patients on average had an overall improvement in pain.

There was a high degree of heterogeneity in functional outcome reporting. Five studies[4,5,9,14,27] utilized ASES score, while 4 studies[9,15,21,23] used Constant-Murley score. From the 5 studies[4,5,9,14,27] reporting ASES score, 3 reported pre- and postoperative scores, showing an improvement from 47.4 ± 5.95 to 90.8 ± 0.9.[5,9,14] Of the 4 studies[9,15,21,23] utilizing Constant-Murley score, 3 provided pre- and postoperative results, showing improvement from 48.1 ± 4.74 to 91.4 ± 6.1.[9,15,23] The other scores included L'Insalata, UCLA, SANE, WORC, KJOC, QuickDASH, SF-12 (physical component summary), and PSS. All studies reported improvement in these scores, with 8 studies[2,3,5,9,11,14,15,27] reporting a statistically significant improvement.

DISCUSSION

In this review, studies utilizing arthroscopic techniques for RCR were analyzed to determine and compare the rate of RTS among competitive and recreational athletes. The most important findings from this meta-analysis were the overall rates of RTS for competitive and recreational athletes after arthroscopic RCR, which were 85.5% overall, 84.8% for competitive athletes, and 86.4% for recreational athletes. The overall rate of RTS at the same level or higher in the meta-analysis was 70.2%, with 61.5% of competitive athletes and 73.3% of recreational athletes returning to the same level or higher. The differences regarding overall rate of RTS and rate of RTS at the same level or higher were not statistically significant in the meta-analysis. The results of the present meta-analysis differ from the systematic review by Klouche et al,[13] who reported a higher rate of return for recreational athletes at 81.4% and a significantly lower rate for competitive athletes at 49.9%. The pooling of open, mini-open, and arthroscopic procedures in their study may help explain this discrepancy. Given the higher physical demands of competitive athletes, the possible increased soft tissue trauma and scar tissue adhesions associated with open procedures could have caused more harmful effects for the competitive athlete than the recreational athlete. Therefore, including only patients who underwent arthroscopic RCR in our study may be a factor in the differences, as the less invasive arthroscopic approach is believed to minimize soft tissue trauma and scar tissue adhesion—both of which can have positive effects on competitive athletes' performance. Also, arthroscopic procedures offer a quicker recovery time as compared with open procedures, thus promoting quicker and potentially higher rates of RTS.[29] Moreover, differences in the definition of "competitive" may be a factor. Our study utilized a broader definition of competitive athletes, including athletes involved in leagues (competitive, high school, and collegiate) as well as professional athletes, while other studies focused only on professional athletes.[8,23]

Evaluating the RTS rate for patients may be misleading, as players sometimes do not return to their same levels of preinjury play for multiple reasons that may or may not be related to the RCR or the function of the shoulder. While return to a lower level of activity may be career ending for a competitive athlete, a recreational athlete might find this acceptable. Competitive athletes who are at or near the end of their careers may also have a number of factors influencing their RTS such as contractual factors, age-related decline in performance, injuries to other body parts, and other considerations. Across studies, the rates of RTS showed major variance for the competitive athletes. While Tambe et al[23] reported a rate as high as 90.1% among rugby players, none of the professional baseball players reported by Dines et al[8] were able to return to their preoperative levels of pitching. Possible reasons for this discrepancy may include varying requirements on the shoulder in different sports or a lack of consensus for reporting RTS. Most studies utilized a subjective reporting system, with the exception of 1 study, which used objective performance statistics to evaluate the performance levels of competitive athletes.[8] Another reason may be the lack of consideration for switching positions. One study[4] reported that 93% of the overhead athletes who had surgery on their throwing shoulders returned to the same levels of play, but 64% of them had to switch positions because of a loss of throwing velocity or distance. Thus, for proper analysis, future studies should add comprehensive objective assessment of RTS after arthroscopic RCR in competitive athletes.

While many factors influence RTS our study found neither age nor follow-up time had an effect. One would expect a natural decline in sports participation with older age and longer follow-up, but with the numbers available for this study, those trends were not present. The duration of follow-up for each study included in the meta-analysis is an important variable to assess, as a shorter mean follow-up from surgery may not adequately capture whether the athlete is truly able to return. The studies included in the analysis had a wide range of mean age (16.1-73 years) and mean follow-up time (18-74.4 months). Thus, the results of our meta-analysis should be interpreted judiciously, as the levels of sport activity to which patients return differ immensely, say, between a young professional baseball player and an elderly recreational golf player. Because of the variety of reporting and the lack of specific outcome data for every athlete, we were not able to perform a more detailed analysis.

To further understand athletes' RTS after RCR, concomitant lesions were considered and were present in a majority of patients. One study[4] could not detect a significant difference in outcomes between patients with and without concomitant instability or SLAP repair. Seventeen of these patients had isolated rotator cuff tears, while 14 patients had concomitant labral repairs. Out of these 2 groups, 43% of patients treated with concurrent labral repair reported their athletic performances to be above or equal to their presurgery levels, as opposed to 78% who did not undergo labral repair.[4] Similarly, Van Kleunen et al[25] concluded that for a throwing athlete, the combination of a significant infraspinatus tear, a SLAP tear, and a deficit in glenohumeral internal rotation resulted in a guarded prognosis in return to play at the same level. One should keep in mind that labral tears can also be treated with debridement versus a repair. Thus, the presence of the tear may not be the indicator of a poor return but rather the treatment itself. Overall, concomitant pathology should not be overlooked and should be addressed carefully, especially for overhead athletes undergoing RCR.

Athletes who practice overhead and contact sports may be more susceptible to failure to return to a similar level of sport.[18] This study found only 13 of 34 (38%) baseball/softball players who returned to sport were able to return to the same level of play or higher. This rate decreased to 30% for competitive athletes when the tear involved the dominant shoulder. Unfortunately, there are no studies comparing the results of RCR between athletes who play overhead and contact sports and those who participate in nonoverhead or noncontact sports. Moreover, the majority of the studies did not differentiate between competitive and recreational athletes within these subgroups. Finally, it is important to note that RTS may be completely unrelated to the injury and subsequent surgery to the shoulder[3] and that dropout from competitive sports may be the result of fear of reinjury[6] or any number of other related or unrelated factors. Prospective studies reporting a thorough assessment of RTS including tendon healing, type and level of sports, as well as psychological factors, are needed to understand the areas of improvement in arthroscopic RCR of athletes.

Limitations

Metaregressions in general and in this study in particular are susceptible to confounding among moderator variables. The level of evidence in the majority of included studies was low (3 or 4). Evaluation of study quality revealed a median Coleman Methodology Score of 65 (interpreted as fair quality). This was mainly attributable to the numerous retrospective designs, with only 3 studies rated good or excellent among the inclusion set. The possibility of aggregation bias (also known as the ecological fallacy or Simpson paradox), which can occur when covariates are inferred from study means rather than individual-level data, is also a limitation of our metaregressions. The variety of patient populations, RTS metrics, and clinical outcome measurements created a heterogeneous study cohort. The heterogeneity of the included studies limited the amount of comparative analyses that could be performed.

CONCLUSION

The majority of athletes (70.2%) were able to return to a preinjury level of play after arthroscopic RCR. While recreational sports participation (73.3%) was associated with higher rates of return, competitive sports (61.5%) and overhead sports (38%) were associated with lower rates of return. There are direct, indirect, and unrelated reasons why athletes do not RTS. Studying the predictive factors of RTS will help clinicians understand how to improve rates of return and predict which patients have a higher likelihood of returning. While reasons for not returning will likely remain multifactorial, more studies like this need to be performed.

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