Meta-Analysis

Arthroscopic Repair for Posterior Shoulder Instability Is Associated With Favorable Outcomes and High Return to Sport or Work: A Systematic Review and Meta-Analysis

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Purpose: To assess clinical outcomes of primary arthroscopic repair for unilateral posterior shoulder instability (PSI) in all patients, to evaluate clinical outcomes in athletes, and to compare clinical outcomes between contact and overhead athletes. **Methods:** A systematic review was performed using PRISMA Guidelines. Included studies reported on primary arthroscopic treatment of PSI with at least 1 year of follow-up. Studies were excluded if they were not in English, included revisions/open procedures or anterior/multidirectional instability, had fewer than 10 patients or no full text available, or were biomechanical analyses/descriptions of surgical technique. Primary outcomes were rates of return to sport (RTS), return to preinjury level (RTPL), recurrent instability, and revision surgery. Outcomes were evaluated in all patients and all athletes, with further subdivision for *contact* and *overhead*. **Results:** Of the 1,504 screened studies, 30 met inclusion criteria (1,649 shoulders). Mean age at surgery was 23.3 years (range: 12.4−65 years), and mean follow-up was 35.5 months (range: 12−140.4 months). There were 1,051 males and 196 females. RTS rates were 91.7% among all patients and 90.9% in all athletes, with no statistical difference between contact and overhead athletes (92.8% vs 88.1%; $P = .176$). RTPL rates were 78.7% among all patients and 75.6% in all athletes, with no statistical difference between contact and overhead athletes (90.8% vs 62.3%; $P = .072$). Recurrent instability rates were 7.0% among all patients and 8.0% in all athletes, with no statistical difference between contact and overhead athletes (7.3% vs 7.4%; $P = .981$). Revision rates were 3.7% among all patients and 3.3% in all athletes, with no statistical difference between contact and overhead athletes (6.8% vs. 0%; $P = 1$). **Conclusion:** Primary arthroscopic treatment of PSI is associated with favorable outcomes and high return to sport and work rates. Recurrent instability and pain were the most common reasons for revision. **Level of Evidence:** Level IV, Systematic review and meta-analysis of Level II to IV studies.

Posterior shoulder instability (PSI) is historically less commonly encountered than anterior instability and presents a diagnostic challenge due to its often vague presentation and symptoms.[1] Although overall less prevalent than anterior shoulder instability, PSI is relatively common in young athletes and the active military population with an incidence ranging from 5 to 18% of all shoulder instability cases.[2-4] Because of this predilection toward both young and athletic patient cohorts, proper diagnosis and treatment are imperative

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to maximize return to sport (RTS) and return to work (RTW).

PSI typically arises from three main mechanisms: acute trauma, repeated microtrauma, or an atraumatic onset. Treatment options for PSI include either nonoperative approaches or surgical fixation in the form of open or arthroscopic labral repair.[5] Surgical intervention for PSI patients has become increasingly more common with higher rates seen between 2009 and 2015 compared with between 1996 and 2002.[6] Despite the increased reliance on surgery, there is still some debate regarding postoperative outcomes following surgical repair. Some evidence suggests that no significant differences exist in either patient satisfaction or RTS when comparing open and arthroscopic repair.[7] However, two systematic reviews and meta-analyses indicate that arthroscopic repair is associated with a lower recurrence rate, higher subjective stability scores, higher patient satisfaction, higher overall RTS, and higher return to preinjury level of sports.[8,9] Although various arthroscopic techniques have been described, the most common means of fixation include anchor or anchorless suture fixation of the posterior labrum with or without capsular plication.[10] When comparing operative to nonoperative treatment in patients with pain or recurrent PSI, operative treatment has been associated with better outcomes.[5,11]

The primary objectives of this systematic review were to assess clinical outcomes of primary arthroscopic repair for unilateral PSI in all patients, to evaluate clinical outcomes in athletes, and to compare clinical outcomes between contact and overhead athletes. We hypothesized that primary arthroscopic repair would be effective in treating PSI with high rates of RTS and low rates of recurrent instability across all groups.

Methods

Search Strategy

A systematic search following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Guidelines was conducted with regard to the peer-reviewed literature on arthroscopic repair of PSI. Medline/PubMed was searched on November 1, 2020, with the following Boolean search terms: (((posterior glenohumeral instability) or (posterior labral lesion) or (posterior labral tear) or (posterior labral laxity) or (posterior bankart) or (reverse bankart) or (posterior labral pathology) or (posterior labral injury) or (posterior glenoid labral tear) or (posterior shoulder instability) or (recurrent posterior subluxation of the shoulder) or (posterior instability of the glenohumeral joint)) AND ((arthroscopic repair) or (arthroscopic labral repair) or (arthroscopic management) or (arthroscopic treatment) or (Arthroscopic posterior labral repair) or (arthroscope) or (posterior labral repair) or (capsulolabral repair) or (capsulolabral reconstruction) or (sport) or (work) or (athlete) or (return to athletics) or (return to preinjury activity) or (return to practice) or (athlete population) or (return to competition) or (return to play) or (return to sport) or (athletic population) or (throwing athlete) or (non-throwing athlete))). Filters were not used in order to increase sensitivity.

Eligibility Criteria

The search return was extracted, and duplicate articles were excluded. In phase 2, the titles and abstracts were examined for relevanceby two authors (AC, AJM). The reference lists from review articles were manually searched for relevant studies that the database algorithm screened out. Studies were screened out for the following exclusion criteria: (1) non-English text, (2) abstract only, (3) case reports or series with fewer than 10 patients, (4) cadaveric or biomechanical studies, (5) studies with multiple treatments without stratification by operation type, (6) open or mini-open surgery, (7) bone grafting procedures, or (8) anterior instability or multidirectional instability (MDI). Studies were evaluated only if (1) they included arthroscopic fixation for posterior instability, (2) included postoperative outcomes, including ASES score or complications, and (3) had at least 1 year of follow-up.

Quality Assessment

The risk of bias in nonrandomized studies of interventions was determined by two authors (A.J.M., J.S.) to assess the quality of each included case series.The ROBINS-I risk of bias tool released by the Cochrane Non-Randomized Study Group was used in this process. The assessment of these studies included 7 criteria: (1) bias due to confounding, (2) bias due to selection of participants, (3) bias in classification of interventions, (4) bias due to deviations from intended interventions, (5) bias due to missing data, (6) bias in measurement of outcomes, and (7) bias in selection of the reported result. Each criterion was rated as low, moderate, serious, or critical risk of bias.

Article Review

In the third phase, "eligibility," the remaining articles were screened to ensure they met the inclusion and exclusion criteria. The data were extracted and checked for accuracy by three authors (A.C., A.J.M., X.L.). Conflicts were resolved by referring to the study. In the case of unresolved conflicts or issues, the final decision was made by the senior authors.

Data Extraction and Assessment

In phase 4, "inclusion," the following data were extracted from the eligible articles: name of the first author, year of publication, level of evidence, cohort,

Table 1. Table of Study Characteristics for Included Studies

Study	Key Features
Arner et al., 2015	• Retrospective case series of American football players with posterior shoulder instability who underwent arthroscopic capsulolabral repair • No large comparison groups • Minimum 2-year follow-up • Level of Evidence: IV
Arner et al., 2018[14]	• Prospective case series of throwing athletes who underwent arthroscopic posterior capsulolabral reconstruction for posterior shoulder instability • No large group comparison groups • Minimum 12-month follow-up • Level of Evidence: IV
Asturias et al., 2020[15]	• Retrospective case series of children with posterior shoulder instability who underwent arthroscopic shoulder surgery • No large comparison groups • Minimum 2-year follow-up • Level of Evidence: IV
Badge, 2009	• Retrospective case series of elite rugby players who underwent arthroscopic shoulder surgery for posterior labral injury • No large comparison groups • Minimum 1-year Vfollow-up • Level of Evidence: IV
Bents, 2017	• Retrospective cohort study of patients with labral tears who underwent arthroscopic repair • Three comparison groups were included: patients with anterior labral repair, posterior labral repair, and superior labrum anterior to posterior repair • Minimum 1-year follow-up • Level of Evidence: III
Bernhardson, 2019	• Prospective cohort study of patients with posterior shoulder instability compared with patients experiencing anterior instability • All patients underwent arthroscopic Bankart repair • Bivariate statistical tools, including Fisher exact test and independent-samples *t*-test used to compare groups with respect to potentially confounding demographic and other baseline covariates • Minimum 2-year follow-up • Level of Evidence: II
Bisson, 2005	• Retrospective case series of patients with posterior instability without labral detachment who were treated with thermal capsulorrhaphy • No large comparison groups • Minimum 26-month follow-up • Level of Evidence: IV
Bottoni, 2005	• Retrospective case series of patients who underwent arthroscopic posterior shoulder stabilization compared with patients that underwent open repair • Minimum 2-year follow-up • Level of Evidence: IV
Bradley, 2006	• Prospective case series of patients with posterior shoulder instability who were treated with arthroscopic capsulobral reconstruction • No large comparison groups • Minimum 1-year follow-up • Level of Evidence: IV
Bradley, 2013	• Prospective cohort study of athletes with posterior shoulder instability treated with arthroscopic capsulolabral reconstruction • Subanalysis of contact athletes was compared with the entire cohort • Minimum 1-year follow-up • Level of Evidence: II
Chan, 2020	• Retrospective case series of active-duty military service members who underwent isolated, primary arthroscopic posterior labral repair • No large comparison groups • Minimum 2-year follow-up • Level of Evidence: IV
Galvin, 2017	• Retrospective case series of male patients who underwent arthroscopic posterior labral repair for symptomatic posterior shoulder instability • Patients with glenoid dysplasia were compared to patients without dysplasia • Minimum 2-year follow-up • Level of Evidence: IV

(continued)

Table 1. Continued

Study	Key Features
Garcia, 2015	• Retrospective case series of patients treated for dislocation and posterior shoulder instability with arthroscopic reverse Bankart repair • No large comparison groups • Minimum 1-year follow-up • Level of Evidence: IV
Hansen, 2020	• Retrospective cohort study of patients under the age of 19 who were treated for superior and posterior labral pathology • Patients with posterior labral pathology were compared with superior anterior to posterior labral pathology • Regression analysis was used to determine whether sport type or tear cause confounded the relationship between tear type and outcome measures • Minimum 2-year follow-up • Level of Evidence: III
Katthagen et al., 2017	• Retrospective cohort study of patients with traumatic onset of posterior shoulder instability compared with patients with atraumatic onset • Minimum 2-year follow-up • Level of Evidence: III
Kercher, 2019	• Retrospective case series of baseball players who underwent arthroscopic posterior labral repair • No large comparison groups • Minimum 2-year follow-up • Level of Evidence: IV
Kim, 2003	• Prospective case series of patients with traumatic recurrent posterior shoulder subluxation treated with arthroscopic labral repair and posterior capsular shift • No large comparison groups • Minimum 2-year follow-up • Level of Evidence: IV
Kraeutler, 2018	• Retrospective cohort study of patients who underwent arthroscopic anterior, posterior, or combined anterior and posterior shoulder stabilization • Three major comparison groups, including anterior, posterior, or combined anterior and posterior repair • Minimum 2-year follow-up • Level of Evidence: III
Lenart, 2012	• Retrospective case series of patients with symptomatic recurrent posterior shoulder instability who were treated with arthroscopic repair • No large comparison groups • Minimum 1-year follow-up • Level of Evidence: IV
Maalouly, 2020	• Retrospective case series of patients with symptomatic posterior instability treated with arthroscopic repair • No large comparison groups • Minimum 3-year follow-up • Level of Evidence: IV
Mauro, 2016	• Prospective case series of athletes treated with arthroscopic capsulolabral repair for isolated posterior shoulder instability • No large comparison groups • Minimum 1-year follow-up • Level of Evidence: IV
McClincy, 2018	• Retrospective cohort study of adolescent athletes with posterior shoulder instability who were treated with arthroscopic posterior capsulolabral reconstruction • Subgroup analysis of contact, throwing, and multisport athletes was conducted • Minimum 2-year follow-up • Level of Evidence: III
Radkowski et al., 2008	• Prospective cohort study of patients with posterior shoulder instability, all treated with arthroscopic capsulolabral reconstruction • Two groups, throwing athletes compared with nonthrowing athletes • Minimum 1-year follow-up • Level of Evidence: II
Robins, 2017	• Retrospective cohort study of NCAA Division I football players who underwent arthroscopic surgery for recurrent shoulder instability • Three comparison groups were included: patients with anterior shoulder instability, posterior shoulder instability, and anterior-posterior instability • Mean 3.3-year follow-up • Level of Evidence: III

(continued)

Table 1. Continued

Study	Key Features
Savoie, 2008	• Retrospective case series of patients with posterior instability who failed vigorous rehabilitation and were treated arthroscopically • No large comparison groups • Minimum 12-month follow-up • Level of Evidence: IV
Wanich, 2012	• Retrospective case series of baseball players diagnosed with posterior labral tears and treated arthroscopically • No large comparison groups • Minimum 18-month follow-up • Level of Evidence: IV
Williams III, 2003	• Retrospective case series of patients who underwent arthroscopic repair of posterior capsulolabral detachment • No large comparison groups • Minimum 2-year follow-up • Level of Evidence: IV
Wolf, 1998	• Retrospective case series of patients treated arthroscopically for posterior shoulder instability • No large comparison groups • Minimum 2-year follow-up • Level of Evidence: IV
Wolfe, 2020	• Retrospective case series of patients undergoing isolated arthroscopic posterior shoulder stabilization. • No large comparison groups • Minimum 12-month follow-up • Level of Evidence: IV
Wooten, 2015	• Retrospective case series of adolescent athletes with recurrent posterior shoulder instability who were treated with arthroscopic posterior capsulolabral reconstruction • No large comparison groups • Minimum 2-year follow-up • Level of Evidence: IV

injury onset, procedure, number of patients, shoulders, contact athletes, overhead/throwing athletes, males, and females, age, follow-up length, concomitant procedures, indication for surgery, return to sport (RTS), return to preinjury level (RTPL), range of motion, American Shoulder and Elbow (ASES) score, complications, subjective stability, muscle strength, satisfaction, revision, and return to the operating room.

The total population was divided into subgroups, when possible, for further analysis. In order to be included in one of these subgroups, the study had to provide data for isolated groups of patients. Subgroups included *athletes*, *contact athletes*, and *overhead athletes*. For example, if the study included athletes and nonathletes without differentiating, the athletes would not be included in the *athletes* subgroup. Subgroups consisted of studies where the outcomes of only *athletes*, *contact athletes*, or *overhead athletes* were able to be separated. Conversely, the entire cohort of all patients is a mix of athletes, workers, and nonathletes. Studies were only included in these subgroups if the patients were able to be stratified from reported literature.

The extracted data from the 30 primary research studies were entered into a database. All calculations were performed by the number of shoulders rather than by patient. Our primary outcomes were the rates of RTS, RTPL, recurrence of instability, and revision/reoperation. Toward each of our aims, meta-analysis was performed to

Table 2. Patient Demographics

Demographics	Total Population Population (Number of Shoulders)	All Athletes Athletes (Number of Shoulders)	Contact Athletes Athletes (Number of Shoulders)	Overhead Athletes Athletes (Number of Shoulders)
Number of studies	30	17	7	5
Number of patients	1,592	1,008	287	159
Number of shoulders	1,649	1,065	342	159
Number of contact athletes	544	497	342	0
Number of overhead athletes	314	283	0	159
Sex ratio (male:female)	1,051:196	615:107	53:0	107:20
Mean age in years (range)	23.3 (12.4–65)	22.8 (15–65)	21.3	19.8
Mean follow-up in months (range)	35.5 (12–140.4)	38.0 (12–115)	36.1	36.2
Injury onset (traumatic)	506/913 (55.4%)	276/464 (59.5%)	11/11 (100%)	9/70 (12.9%)

calculate cumulative rates of each primary outcome using forest plots. We anticipated substantial heterogeneity in the design and methodology of the included studies involved in data collection; thus, we used a random-effects model for meta-analysis a priori.[12] The I^2 statistic was used to assess the heterogeneity of the results. The true effect size in 95% of the population (95% prediction interval) was calculated using the variance of true effects (T^2) and, thus, the SD of true effects (T). Meta-analysis was performed using the *metafor* package.[13] Secondary outcomes were summarized for all patients and reported as ranges, given limited data availability. Data were collected and stored in Microsoft Excel (Microsoft Corporation, Redmond, VA), and was further analyzed using R version 3.41 (R Foundation for Statistical Computing, Vienna, Austria) with an α of 0.05.

Results

On the basis of the aforementioned search criteria, 1,504 studies were screened and 30 met inclusion criteria (Table 1). The 30 studies consisted of 1,649 shoulders in 1,592 patients. In studies, including sex demographics (Table 2), 1,051 patients were male, and 196 were female. The average age at the time of surgery was 23.3 years (range: 12.4−65 years), and the average follow-up was 35.5 months (range: 12−140.4 months). The cause of PSI was traumatic in 55.4% of cases (506/913 shoulders). There were 1,065 athletes, including 342 *contact athletes* and 159 *overhead athletes*. Because of our narrow inclusion criteria and outcome measures, heterogeneity for the primary outcome is reasonably low, justifying pooling of low level of evidence studies.

Return to Sport

Of the 30 included studies, 18 reported RTS data for an overall cohort of 945 shoulders (890 patients) (Fig. 1), with an overall rate of 91.7% [95% confidence interval (CI): 88.2%−94.3%]. In all athletes (Fig. 2A), the RTS rate was 90.9% [87.4%−93.6%]. There was no statistically significant difference in the RTS rate between contact and overhead athletes (92.8% [87.1%−96.1%] vs 88.1% [82.0%−92.2%]; $P = .176$; Fig. 2B). Return to preinjury level data were available for 862 shoulders (800 patients) (Fig. 3), with an overall rate of 78.7% [66.1%−87.5%]. In all athletes (Fig. 4A), the RTPL rate was 75.6% [63.1%−85.0%]. There was no statistically significant difference in the RTS rate between contact and overhead athletes (90.8% [59.1%−98.5%] vs 62.3% [54.5%−69.5%]; $P = .072$; Fig. 4B).

Recurrent Instability

In all patients, recurrent instability occurred at a rate of 7.0% [5.5%−8.8%] (Fig. 5). In *all athletes* (Fig. 6A), recurrent instability occurred in 8.0% [6.5%−9.9%]. There was no statistically significant difference in the rate of recurrent instability between contact and overhead athletes (7.3% [4.4%−11.9%] vs 7.4% [3.6%−14.7%]; $P = .981$; Fig. 6B).

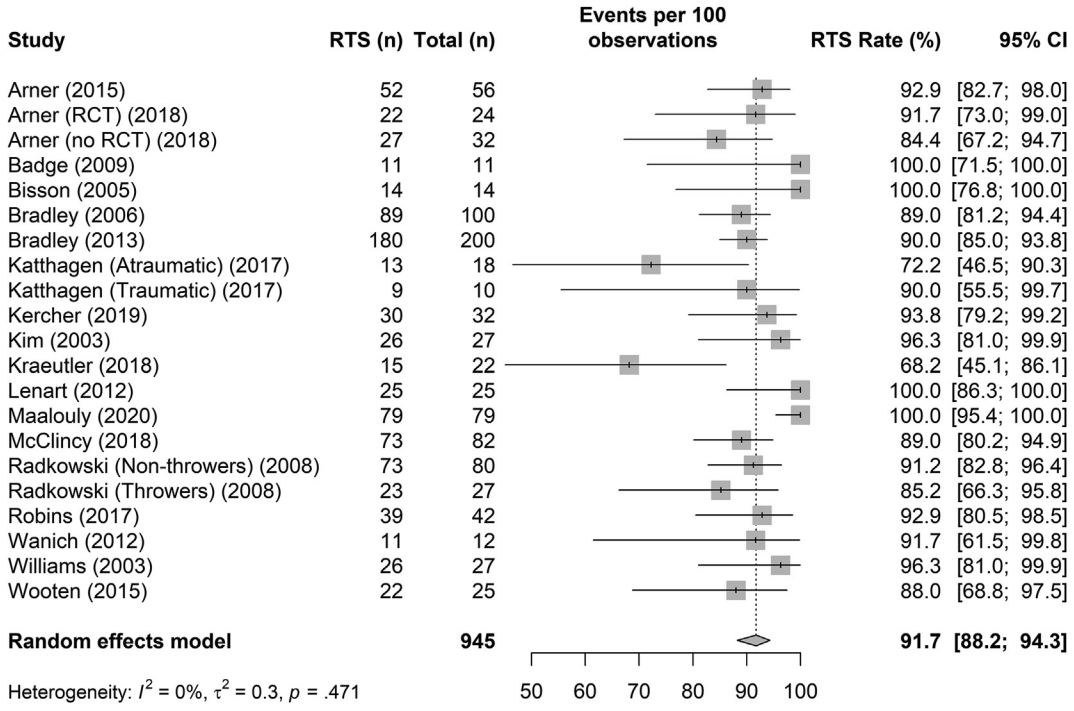

Fig. 1. Forest plot of return to sport rates of all athletes.

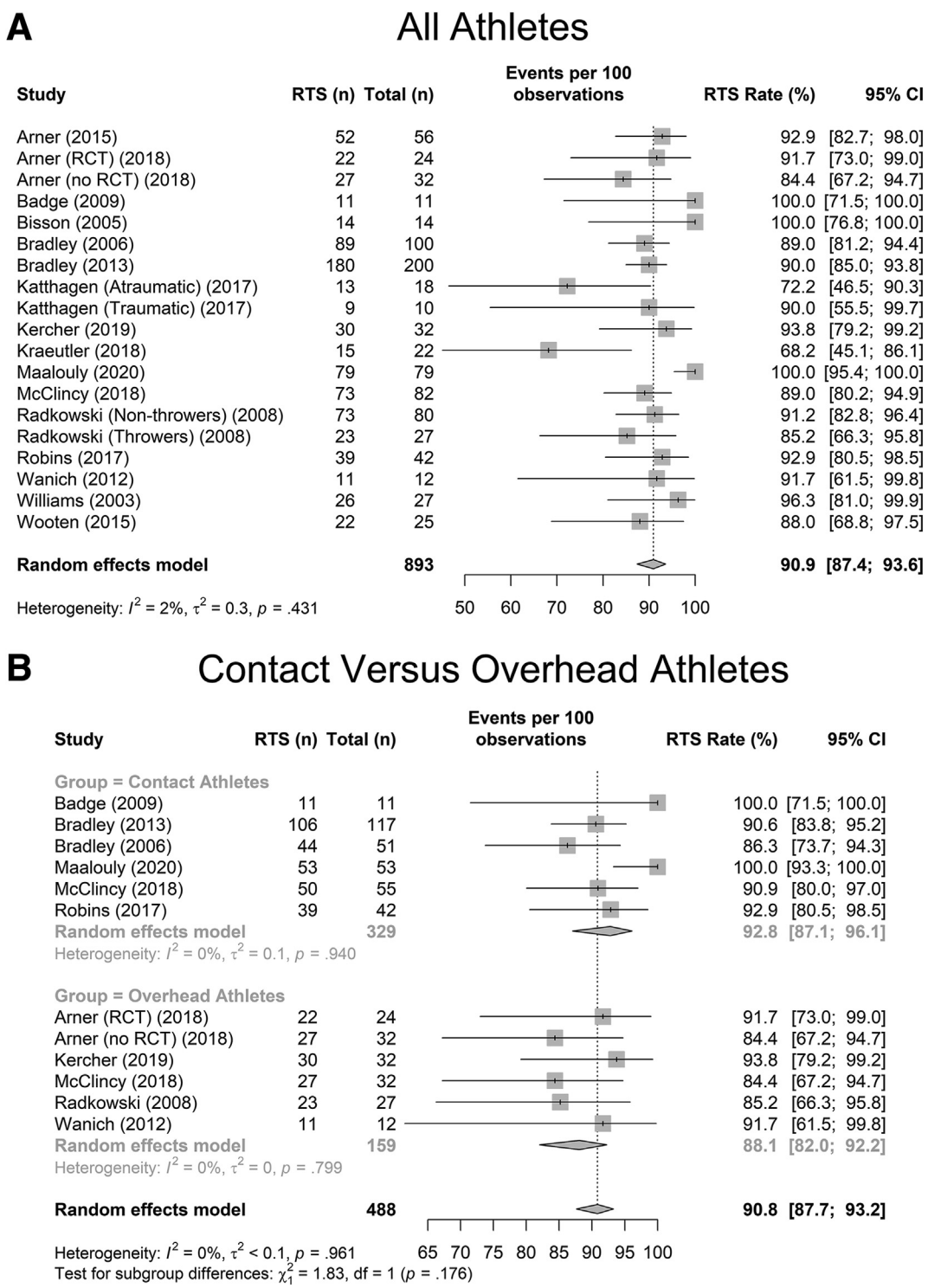

Fig. 2. Forest plot of return to sport rates for all athletes, with subanalyses for contact versus overhead athletes.

Complications

Complications, excluding recurrent instability and persistent pain, were reported in 25/30 studies (Table 3). Commonly reported complications included subacromial impingement, adhesive capsulitis, stiffness, superficial or deep infection, and other (eg, adhesive capsulitis, anchor failure). Bradley et al. 2006[3] reported 2 occurrences of subacromial impingement, which required further intervention.

Revision/Reoperation

Revision/reoperation rates were reported in 23 studies (1,280 shoulders, 1,226 patients), with an overall rate of 3.7% [2.1%−6.2%] (Fig. 7). In *all*

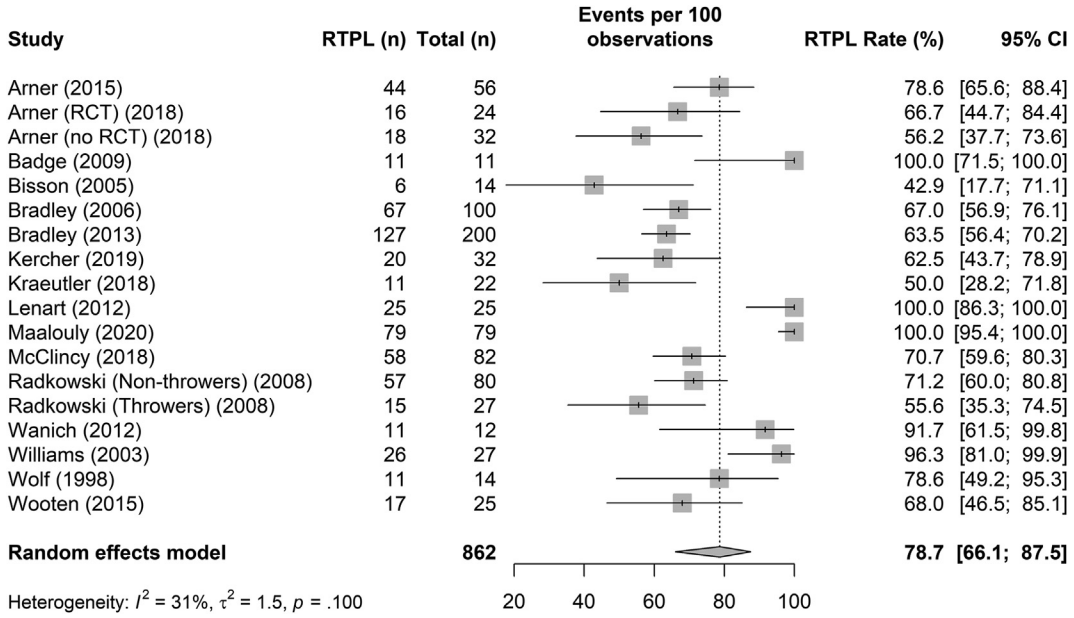

Fig. 3. Forest plot of return to preinjury levels forall athletes.

athletes (Fig. 8A), the revision rate was 3.3% [1.4%−7.7%]. There was no statistically significant difference in the rate of recurrent instability between contact and overhead athletes (6.8% [4.0%−11.3%] vs 0% [0%−100%]; $P = .999$; Fig. 8B); no instances of revision surgery were reported in the small overhead athlete sample (n = 39).

Secondary Outcome Measures

Functional Outcome Measures

Outcomes reporting was inconsistent across the 30 included studies. The most commonly reported outcome measure was the ASES—13 studies included both preoperative and postoperative ASES scores. Mean ASES scores ranged from 41.8 to 69.9 preoperatively and from 82.9 to 99.9 postoperatively.

Subjective Stability/Muscle Strength/Patient Satisfaction

Eleven studies (718 shoulders, 663 patients) reported on subjective stability postoperatively. Patients reporting good or excellent stability ranged from 47.4 to 96.3% within these studies. Muscle strength was reported in 7 studies (535 shoulders, 494 patients). The proportion of patients reporting normal muscle strength postoperatively in these studies ranged from 48.0 to 92.6%

Patient satisfaction was reported in 8/30 studies (480 shoulders, 432 patients). Patients who were satisfied or very satisfied with the surgery ranged from 64.9% to 100% within these studies.

Quality

The quality and resultant risk-of-bias assessment are summarized in Fig. 9. Of the 30 studies included in this review, 27 were rated as having serious concerns of bias present. The most common serious concern of bias was due to bias in the measurement of outcomes, for example, due to observer bias when obtaining patient-reported outcome measures by the surgeon who performed the intervention. The other 3 studies were all rated as having moderate concerns of bias and, thus, had no serious or critical ratings.

Discussion

The primary finding of this systematic review and meta-analysis was that there is a high RTS among all patients (91.7%) and *all athletes* (90.9%) following primary arthroscopic repair for posterior labral instability, with no statistical difference between contact and overhead athletes (92.8% vs 88.1%). Further, subgroup analyses found that the rate of RTPL was 78.7% among all patients and 75.6% in *all athletes*, with no statistical difference between contact and overhead athletes (90.8% vs 62.3%; $P = .072$). Operative management of posterior shoulder instability resulted in both a high rate of return to sport, in addition to significant improvement in functional outcomes and patient satisfaction.

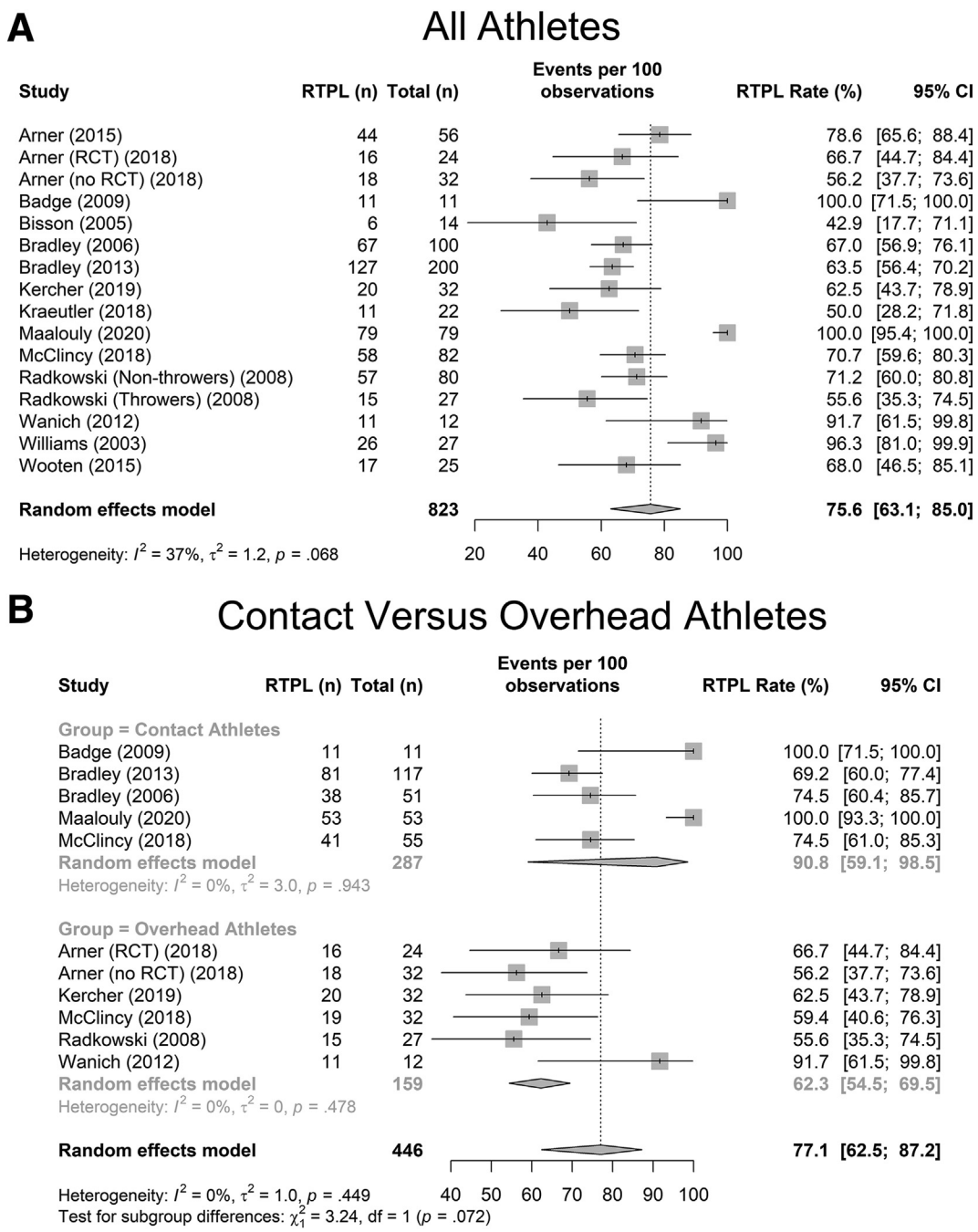

Fig. 4. Forest plot of return to preinjury levels for all athletes, with subanalyses for contact versusoverhead athletes.

Specifically, the RTS rates for contact and overhead athletes were similar, as *contact athletes* ranged from 86.3% to 100%, while the *overhead athletes* had a range of 85.2% to 93.8%. Among these patients, the return to preinjury level rates ranged from 69.2% to 100% among *contact athletes* and 55.6% to 91.7% among *overhead athletes*. The majority of athletes that returned to sport were, thus, also returning to preinjury level of play. All studies included reported higher average postoperative ASES scores than preoperative, as the ranges were 41.8 to 69.9 preoperatively and 82.9% to 99.9 post-operatively. The improvement in shoulder function and subjective pain agreed well with patient satisfaction outcomes, as all studies reporting this measure indicated a majority of patients were satisfied or very satisfied (64.9%−100%). The number of complications reported in each study was relatively low, with the range being 0 to 9 among all studies reporting on athletes. Similarly,

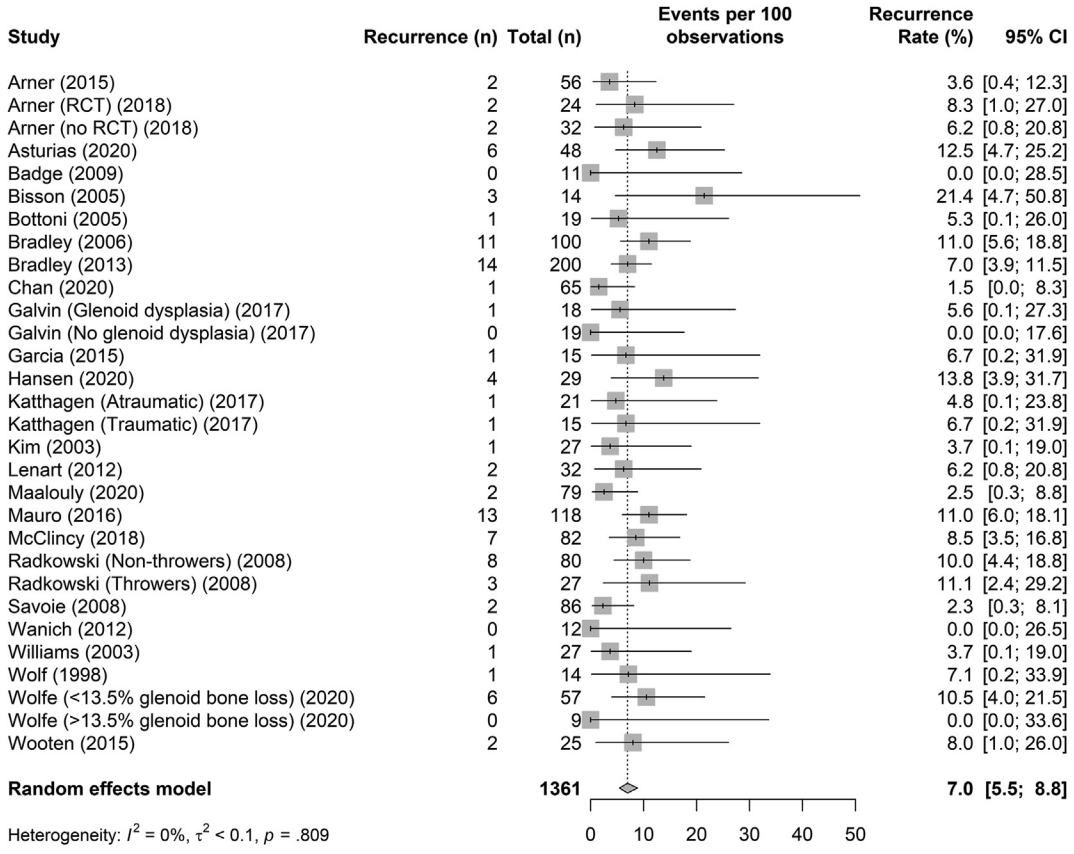

Fig. 5. Forest plot of overall recurrence rates for the entire cohort (all population).

there were relatively few revisions, with ranges of 0 to 6 among *contact athletes* and 0 to 13 among *all athletes*.

PSI contributes to 5.2% to 18% of all shoulder instability cases.[4,16–18] In 2015, Delong et al.[8] presented the first systematic review and meta-analysis of all available literature reporting on clinical outcomes following arthroscopic stabilization procedures in the setting of unilateral PSI. The current systematic review includes 31 studies with nearly double the number of patients (1,649 shoulders, 1,592 patients) to provide an update on clinical outcomes for patients with unidirectional PSI treated with primary arthroscopic surgery. Delong et al. showed that arthroscopic procedures were an effective and reliable treatment option for unidirectional PSI with respect to outcome scores, patient satisfaction, and return to play. Despite similar outcome measures to the *all athlete* and *contact athletes* populations, *overhead athletes* were less likely to return to their preinjury level of sport.[8] Similarly, in our patient cohort, *overhead athletes* more often returned to their preinjury level at a lower rate compared to *contact athletes* and the general *all athletes* groups. In the Delong et al.[8] study, when compared to open procedures, those treated arthroscopically had superior outcomes for stability, recurrence of instability, RTS, patient satisfaction, and return to previous level of play. Risk factors that were associated with increased recurrent instability and revision rates included prior surgery, diagnostic elements, repair technique, postoperative mobilization factors, and certain pathologic subsets.

Return to Sport and Work

Within our patient cohort, a high proportion of each population returned to sport (85.2%–100%), at rates similar to that previously reported by Delong et al. in 2015.[8] Of those patients for whom there were available data, most also returned to their preinjury level of play (55.6%–100%). When stratified for subgroup analysis, the results showed differences across *contact* and *overhead athlete* groups. Specifically, while the overall ranges of RTS were similar (86.3%–100% *contact athletes*, 85.2%–93.8% *overhead athletes*), *overhead athletes* trended toward being less likely to return to their preinjury level, with 55.6% to 91.7% doing so compared to 69.2% to 100% in *contact athletes*.

Pavlik et al.[19] recently reported a 98.2% RTS activity rate in their single-institution case series of 40 arthroscopic stabilization procedures (37 shoulders) for PSI, with 27/36 patients (72.9%) returning to their original sport and 19/36 patients (51.4%) at their preinjury level. A significantly higher rate of return to the same

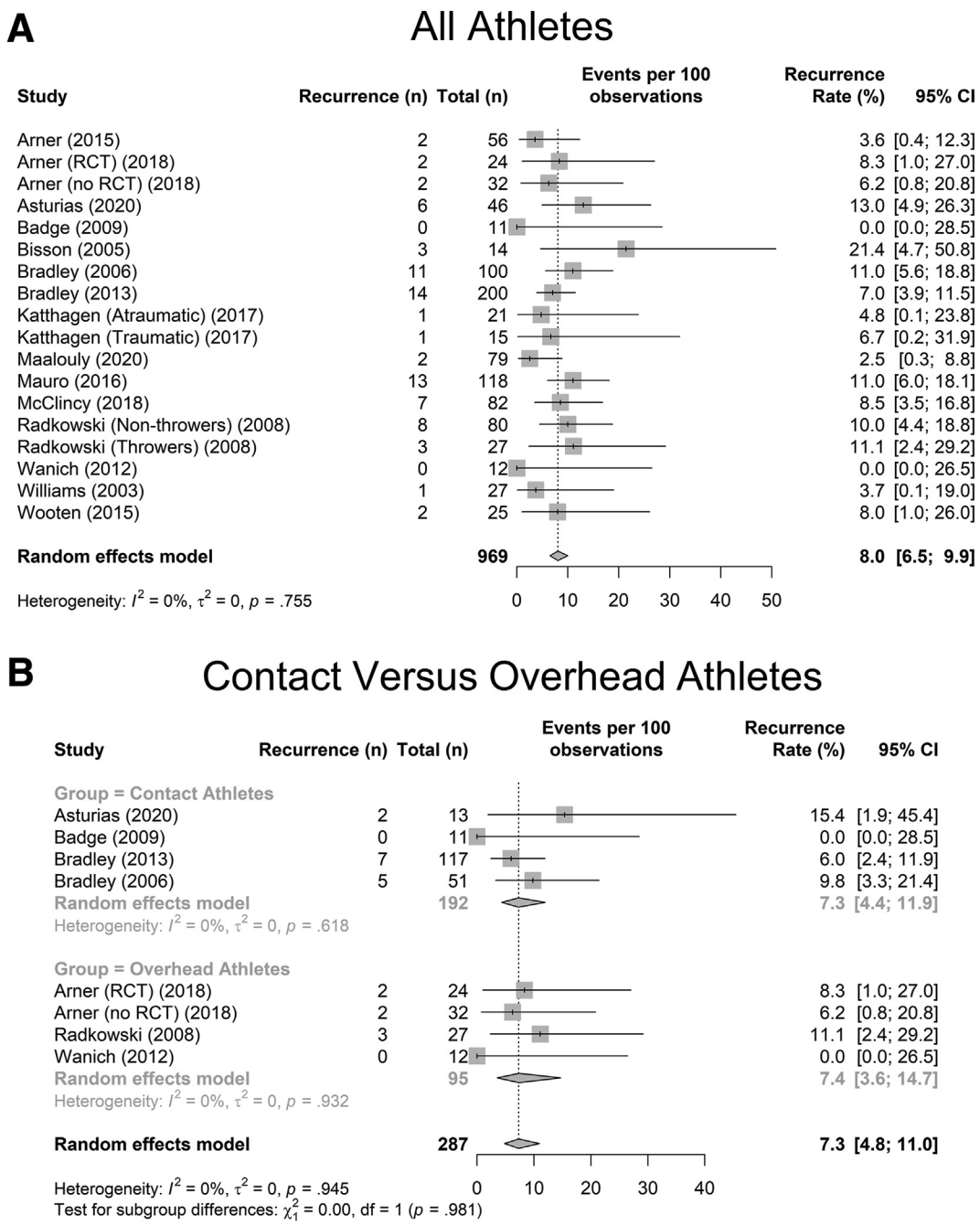

Fig. 6. Forest plot of overall recurrence rates for all athletes, with subanlyses for contact versus overhead athletes.

sport was observed for athletes who had a traumatic injury as compared to the subgroup that did not. Katthagen et al.[20] retrospectively reviewed 36 patients with PSI who underwent arthroscopic posterior capsulolabral anchor repair for traumatic and atraumatic reasons and were active in sports at a minimum of 2 years follow-up. For the 89% of patients with available postoperative outcomes data, there were no significant differences in RTS or postoperative redislocation rates between groups. While ASES and SF-12 scores improved significantly in both groups, those with traumatic-onset PSI had statistically improved outcomes. Similarly, Arner et al.[21] evaluated subjective and clinical outcome data of arthroscopic posterior capsulolabral repair for the treatment of symptomatic unidirectional PSI in 56 consecutive American football players. At a mean follow-up of 44.7 months, 93% returned to sport, and 79% returned to sport at the same level of play. Excellent or good results (ASES score >60, stability <6) were achieved in 96.5% of athletes, and 96% were satisfied with their operations. Furthermore, a systematic review by Leivadiotou

Table 3. Complications

Complications	Total Population (n = 1361 Shoulders)	All Athletes (n = 969 Shoulders)	Contact Athletes (n = 192 Shoulders)	Overhead Athletes (n = 95 Shoulders)
Overall complications	19	16	6	1
Subacromial impingement	2	2	0	0
Adhesive capsulitis	2	0	0	0
Stiffness	0	0	0	0
Deep infection	0	0	0	0
Superficial infection	1	1	0	0
Other	13	13	6	1
Secondary complications	1	0	0	0

et al.[22] looked at early and midterm outcomes across 6 studies (387 patients, 396 shoulders) and reported an average 92.5% RTS rate.

More recently, Matar et al.[23] reported a mean RTS of 86.9% after surgical treatment for unidirectional PSI or painful posterior labral tear in their systematic review of 23 studies (1,047 patients). The mean RTS to the preinjury level was 74.9%. Eight out of 23 included studies stratified athletes of a particular sport or activity, including 4/8 involving contact sport football, rugby, and lacrosse players. In this select cohort, the return to preinjury level was from 78.5 to 100%. Existing literature has shown differences with respect to unique subsets of athletes, namely overhead/throwing as compared to contact athletes. Radkowkski et al.[24] prospectively evaluated 98 athletes (107 shoulders) treated with arthroscopic posterior capsulolabral repair or, rarely, capsular plication alone. At a mean follow-up of 27 months, excellent or good results were seen in 89% of throwers compared to 93% nonthrowers. Further, in their meta-analysis, Delong et al.[8] found that RTS for overhead/throwing athletes was 84% compared to 92% for the overall athletic population and 89% for contact athletes. More concerning, however, is that 58% of overhead/throwing athletes returned to their previous level of play compared to 67% and 71% in their overall athletic and contact sports counterparts, respectively. A more recent systematic review of 1,100 patients (1,153 shoulders) across 32 studies by Gouveia et al.[9] reported a pooled

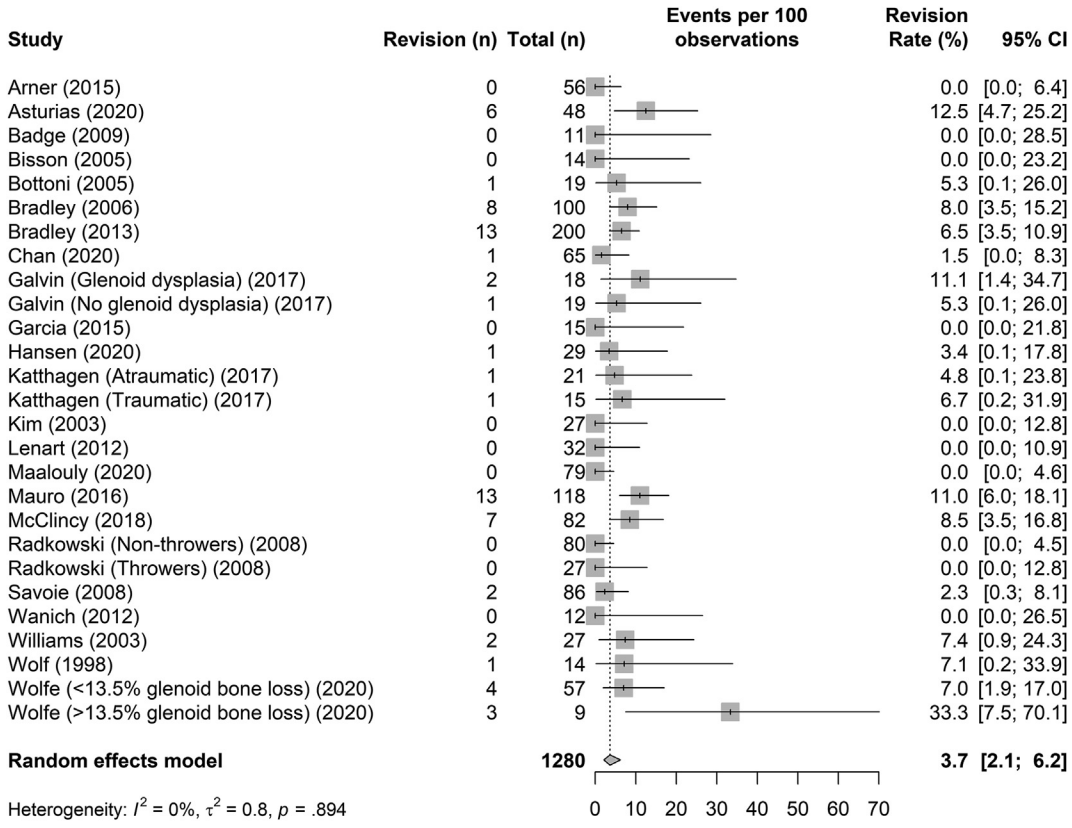

Fig. 7. Forest plot of revision rates for the entire cohort (all population).

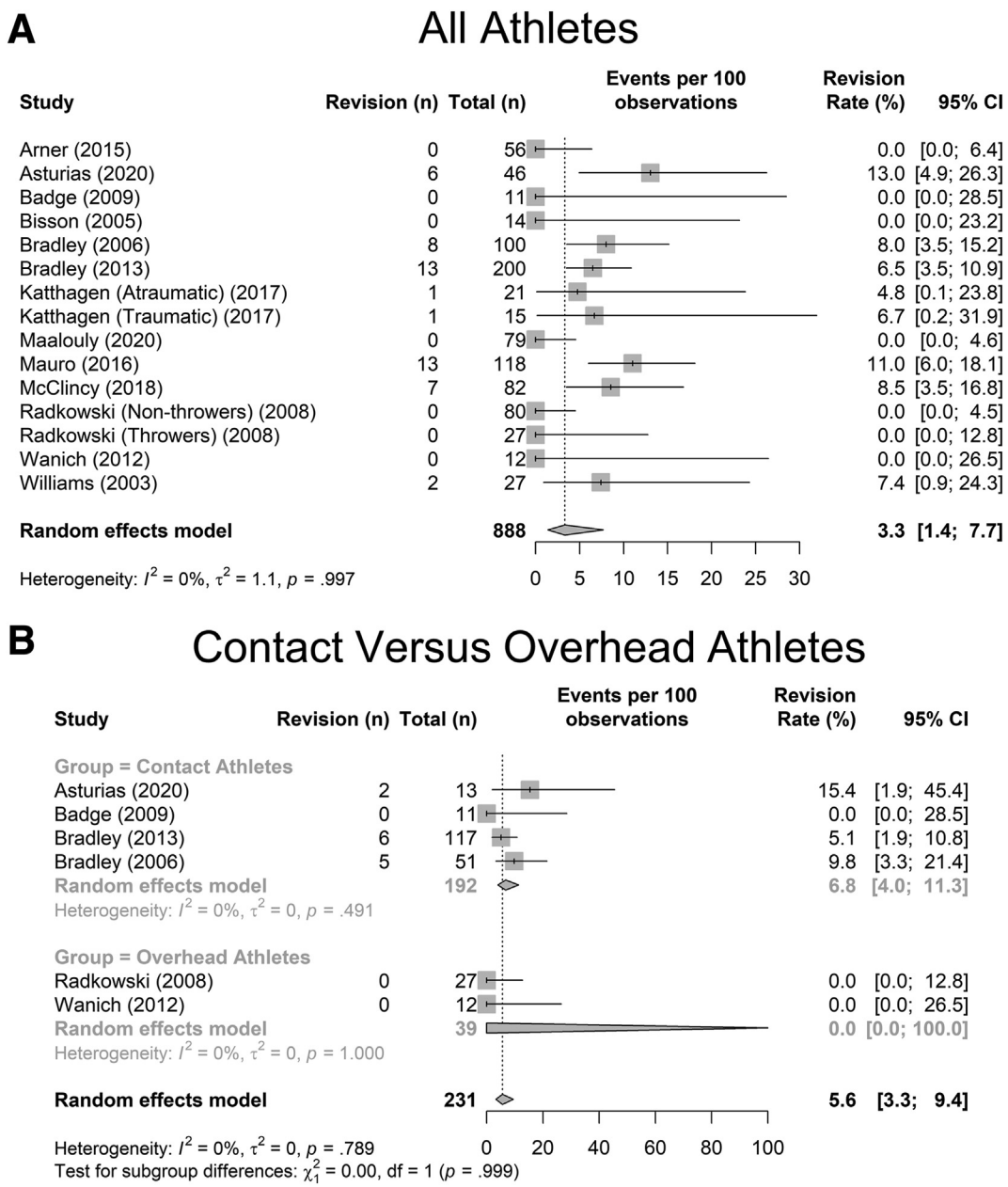

Fig. 8. Forest plot of revision rates for all athletes, with subanalyses for contact versus overhead athletes.

rate of 88% return to any level of sport, with 68% returning to preinjury level. Similar differences were observed between contact and throwing athletes with 94% and 88% returning to sport, respectively.

Understanding overhead/throwing sports as an independent risk factor is critical for patient management and when considering functional outcome scoring. Namely, the repetitive stresses on the capsulolabral complex during the act of overhead throwing places considerable strain on the athlete's shoulder. For these select individuals, whose sport or position requires high numbers of throwing repetitions at maximum or near-maximum effort, any reduction in power or accuracy may negatively affect performance and, subsequently, their ability to return to preinjury levels.[9] The discrepancies between RTS and RTPL may be reflective of this challenging clinical dilemma.

Postoperative Functional Scores and Outcomes

Preoperative and postoperative ASES values were reported across 13 studies (989 shoulders, 938 patients). Ranges for ASES scores within these studies improved from 41.8 to 69.9 preoperatively to 82.9–99.9 postoperatively. These values are similar to those published in a previous systematic review by

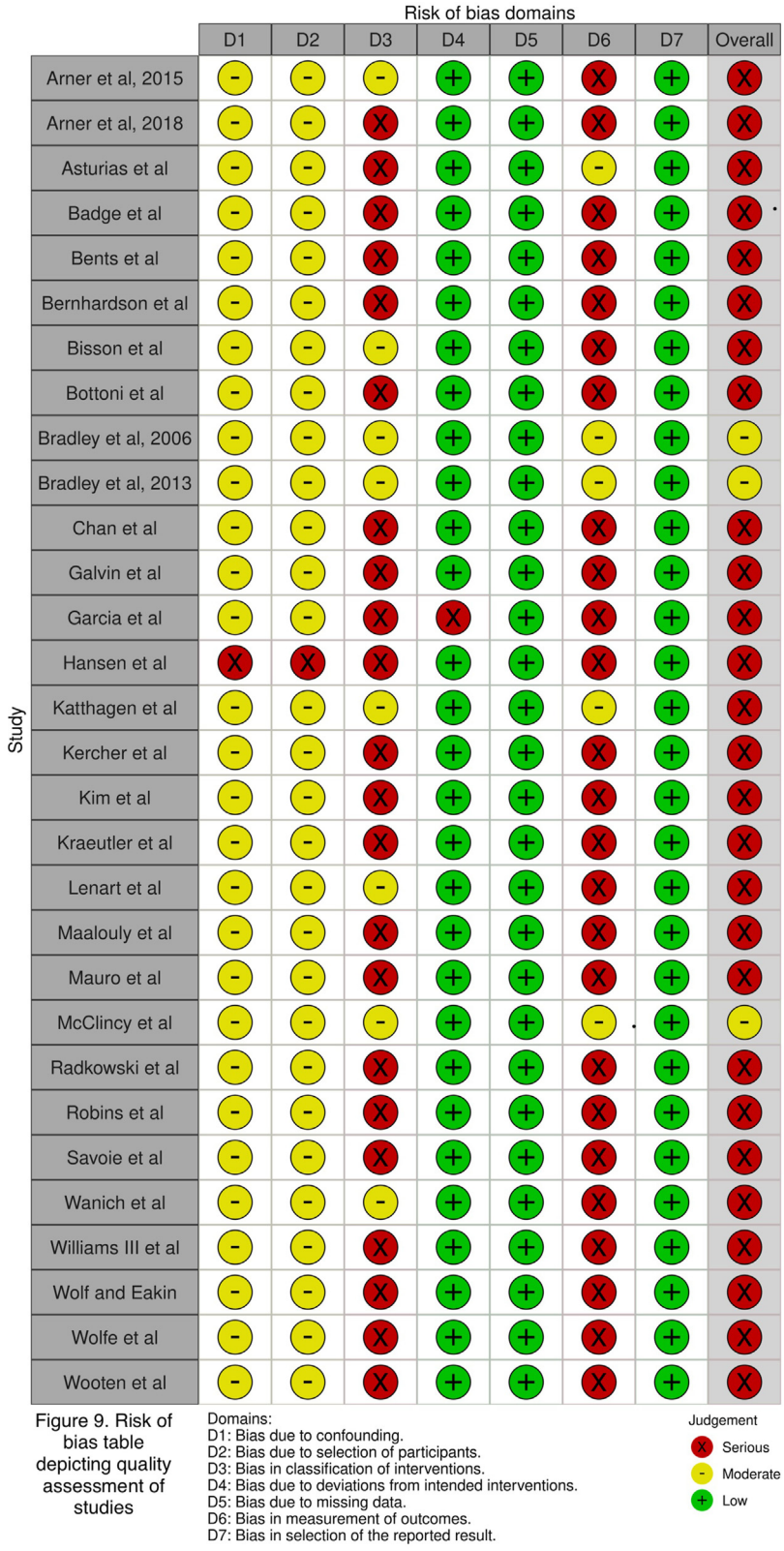

Figure 9. Risk of bias table depicting quality assessment of studies

Fig. 9. Risk of bias table depicting quality assessment of studies.

Delong et al.[8] in 2015. The increase in scores seen in most studies is greater than the minimal clinically important difference in ASES, which is 27.1.[25] Outcomes for patient-reported shoulder stability varied (ranged from 47.4 to 96.3% of patients reporting good or excellent stability), although this level is likely dependent on type of sport.

Studies with data available on return of normal muscular strength at latest follow-up demonstrated a range of 48.0% to 92.6%—with most studies reporting values slightly less than that previously reported.[9] The percentage of patients reporting feeling satisfied/very satisfied—or stating they would have surgery again under similar circumstances—ranged from 64.9 to 100%. In their systematic review, Delong et al.[8] identified the pitfalls and challenges in comparing patient outcomes for PSI, namely the spectrum of reported functional outcomes prevalent throughout the existing literature. Specifically, their review identified 21 different functional outcome measures used to evaluate outcomes in the setting of PSI. The most prevalent functional outcome measures used in their review was the ASES (9/27 studies, 524 shoulders), resulting in a mean value of 90% of the maximum ideal score. In the aforementioned systematic review by Leivadiotou et al.[22], the most commonly used outcome score was also the ASES score, with a mean value of 91.3 postoperatively. When compared to 51 shoulders in contact athletes, there were significant improvements in stability, function, and pain. Further, Provencher et al.[26] evaluated the outcomes in 33 consecutive patients treated arthroscopically with suture anchors, suture capsulolabral plication, or both. At a mean follow-up of 39.1 months, outcome scores demonstrated mean ASES of 94.6, Subjective Patient Shoulder Evaluation of 20, WOSI Index of 389.4 (81.5% of normal), and Single Assessment Numeric Evaluation (SANE) of 87.5. The authors concluded that the WOSI criteria was much more stringent in evaluating overall shoulder function after instability surgery.

Complication, Recurrent Instability, and Revision Rates

Among the *entire population*, there were 19 complications while the subgroup *all athletes'* population, accounted for 16 of these complications Additionally, there were 67 revisions in the *entire* population and 51 total revisions among *all athletes*. Surgical failures, including recurrent instability were not considered to be complications but rather deemed as failures. Most of the studies included in this review reported complication and revision rates that were lower than the 2.48% and 6.82% rates reported by Delong and colleagues,[8] respectively. Certainly, the reasons for these findings are multifactorial, but improvements in arthroscopic techniques may have played a role in decreasing complication and revision rates and decreasing the rate of persistent pain.

Limitations

RTS and return to preinjury level is often at the top of the young athlete's mind and an important factor for orthopaedic surgeons to consider. While RTS was commonly reported (18/31studies), it was oftentimes not done soin a standardized definition.Further, the current review was unable to control for the multiple factors that play an important role in returning to sport (eg, patient, surgical technique, physical therapy, sport, and participation level). Care was taken to describe patient demographics and type of athlete as much as possible so as to avoid misrepresentation of the data.

Conclusions

Primary arthroscopic treatment of PSI is associated with favorable outcomes and high return to sport and work rates. Recurrent instability and pain were the most common reasons for revision.

Disclosures

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