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Return to Preinjury Levels of Participation After Superior Labral Repair in Overhead Athletes: A Systematic Review

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Context: Athletes often preoperatively weigh the risks and benefits of electing to undergo an orthopaedic procedure to repair damaged tissue. A common concern for athletes is being able to return to their maximum levels of competition after shoulder surgery, whereas clinicians struggle with the ability to provide a consistent prognosis of successful return to participation after surgery. The variation in study details and rates of return in the existing literature have not supplied clinicians with enough evidence to give overhead athletes adequate information regarding successful return to participation when deciding to undergo shoulder surgery.

Objective: To investigate the odds of overhead athletes returning to preinjury levels of participation after arthroscopic superior labral repair.

Data Sources: The CINAHL, MEDLINE, and SPORTDiscus databases from 1972 to 2013.

Study Selection: The criteria for article selection were (1) The study was written in English. (2) The study reported surgical repair of an isolated superior labral injury or a superior labral injury with soft tissue debridement. (3) The study involved overhead athletes equal to or less than 40 years of age. (4) The study assessed return to the preinjury level of participation.

Data Extraction: We critically reviewed articles for quality and bias and calculated and compared odds ratios for return to full participation for dichotomous populations or surgical procedures.

Data Synthesis: Of 215 identified articles, 11 were retained: 5 articles about isolated superior labral repair and 6 articles about labral repair with soft tissue debridement. The quality range was 11 to 17 (42% to 70%) of a possible 24 points. Odds ratios could be generated for 8 of 11 studies. Nonbaseball, nonoverhead, and nonthrowing athletes had a 2.3 to 5.8 times greater chance of full return to participation than overhead/throwing athletes after isolated superior labral repair. Similarly, nonoverhead athletes had 1.5 to 3.5 times greater odds for full return than overhead athletes after labral repair with soft tissue debridement. In 1 study, researchers compared surgical procedures and found that overhead athletes who underwent isolated superior labral repair were 28 times more likely to return to full participation than those who underwent concurrent labral repair and soft tissue debridement ($P < .05$).

Conclusions: The rate of return to participation after shoulder surgery within the literature is inconsistent. Odds of returning to preinjury levels of participation after arthroscopic superior labral repair with or without soft tissue debridement are consistently lower in overhead/throwing athletes than in nonoverhead/nonthrowing athletes. The variable rates of return within each group could be due to multiple confounding variables not consistently accounted for in the articles.

Key Words: return to play, odds of return, shoulder injuries

Key Points

- Odds ratios of full return to participation were greater for nonoverhead athletes after superior labral repair.
- Evidence supporting return to participation after superior labral repair was low to moderate.

Shoulder injury, which can affect either the static or dynamic anatomical structures, can result in poor upper extremity function and suboptimal athletic performance. In the overhead athlete, anatomic tissue derangement frequently manifests as superior labral injury, which may occur alone or with concurrent rotator cuff injury (internal impingement).[1] In either condition, symptoms can present as pain on external rotation and cocking, weakness in clinical or functional upper extremity strength, symptoms of internal derangement (clicking, catching, sliding), and functional problems with velocity or control during overhead tasks.[2] In many patients, the symptoms of tissue derangement can be addressed nonoperatively with rehabilitation; however, if nonoperative efforts do not resolve symptoms or restore performance, operative management may be warranted to restore the compromised anatomy.

Patients often preoperatively weigh the risks and benefits of electing to undergo an orthopaedic procedure to repair damaged tissue. A common concern for patients is being able to return to their maximum levels of competition after shoulder surgery, whereas clinicians are concerned with providing a consistent prognosis of successful return to participation after surgery. In a systematic review, Gorantla et al[3] examined postoperative subjective outcomes after the repair of type II superior labral lesions. The researchers identified multiple differences among the reviewed studies, including variations in patient populations (eg, athletes,

Table 1. Systematic Review Search Terms Using Patient or Problem, Intervention, Comparison, Outcome Method

Patient or Problem	Intervention	Comparison	Outcome	Final Patient or Problem, Intervention, Comparison, Outcome Combination
Athlete[a]		NA		Athlete[a] and overhead or throwing
AND				AND
Overhead				
OR				
Throwing				
	Rotator cuff[a]			Rotator cuff[a] or SLAP or superior labrum anterior posterior or superior labrum and shoulder
	OR			AND
	SLAP			
	OR			
	Superior labrum anterior posterior			
	OR			
	Superior labrum			
	AND			
	Shoulder			
			Return to	Return to and play or competition or activity or sport or preinjury levels or preinjury levels
			AND	
			Play	
			OR	
			Competition	
			OR	
			Activity	
			OR	
			Sport	
			OR	
			Pre-injury Levels	
			OR	
			Preinjury Levels	
1188	5563		2 220 316	215

Abbreviations: NA, not applicable; SLAP, superior labrum, anterior to posterior.

[a] Denotes selection of all variations of the term.

workers, general population), diagnosis, surgical technique, and size of the patient populations. Of the studies with populations comprising overhead athletes (5 of 11), return-to-participation rates varied from 22% to 92%.[3] The variations in study details and rates of return have not supplied clinicians with enough evidence to provide overhead athletes with adequate information about successful return to participation when considering shoulder surgery. Therefore, the purpose of our systemic review was to investigate the odds of return to preinjury levels of participation of overhead athletes after arthroscopic superior labral repair. Two primary objectives were addressed in this systematic review using the patient, intervention, and outcome format: (1) In patients undergoing isolated superior labral repair (intervention), were the odds of returning to preinjury level of participation (outcome) equal between overhead and nonoverhead athletes (patient)? (2) In patients undergoing labral repair with soft tissue debridement (intervention), were the odds of returning to preinjury level of participation (outcome) equal between overhead and nonoverhead athletes (patient)?

METHODS

Data Acquisition

Search Strategy. We accessed the CINAHL, MEDLINE, and SPORTDiscus online databases to search the terms listed in Table 1. Terms were searched individually and then combined into distinct Boolean phrases. The search limits were human studies, English-language articles only, and years 1972 to 2013. In some cases, review of a retrieved article revealed potential citations not originally identified in the electronic search. A total of 215 articles were retrieved from the systematic search (Figure).

Study Selection and Retention. Articles were retained based on the following inclusion criteria: articles reporting surgical repair of an isolated superior labral injury or a labral injury with soft tissue debridement, patient population comprising overhead athletes with a mean age equal to or less than 40 years, and record of assessment of return to preinjury level of participation. We excluded articles if the type of labral lesion repaired was not identified (this was done to avoid including studies in which only debridement of the labrum occurred) or if the surgical technique or procedure was not described in detail. Additionally, articles were excluded if concurrent repair of the superior labrum and rotator cuff was performed. We excluded literature (nonsystematic) reviews and current concepts or opinion papers because the level of evidence was less than level 4 case series (Figure).[4]

Data Extraction and Analysis

For this systematic review, we collected and recorded from each article the percentage of athletes who returned to

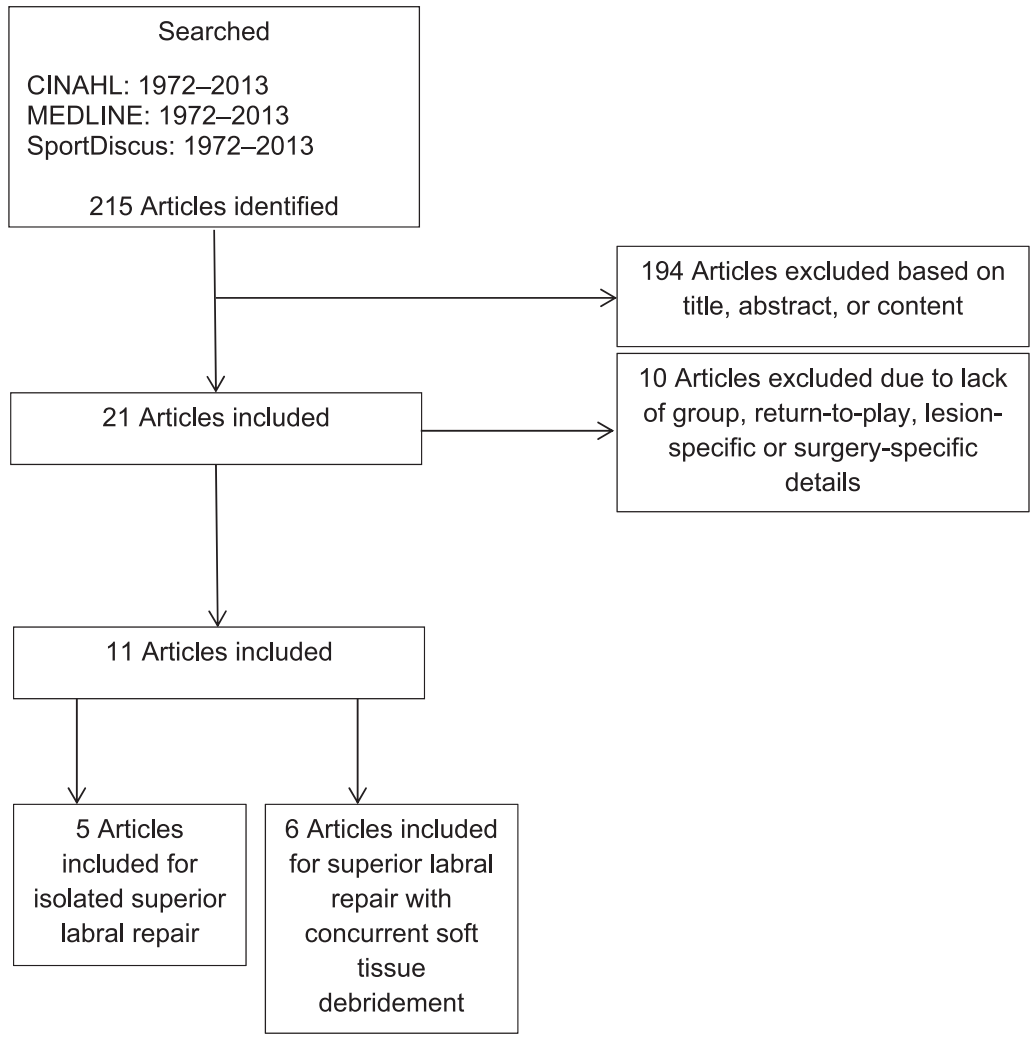

Figure. Flow chart for selecting articles to be included in the systematic review.

full participation so that we could calculate the primary measure of interest, odds of return to full participation, for this systematic review. For studies that provided data regarding return to participation for dichotomous populations or surgical procedures, we constructed 2 × 2 contingency tables in Excel (version 2007; Microsoft Corporation, Redman, WA) to calculate the odds of return to full activity for each comparative group. We calculated the odds of full return to condense the reported rates of return into a more definable chance of success or failure after surgery. When return to participation was reported only as a percentage (without the raw data), we multiplied the percentage of participants who returned by the total number of participants in each subgroup to complete the 2

Table 2. Assessment of Risk Criteria for Case Series Reports

Type of Bias	Criterion
Attrition	Attrition includes loss to follow up, exclusion of participants, and dropouts. Were missing data handled appropriately, such as using intent-to-treat analysis?
Detection	Were the assessors of the outcome blinded to the intervention?
	Were interventions assessed or defined using valid and reliable measures and implemented across all study participants?
	Were outcomes assessed or defined using valid and reliable measures and implemented across all study participants?
	Were confounding variables assessed using valid and reliable measures and implemented across all study participants?
Performance	Did researchers rule out any impact from a concurrent intervention that might bias the results?
	Did the study maintain fidelity to the intervention protocol?
Recall	Was information collected prospectively and compared to a similar follow-up measure?
Reporting	Were the potential outcomes prespecified by the researchers and were all prespecified outcomes reported?
Selection	Does the design or analysis control account for important confounding and modifying variables through matching, stratification, multivariable analysis, or other approaches?

Adapted from Viswanathan M, Ansari MT, Berkman ND, et al. Assessing the risk of bias of individual studies in systematic reviews of health care interventions. Agency for Healthcare Research and Quality Web site. http://www.effectivehealthcare.ahrq.gov/search-for-guides-reviews-and-reports/?pageaction=displayproduct&productid=998. 2012.

Table 3. Study Descriptive Details and Original Reported Return-to-Participation Rates After Isolated Superior Labrum Anterior-Posterior Repair or Superior Labrum Anterior-Posterior Repair With Concurrent Procedures, Continued on Next Page

Authors (Year)	Participant Demographics	Sports Included	Surgical Procedure	Follow-Up Time	Return to Participation[a]	Return to Participation Determined[b]
Kim et al[5] (2002)	N = 34; 30 males, 4 females; mean age = 26 y; 18 overhead athletes, 12 contact athletes, 4 no sport	Baseball, tennis, and volleyball	Isolated SLAP repair	33 mo (range, 24–49 mo)	Overhead sports: 22% full return and 78% return with some limitation Nonoverhead sports: 63% full return and 38% return with some limitation	Postoperative assessment of preinjury and postinjury function via visual analog scale with a 5-level graded scale of limitation (*return with no limitation* to *return with severe limitation*)
Cohen et al[12] (2006)	N = 39; 37 males, 2 females; mean age = 34 y; 8 throwing athletes (all baseball), 21 nonthrowing athletes	Baseball, football, hockey, lacrosse, skiing, soccer, and volleyball	Isolated SLAP repair	44 mo (range, 25–97 mo)	Throwers: 37% full return and 63% return with limitation All athletes: 48% full return, 45% return with limitation, and 7% no return	Postoperative assessment of preinjury and postinjury function via oral question
Yung et al[13] (2008)	N = 16; 13 males, 3 females; mean age = 24 y; 13 overhead athletes	Badminton, handball, tennis, and weight lifting	Isolated SLAP repair	27.6 mo (range, 24–31 mo)	Overhead athletes: 92% full return Nonoverhead athletes: 100% full return	Postoperative assessment of preinjury and postinjury function via oral question
Maier et al[14] (2013)	N = 24; 20 males, 4 females; mean age = 36 y; 18 overhead athletes	Badminton, basketball, boxing, climbing, soccer, swimming, tennis, volleyball, and weight lifting	Isolated SLAP repair with suture anchor or transglenoid suture	24 mo (range, 24–96 mo)	All athletes: 58% full return Overhead athletes: 67% full return Nonoverhead athletes: 50% full return	Postoperative assessment of preinjury and postinjury function via oral question, Constant Score, and subjective shoulder value
Park et al[15] (2013)	N = 24; 18 males, 6 females; mean age = 23 y; 24 overhead athletes	Badminton, baseball, javelin, and volleyball	Isolated SLAP repair	45.8 mo (range, 24–68 mo)	All athletes: 50% full return Baseball: 38% full return Other athletes: 75% full return	Postoperative assessment of preinjury and postinjury function via oral question
Morgan et al[16] (1998)	N = 53; mean age = 24 y (range, 15–36 y); 53 overhead athletes	Baseball, tennis, and volleyball	SLAP repair with rotator cuff repair	12 mo	Pitchers: 84% full return and 16% return with limitation	Postoperative assessment of preinjury and postinjury function via oral question
Ide et al[17] (2005)	N = 40; 33 males, 7 females; mean age = 24 y	Baseball, basketball, goalkeeping, handball, racquetball, softball, swimming, and volleyball	SLAP repair with rotator cuff debridement	41 mo (range, 24–58 mo)	Baseball: 63% full return and 37% return with limitation Other sports: 86% full return and 14% return with limitation	Postoperative assessment of preinjury and postinjury function via oral question with a 4-level graded scale of limitation (*return with no limitation* to *no return due to severe limitation*)
Brockmeier et al[18] (2009)	N = 47; 39 males, 8 females; mean age = 36 y (range, 14–49 y); 34 athletes	Baseball, softball, squash, swimming, tennis, and volleyball	SLAP repair with acromioplasty, bursectomy, distal clavicle excision, or rotator cuff debridement	Minimum 2 y	Overhead sports: 71% full return Other sports: 74% full return	Postoperative assessment of preinjury and postinjury function via oral question
Friel et al[19] (2010)	N = 48; 39 males, 9 females; mean age = 33 y (range, 16–59 y); 22 overhead athletes	Baseball, tennis, and volleyball	SLAP repair with Bankart, subacromial decompression, distal clavicle excision, or debridement	39 mo (range, 24–68 mo)	All overhead athletes: 59% full return	Postoperative assessment of preinjury and postinjury function via questionnaire

Table 3. Continued From Previous Page

Authors (Year)	Participant Demographics	Sports Included	Surgical Procedure	Follow-Up Time	Return to Participation[a]	Return to Participation Determined[b]
Park and Glousman[20] (2011)	N = 12; 10 males, 2 females; mean age = 32.6 y (range, 19–67 y)	Baseball, softball, and volleyball	SLAP, subacromial decompression, or debridement	50.5 mo (range, 8–81 mo)	Overhead athletes: 41.3% full return No baseball player returned to preinjury level	Postoperative assessment of preinjury and postinjury function via oral question
Neri et al[21] (2011)	N = 23; mean age = 25 y (range, 18–45 y)	Baseball, tennis, volleyball, and water polo	SLAP repair with rotator cuff debridement	38 mo (range, 12–70 mo)	All athletes: 57% full return, 26% return with limitation, and 17% no return	Postoperative assessment of preinjury and postinjury function via oral question

Abbreviation: SLAP, superior labrum, anterior to posterior.

[a] The return-to-participation rates after superior labrum anterior-posterior repair or superior labrum anterior-posterior repair with concurrent procedure are provided as percentages.

[b] Summary of return to participation was determined from each article.

$\times$ 2 table. Odds for a distinct group were computed by dividing 1 return-to-participation variable by another.

For example, in 1 study, 4 overhead athletes returned to full participation, and 14 overhead athletes returned to limited activity; however, 10 nonoverhead athletes returned to full participation, with only 6 returning in a limited capacity.[5] To calculate the odds for each group of athletes, we simply divided the occurrences for each group (overhead athletes: 4 with full return divided by 14 with limited return = 0.3; nonoverhead athletes: 10 with full return divided by 6 with limited return = 1.7). When the calculated odds were 1.0 or less, the resultant interpretation was that the chance of not returning to full activity after surgery was greater. Conversely, when the odds were greater than 1.0, the interpretation was that the chance of returning to full activity after surgery was greater.[6]

The odds were needed to calculate the final odds ratios (ORs) that would compare the odds of the event of interest (returning to full activity) between the specified groups (eg, overhead versus nonoverhead athletes, throwing versus nonthrowing athletes) for each study. Therefore, using the example given, the OR calculation of 1.7/0.3 = 5.8 would be interpreted as nonoverhead athletes being 5.8 times more likely to return to full activity after surgery than overhead athletes. An OR greater than 1.0 would indicate a possible statistical relationship or association between the variables.[6] To confirm if a statistical association existed, 95% confidence intervals (CIs) were constructed. If the 95% CI contained the value 1.0, then no statistical association was present at an α level of .05.

Assessment of Quality and Bias for Retained Articles

We used the intervention study appraisal score sheet described by MacDermid[7] to assess the quality of each article retained for the systematic review. This instrument was selected because it aligned well with case series reports that characterized most of the retained articles' designs. The assessment sheet comprised 24 questions divided among 7 subheadings (study question, study design, subjects, intervention, outcomes, analysis, and recommendations); each question could receive a score ranging from 0 to 2 for a maximum score of 48 points. This scoring sheet was modified to a binary (*yes* = 1 or *no* = 0) scoring system, yielding a possible 24 points to better illustrate commonalities among retained studies. Two of the authors (A. S., N. M.) individually reviewed and appraised each retained article. Upon completion of all appraisals, the 2 authors met to compare their results. When the authors agreed on an individual article's score, they accepted it. When the authors disagreed on a score, they revisited the article and discussed the discrepancy in score until agreement was reached. If agreement could not be reached, a third author (T.L.U.) was consulted to serve as the final authority. After the critical appraisal, the appropriate strength of recommendation was selected using the Strength of Recommendation Taxonomy, which consists of ratings of A, B, or C (high to low).[8]

We determined the risk of bias per the recommendations from the PRISMA guidelines.[9,10] The retained articles were assessed for different types of bias, including selection, performance, attrition, detection, reporting, and recall.[11] Each type of bias was determined by the primary author per

Table 4. Surgical Technique Comparison

Study (Year)	Portal Location Described?	Hardware Identified?	No. of Anchors Reported?	Anchor Location Described?
Kim et al[5] (2002)	Yes	Yes	≥1	Base of biceps
Cohen et al[12] (2006)	Yes	Yes	1–4	Where indicated
Yung et al[13] (2008)	Yes	Yes	2–4	2:00 to 10:00
Maier et al[14] (2013)	Yes	Yes	1–2	Where indicated based on lesion type
Park et al[15] (2013)	Yes	Yes	≥1	12:00 for double-loaded suture anchor or 11:00 and 1:00 for single-loaded suture anchor
Morgan et al[16] (1998)	Yes	Yes	No	Articular margin
Ide et al[17] (2005)	Yes	Yes	≥2	11:00 to 1:00
Brockmeier et al[18] (2009)	Yes	Yes	≥1	Articular margin not beyond 10:00
Friel et al[19] (2010)	Yes	Yes	≥1	Base of biceps to 11:00
Park and Glousman[20] (2011)	Yes	Yes	No	No
Neri et al[21] (2011)	Yes	Yes	Mean = 2.3	On either side of biceps

the definitions provided by the Agency for Healthcare Research and Quality (Table 2).

RESULTS

The findings from each study are summarized in Table 3. Five articles that met all inclusion criteria were retained because they provided information about return to preinjury level of participation after isolated superior labral repair.[5,12–15] Another 6 articles were retained because they met all inclusion criteria and focused on superior labral repair with concurrent shoulder procedures (ie, labral repair with debridement of the rotator cuff or other surrounding tissue).[16–21] Surgical details for the labral-repair procedures are reported in Table 4.

Return to Preinjury Levels of Participation

Isolated Superior Labral Repair. The proportion of athletes who returned to their preinjury levels of participation after isolated superior labral repair was reported to range from 22% to 92% for the 5 studies reviewed.[5,12–15] In 2 studies,[5,12] the authors subdivided return to participation into 2 levels (full return, limited return) based on perceived functional limitation; full return for overhead or throwing athletes ranged from 22% to 37%, but 63% to 78% of athletes returned with limitation. These authors also reported that a higher percentage (48% to 63%) of nonoverhead or nonthrowing athletes returned in full, whereas only 38% to 45% returned with limitation.[5,12] In 3 other studies,[13–15] investigators divided return to participation into full return and no return. When comparing baseball players with other overhead athletes, return to full participation was 38% for the former and 75% for the latter.[15] When comparing the return to full activity for 2 repair techniques,[14] we observed that suture anchor repairs were superior to transglenoid suture repairs; however, little difference existed in the rate of return to full activity for overhead athletes between the techniques (56% for suture anchor and 67% for transglenoid suture repair). When comparing specific sports, Yung et al[13] demonstrated a 92% return to participation for tennis, handball, and badminton athletes.

Using the originally reported return-to-participation rates, we generated ORs for full return for 4 of 5 studies (Table 5).[5,12,14,15] Authors of 3 studies found that nonbaseball players (OR = 5.0; 95% CI = 0.8, 33.2),[15] nonthrowers (OR = 2.3; 95% CI = 0.4, 12.5),[12] and nonoverhead athletes (OR = 5.8; 95% CI = 1.3, 26.2; $P < .05$)[5] had at least a 2 times greater chance of returning to full activity after isolated superior labral repair. Yung et al[13] noted return-to-participation rates of 92% for 12 of 13 overhead athletes and 100% for 3 of 3 patients classified as nonoverhead athletes (n = 2) or nonathletes (n = 1). We could not calculate the odds because the denominator was zero, nullifying the calculation and limiting the comparison between overhead and nonoverhead athletes.

Concurrent Shoulder Procedures. Researchers[16–21] examining various types of overhead athletes after superior labral repair with concurrent procedures reported

Table 5. Return-to-Participation Odds and Interpretations for Athletes With Isolated Superior Labral Repair

Study (Year)	Comparison	Full Return	Limited or No Return	Total	Odds[a]	Odds Ratio[b]	95% Confidence Interval	Greater Chance of Full Return?
Kim et al[5] (2002)	Overhead	4	14 Limited return	18	0.3			
	Nonoverhead	10	6 Limited return	16	1.7	5.8[c]	1.3, 26.2	Yes
Cohen et al[12] (2006)	Thrower	3	5 Limited return	8	0.6			
	Nonthrower	11	8 Limited return	19	1.4	2.3	0.4, 12.5	Yes
Maier et al[14] (2013)	Overhead (suture anchor)	5	4 No return	9	1.3			
	Overhead (transglenoid suture)	6	3 No return	9	2.0	1.6	0.2, 10.8	Yes
Park et al[15] (2013)	Baseball	6	10 No return	16	0.2			
	Other overhead	6	2 No return	8	3.0	5.0	0.8, 33.2	Yes

[a] Calculation of odds = full return divided by limited or no return.
[b] Calculation of odds ratio = group with greater chance of success for full return divided by group with lesser chance for full return.
[c] Indicates difference ($P < .05$).

Table 6. Return-to-Participation Odds and Interpretations for Athletes With Concurrent Superior Labral Repair and Soft Tissue Debridement

Study (Year)	Comparison	Full Return	Limited or No Return	Total	Odds[a]	Odds Ratio[b]	95% Confidence Interval	Greater Chance of Full Return?
Ide et al[17] (2005)	Baseball	12	7 Limited return	19	1.7			
	Other	18	3 Limited return	21	6.0	3.5	0.8, 16.3	Yes
Brockmeier et al[18] (2009)	Overhead	20	8 No return	28	2.5			
	Other	5	1 No return	6	5.0	2.0	0.2, 19.9	Yes
Friel et al[19] (2010)	Overhead	13	10 No return	23	1.3			
	Nonoverhead	10	5 No return	15	2.0	1.5	0.4, 6.0	Yes
Neri et al[21] (2011)[c]	Superior labral repair	12	3 No return	15	4.0			
	Superior labral repair with concurrent rotator cuff debridement	1	7 No return	8	0.1	28.0[d]	2.4, 323.7	Yes

[a] Calculation of odds = full return divided by limited or no return.
[b] Calculation of odds ratio = group with greater chance of success for full return divided by group with lesser chance for full return.
[c] Indicates that all patients in this case series were classified as overhead athletes (baseball, tennis, volleyball, water polo).
[d] Indicates difference ($P < .05$).

return to preinjury levels of participation ranging from 41% to 86%. Concurrent procedures consisted of debridement of partial-thickness rotator cuff tear or the labrum, subacromial decompression, bursectomy, or distal clavicle excision. Follow-up time ranged from 12 to 120 months, with the populations from all articles including baseball players. Researchers who categorized return to participation with limitation reported that 14% to 37% of athletes returned with limitation,[16,17,21] whereas those who focused on no return reported that 17% to 100% of athletes did not return to sport after surgery.[18–21]

Using the originally reported return-to-participation rates, we generated ORs for 4 of the 6 studies that focused on labral repair with concurrent soft tissue debridement (Table 6).[17–19,21] The subgroupings for each study varied: authors comparing baseball and "other" sports,[17] overhead and nonoverhead athletes,[18,19] and only overhead athletes who underwent surgery for superior labral tears and superior labral tears with concomitant rotator cuff injury.[21] Ide et al[17] reported that both baseball and "other" athletes had positive chances of returning to full participation (all odds > 1.0); however, the other group had a greater chance of successful return to full activity (OR = 3.5; 95% CI = 0.8, 16.3) than did baseball athletes. The 2 investigations also showed that overhead athletes (odds = 1.3–2.5) and nonoverhead/other athletes (odds = 2.0–5.0) both had positive odds for returning to full activity after superior labral repair with soft tissue debridement, but again the ORs favored the nonoverhead (OR = 1.5; 95% CI = 0.4, 6.0)[19] and other (OR = 2.0; 95% CI = 0.2, 19.9) groups.[18] These observations were not different, as each 95% CI contained the value 1.0. When comparing surgical procedures among only overhead athletes, most of whom were baseball players (20 of 23 patients), Neri et al[21] observed an association for athletes who underwent isolated superior labral repair. The patients with isolated repairs had a much greater chance of returning to full participation (OR = 28; 95% CI = 2.4, 323.7; $P < .05$) than those who underwent concurrent labral repair and soft tissue debridement.[21]

Critical Appraisal Results

The results of the critical appraisal outcomes are presented in Table 7. Of 24 possible points available as part of the binary assessment, the scores of the 5 studies specific to isolated superior labral repair ranged from 10 to 15 total points (42% to 63% of available points). The 6 articles that described superior labral repair with concurrent soft tissue debridement scored from 11 to 17 points (42% to 70%) of the 24 possible points. The wide variation of return-to-participation findings among the 11 studies suggests that the Strength of Recommendation Taxonomy recommendation would be C due to the quality of the studies with level 3 (case series) evidence.[8]

Risk of Bias Results

The risk-of-bias assessment revealed that recall bias was the most prevalent across all studies (100%) because return to participation was assessed 1 to 2 years after patients were discharged from formal care. Both detection bias and selection bias were evident in 73% of the studies reviewed (Table 8).

DISCUSSION

Injuries to the glenoid labrum or rotator cuff are common in overhead athletes. When nonoperative management of these injuries is unsuccessful, surgical interventions are used. In this systematic review, we identified that return to preinjury levels of participation is variable, and full return is not always attainable after isolated superior labral repair or superior labral repair combined with debridement of other soft tissue. The use of ORs helped to reduce the "noise" within the literature, showing that nonoverhead and nonbaseball athletes had greater chances of returning to full activity after superior labral repair. The authors of the reviewed articles reported return to participation as percentages, which showed inconsistent rates of return (ie, more noise), possibly due to inconsistencies in methods among studies. The defined variables that differed among studies included population demographics (age, sport, years of experience, and level of participation [ie, recreational versus elite athletes]), details related to surgical technique, and postoperative rehabilitation guidelines.

Population Demographics

The mean age of the participants across all studies ranged from 24 to 36 years. This range of ages indicated that the reported return-to-participation rates cannot be extrapolated

Table 7. Critical Appraisal Results for Studies Retained for Systematic Review

	Isolated Superior Labral Repair					Superior Labral Repair With Soft Tissue Debridement						
Criteria	Kim et al[5] (2002)	Cohen et al[12] (2006)	Yung et al[13] (2008)	Maier et al[14] (2013)	Park et al[15] (2013)	Morgan et al[16] (1998)[a]	Ide et al[17] (2005)[a]	Brockmeier et al[18] (2009)[a]	Friel et al[19] (2010)[a]	Park and Glousman[20] (2011)[b]	Neri et al[21] (2011)[a]	Total of All Articles, %
Study question												
Relevant background for research question?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100
Study design												
Comparison group?	Yes	No	No	Yes	No	No	Yes	No	No	No	Yes	36
Patient status at >1 time point?	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	64
Prospective collection?	No	No	Yes	No	No	Yes	Yes	Yes	Yes	No	No	45
Randomized groups?	No	No	No	No	No	No	No	No	No	No	No	0
Patients blinded?	No	No	No	No	No	No	No	No	No	No	No	0
Providers blinded?	No	No	No	No	No	No	No	No	No	No	No	0
Independent evaluator?	No	No	No	Yes	No	No	Yes	No	No	No	No	18
Participants												
Sample and selection bias minimized?	No	Yes	No	No	No	No	Yes	Yes	Yes	No	No	36
Inclusion and exclusion criteria defined?	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	82
Appropriate enrollment obtained?	Yes	No	No	No	No	No	No	Yes	No	No	Yes	27
Appropriate retention and follow up obtained?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	82
Intervention												
Intervention applied via established principles?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100
Provider biases minimized?	No	No	No	Yes	No	Yes	No	Yes	Yes	No	Yes	45
Intervention compared with appropriate comparator?	No	No	No	Yes	No	No	No	No	No	No	No	9
Outcomes												
Primary outcome defined?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100
Secondary outcomes considered?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100
Appropriate follow-up period?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100
Analysis												
Appropriate statistical test or tests performed?	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	73
Power to identify treatment effects?	No	No	No	Yes	No	No	No	No	No	No	No	9
Size of effects and differences reported?	No	No	No	No	No	No	No	No	No	No	No	0
Missing data accounted for and considered?	No	No	No	No	No	No	No	No	No	Yes	No	9
Clinical and practical importance considered in interpreting results?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100
Recommendations												
Conclusion and clinical recommendations supported by the study objectives, analysis, and results?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100
Total per each article, No. (%)	12 (50)	10 (42)	12 (50)	15 (62)	10 (42)	11 (46)	17 (70)	15 (62)	14 (58)	10 (42)	12 (50)	

[a] Includes superior labral repair with debridement of rotator cuff, repair of rotator cuff, subacromial decompression, bursectomy, capsular release, distal clavicle excision, or acromioplasty.
[b] Revision superior labral repair with labral debridement or subacromial decompression.

Table 8. Possible Risk of Bias Results

Study (Year)	Attrition Bias	Detection Bias	Performance Bias	Recall Bias	Reporting Bias	Selection Bias
Isolated superior labral repair						
Kim et al[5] (2002)	No	Yes	No	Yes	No	Yes
Cohen et al[12] (2006)	No	Yes	No	Yes	No	Yes
Yung et al[13] (2008)	No	Yes	Yes	Yes	No	Yes
Maier et al[14] (2013)	No	Yes	No	Yes	No	No
Park et al[15] (2013)	No	Yes	No	Yes	No	Yes
Superior labral repair with soft tissue debridement						
Morgan et al[16] (1998)	No	Yes	Yes	Yes	No	No
Ide et al[17] (2005)	No	No	No	Yes	No	Yes
Brockmeier et al[18] (2009)	No	No	No	Yes	No	Yes
Friel et al[19] (2010)	No	No	No	Yes	No	Yes
Park and Glousman[20] (2011)	Yes	Yes	No	Yes	No	No
Neri et al[21] (2011)	Yes	Yes	No	Yes	No	Yes

to younger age groups, which is a concern because younger athletes (age $<$ 18 years) have a greater chance of advancing to additional stages of participation (collegiate or professional levels) than athletes already performing at those upper levels of competition. If operative intervention is recommended for a younger athlete, supplying preoperative return-to-participation prognoses may be helpful in determining if undergoing the corrective procedure will allow return to the current level of activity and advancement to higher stages of participation. However, it is possible that factors beyond patient age, such as variations in healing rates, skill levels, financial considerations, and internal or external motivators, can influence the decision to have surgery.[22–24] Eisner et al[25] reported a return-to-participation rate of 70% after partial-thickness rotator cuff repair in patients less than age 19 years; however, the article could not be included in this review because it did not meet all inclusion criteria.

The populations across all studies reviewed were heterogeneous, as they comprised multiple types of athletes from various sports with subgroups defined as *overhead/nonoverhead*, *overhead/other*, or *throwing/nonthrowing athletes*. Grouping throwing/overhead sports, such as baseball, softball, swimming, tennis, and volleyball, and nonthrowing/nonoverhead sports, such as football, karate, and weightlifting did not provide a clear estimate of return to participation because individual sports have different biomechanical requirements and demands. Combining athletes from multiple sports into 1 distinct group limits a clinician's ability to delineate return-to-participation prognoses for individual athletes, creating a gap in the knowledge. As such, the calculated ORs need to be interpreted in context for each study.

Another concern that we identified was an overwhelming lack of prospective data collection related to athletic performance and playing status and a lack of reporting of these same factors in the postoperative data. Detection, recall, and selection bias were the most common types of bias present within the studies, likely due to the retrospective case series design. Outcome measures were rarely selected prospectively, and the assessors who performed follow-up examinations were not blinded to the intervention, creating the possibility of detection bias. All individuals were asked orally at postoperative follow-up if they had returned to their preinjury levels of participation, which subjected the responses to recall bias and individual patient perception given that postoperative follow-up occurred between 1 and 10 years. Selection bias was also evident due to a lack of matching or stratification. The identified biases weaken the strength of the information derived from each article because the level of return to participation was not consistently known (full return, limited return, no return, or return with or without pain), thus lessen the usefulness of the reported return-to-participation rates.

Surgical Considerations

Orthopaedic surgeons are charged with determining if apparent shoulder pathologic conditions are clinically important. The decision to recommend or not recommend surgical intervention depends on the information derived from subjective history and objective testing, as well as patient goals and expectations. However, we observed that the likelihood of returning to preinjured levels of participation was inconsistent across studies, indicating that preoperative discussions focused on the rate of return to activity would be difficult for clinicians to have with their patients.

The ORs for returning to full, preinjured levels of participation after isolated superior labral repair favored nonoverhead athletes; however, some overhead athletes did return to full preinjured levels. This observation suggested that some type of return is possible, either in a full or limited capacity, for some overhead athletes after repair, although the exact technique of repair was not standardized. However, only 1 study[5] demonstrated an association, with researchers finding that nonoverhead athletes were 5.8 times more likely to return to full activity after superior labral repair. However, clinicians should interpret this result with caution, as the 95% CI was rather wide (1.3, 26.2). Furthermore, surgically debriding the surrounding soft tissue appeared to confound the return-to-participation rates for overhead athletes, as the odds for returning to full participation after these procedures were all greater than 1, meaning more likely to return to full participation. This observation is in contrast to the isolated repair studies, for which all odds were less than 1 for the overhead-athlete groups. To further examine why greater odds of return to participation occurred with more surgery, 3 possible explanations were identified: unequal group sizes, surgical details, and clinical experience. First, unequal group sizes were identified within and between the studies of isolated

repair and the studies that included concurrent debridement (from which odds could be calculated). The concurrent-debridement studies had an average of 8.5 more patients in the overhead-athlete groups than the same patient groups in the isolated-repair studies.[16–21] The increased number of patients undergoing labral repair with concurrent debridement inflated the odds of successful return, which could explain why the chance of full return was greater after a procedure that involved treatment to more tissue. Conversely, the data from Neri et al[21] suggested a 28 times greater chance of returning to full activity after isolated superior labral repair than after concurrent procedures. However, in that study, twice as many patients were in the isolated superior labral repair group and relatively few patients did not return to full activity, which could account for the difference in observations between the procedures. Second, clinical details, including anatomical considerations (eg, severity of injury, tissue integrity), surgical considerations (placement and amount of hardware, amount of tissue debrided), individual patient differences, and postoperative rehabilitation details, were either not reported or were limited in description. The lack of consistent details among studies possibly limited the ability to draw accurate conclusions regarding return to activity after superior labral repair. Third, differences in clinician experiences and skills are neither standardized nor measurable. Clinicians do not universally agree about how to optimally repair superior labral injuries, suggesting that the optimum method for treating labral pathologic conditions in the symptomatic overhead athlete is not fully understood.[26]

To properly compare results across various studies, we must know the surgical details that were employed to address the superior labral lesions in each cohort of patients. In this review, all researchers reported the techniques used in the surgical procedures; however, gaps among the studies included failure to report the number of anchors used and their placement on the glenoid.[12,14,16,20]

Anchor quantity typically is determined during surgery based on the size of the lesion. Of the 9 studies in which authors reported anchor quantity, the total number of anchors used per patient ranged from 1[5,15,17–19] to 4,[12–14] with a mean of 2.3.[21] The variation in the number of anchors used within and between studies confounded the return-to-participation rates because not all superior labral lesions were the same size and, therefore, were not fixated similarly.

Of similar importance is anchor placement as it relates to both anatomical fixation and restoration of biomechanical capabilities.[27] Inappropriately placed anchors can potentially "strangle the biceps tendon"[19] and not eliminate the dysfunction caused by the lesion.[27] Similar to the discrepancy noted about the quantity of anchors used, variations were present among the 8 studies[5,12,13,16–19,21] in which researchers reported the location of anchor placement. With return-to-participation rates ranging from 22% to 92%, functional restoration for overhead athletes was possibly affected by the location of anchor placement.

Additionally, surgical portal placement has been shown to affect the outcomes for superior labral repairs. Researchers[28] recently reported that poor portal placement during primary superior labral repair can result in full-thickness rotator cuff tears of the supraspinatus. Anchor quantity and placement and portal placement are thought to contribute to restoration of labral function[29] and are necessary information for critically analyzing outcomes, such as patient satisfaction and return to participation.

Rehabilitation

When exploring the reasons why return-to-participation rates for overhead athletes were not more consistent or successful, we should also examine the rehabilitation components. The postoperative rehabilitation guidelines used for each case series were consistent in design, with progressive strengthening and range-of-motion exercises used throughout the rehabilitation process. However, no researchers reported the critical details of the rehabilitation program, including the specific exercises used, patient compliance with the protocol, the duration (total number of visits) or frequency of rehabilitation, exercise dosage, or use of a home program. A detailed outline describing each of these rehabilitation components would allow for better dissemination of these confounding factors, as 1 or more of the components could potentially have affected the postoperative outcome.

Limitations

Our study had limitations, so clinicians need to exercise caution in interpreting these results. The data were derived from retrospective studies with only moderate quality and evident biases. Whereas retrospective studies permit reviewers to establish relatively clear inclusion and exclusion criteria, adequate follow-up time, and definitions of primary and secondary outcomes, each case series was limited by (1) not having a prospective assessment of playing status or functional performance before or immediately after injury diagnosis, (2) no determination of adequate sample size, (3) lack of a thorough statistical analysis, and (4) merging groups of athletes from a variety of sports with a large range of ages. Researchers reported the postoperative rehabilitation as general guidelines and did not provide the specific exercises that were implemented, duration and intensity of the exercises, or number of treatment visits. Given these shortcomings, the best available evidence is not strong enough to concretely supply clinicians with global ORs for return to participation at preinjured levels for either overhead or nonoverhead athletes after operative repair of the superior labrum with or without concurrent soft tissue debridement. Instead, we calculated a range of approximate ORs, showing an apparent trend for nonoverhead athletes to have more success returning to full competition after arthroscopic labral repair. Despite the results favoring nonoverhead athletes, operative treatment for labral pathologic conditions should not be abandoned as a viable option for overhead athletes because operative restoration of the disrupted anatomy may be appropriate based on the functional deficits and demands of each patient. The identified gaps in reporting methods suggested that in future clinical outcomes reports, researchers should control particular areas, such as specific activity, age, surgical details and technique, and rehabilitation. Additionally, future researchers should use prospective data-collection methods related to preoperative and postoperative subjective and objective clinical measures in addition to a preinjury assessment of sport-specific performance. Using these measures would help control for potential biases and

add an integrated, measurable component of function, merging the patient-specific subjective considerations with the objective performance of each athlete.

CONCLUSIONS

Health care providers need to communicate all practical treatment options to patients who have sustained shoulder injuries. We purposely limited the odds of return to participation to overhead athletes, excluding reports in which overhead athletes were not comparatively examined and, thus, were able to generate odds for return to participation after shoulder surgery, which have not been previously reported. Whereas success can be achieved for both overhead and nonoverhead athletes, the odds for full return to activity appear to favor nonoverhead athlete groups. The ORs should allow clinicians to discuss more directly with their patients the likelihood of return to participation after arthroscopic superior labral repair for overhead and nonoverhead athletes.

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