

# Outcome of Type II Superior Labral Anterior Posterior Repairs in Elite Overhead Athletes

## Effect of Concomitant Partial-Thickness Rotator Cuff Tears

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**Background:** There are conflicting reports in the literature regarding the outcome of superior labral anterior posterior (SLAP) repairs in overhead athletes and a paucity of data demonstrating ability to return to prior level of competition.

**Hypothesis:** Kerlan-Jobe Orthopaedic Clinic shoulder and elbow score provides more accurate assessment of shoulder function and ability to return to previous level of athletic competition after SLAP lesion repair than does the conventional American Shoulder and Elbow Surgeons scoring system.

**Study Design:** Cohort study; Level of evidence, 3.

**Methods:** Twenty-three elite (collegiate or professional) overhead athletes who were more than 1-year status postarthroscopic repair of type II SLAP lesions were evaluated using both the Kerlan-Jobe Orthopaedic Clinic shoulder and elbow score and American Shoulder and Elbow Surgeons score. *P* values were computed using the analysis of variance model. Postoperative American Shoulder and Elbow Surgeons and Kerlan-Jobe Orthopaedic Clinic scores from subjects were compared with control values obtained from a healthy athletic cohort; the relationship between the scores was investigated using the linear regression model and assessed using Pearson correlations.

**Results:** At a mean 38-month follow-up, 13 athletes were playing pain free at the time of the questionnaire administration, 6 were playing with pain, and 4 were not playing because of pain. Regarding American Shoulder and Elbow Surgeons scores, 22 athletes (96%) had good-excellent scores, whereas 1 (4%) had a fair score. The Kerlan-Jobe Orthopaedic Clinic scores revealed 9 excellent (39%), 3 good (13%), 4 fair (17%), and 7 poor (30%) results for the same study group. Of the 23 patients, 13 (57%) had returned to their pain-free preinjury levels of competition at final follow-up. The inability to return to this level of competition correlated with the presence of a partial-thickness rotator cuff tear (*P* = .0059). The Kerlan-Jobe Orthopaedic Clinic demonstrated better overall accuracy (85%) than did the American Shoulder and Elbow Surgeons (70%) in evaluating return to pain-free preinjury levels.

**Conclusion:** Return to preinjury level of competition for elite overhead athletes after type II SLAP lesion repairs was 57%, despite high American Shoulder and Elbow Surgeons scores. Return to play status correlated with the presence of a partial-thickness rotator cuff tear. The Kerlan-Jobe Orthopaedic Clinic score, designed specifically for the evaluation of the overhead athlete, was a more accurate assessment tool than was the American Shoulder and Elbow Surgeons in this population of elite overhead athletes with SLAP tears.

**Keywords:** superior labral anterior posterior (SLAP); rotator cuff tear; return to play; overhead athletes

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The diagnosis and treatment of superior labral anterior posterior (SLAP) tears have improved considerably since the original observation by Andrews et al<sup>3</sup> and subsequent description and classification by Snyder et al.<sup>19</sup> The lesion is a well-recognized source of pain and instability, particularly in the shoulders of overhead athletes.<sup>3</sup> Although the mechanism is debated, type II lesions in the overhead athlete are believed to be caused by a peel-back of the superior labrum due to the twisting of the biceps insertion when the arm is brought into abduction and external rotation.<sup>5,14</sup> Unstable type II lesions that fail nonoperative management, particularly in the

forementioned population, typically require surgical stabilization.<sup>2</sup>

There are conflicting reports in the literature regarding the outcome of isolated SLAP repairs in overhead athletes.<sup>6,9,11,15,21</sup> Some authors report worse outcomes for the elite overhead thrower than are reported for the general population or nonthrowing athlete.<sup>10,11</sup> In addition, there is a paucity of data regarding the time to return to sport and level of return after SLAP repairs in overhead athletes.<sup>14,16</sup> Most studies include a mixed patient population (athletes/nonathletes) and/or report "return to sport" as initial return rather than full return to prior level.

Self-reported health surveys are playing an increasingly important role in evaluating and scoring athletes' function and overall health, particularly as a measure of the efficacy of a given treatment. Although several scores have been developed to assess postoperative shoulder function, these are generally targeted for activities of daily living and may not detect subtle changes in the performance of high-level overhead athletes, such as loss of endurance, velocity, power, or control. With the aim to address these issues and provide a better assessment of level of return, the Kerlan-Jobe Orthopaedic Clinic (KJOC) shoulder and elbow score was developed and validated as a functional assessment tool specifically designed for performance assessment of the overhead athlete.

Therefore, the purpose of this study is 3-fold: first, to report the outcome and return to prior level of play after isolated type II SLAP repairs in an elite overhead patient population at a minimum 1-year follow-up; second, to evaluate for any factors that affect outcome and/or ability to return to prior level of play after isolated type II SLAP repairs; third, to evaluate the KJOC score as an outcomes assessment tool in comparison with the conventional scoring system, the American Shoulder and Elbow Surgeons (ASES) score, in discriminating between athletes with varying levels of success in returning to play.

## MATERIALS AND METHODS

### Patient Selection

After obtaining approval from our institutional review board, a study population was recruited through a retrospective review of our clinic's operative database. Subjects were included in the study if they were elite (collegiate or professional) overhead athletes and had a minimum of 1-year clinical follow-up after an arthroscopic suture anchor repair of a type II SLAP lesion. Patients were excluded from the study if they were less than 12 months postsurgery and had a concomitant capsulorrhaphy for instability, rotator cuff repair, subacromial decompression, distal clavicle resection, or subsequent surgical procedure in the affected extremity. Between June 2003 and April 2007, 39 patients were identified matching the aforementioned criteria, and 23 were able to be contacted and available for follow-up. Patient records were reviewed for pertinent operative data (procedure, number of anchors, complications, etc) and

study data (duration of follow-up, range of motion, and pertinent physical examination findings).

### Diagnosis

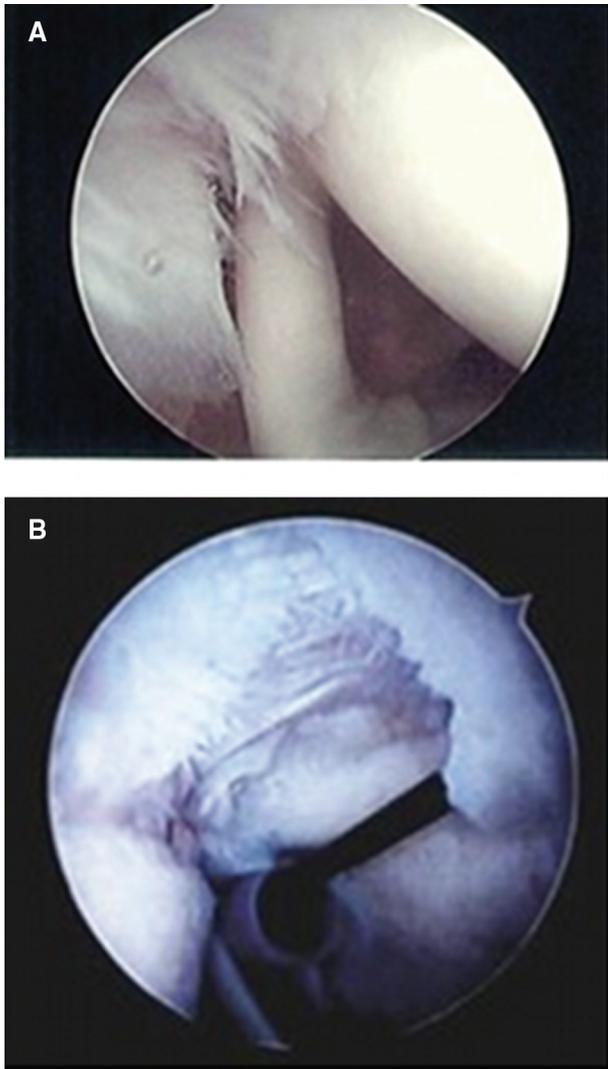
A diagnosis was made based on clinical presentation, symptoms, physical examination, and radiologic findings. Patients were evaluated for SLAP lesions using the active compression test and anterior apprehension/relocation tests. All subjects underwent preoperative plain radiographs (anteroposterior, scapular-Y, and axillary views) as well as MRI with gadolinium contrast medium. A radiologic diagnosis confirmed clinical suspicion by the presence of contrast between the undersurface of the superior labrum and superior glenoid rim. Final confirmation was made at the time of arthroscopic surgery by findings of superior labral detachment >5 mm from the glenoid rim with biceps traction accompanied by superior glenoid wear.

### Examination Under Anesthesia

All patients underwent presurgical examination while under anesthesia in the supine position. Shoulders were placed through a full range of motion, with particular focus on internal and external rotation in 90° of abduction. Anteroposterior laxity was assessed with the arm in varying degrees of rotation while in the abducted position. Laxity was assessed by amount of translation of the humeral head in relation to the glenoid rim. Finally, evidence of inferior translation was assessed by the presence or absence of a sulcus sign. No patient included in this study demonstrated pathologic laxity on the preoperative office examination or examination under anesthesia.

### Surgical Technique

All patients were placed in the lateral decubitus position using a beanbag. The arm was placed in a shoulder traction device (Acufex, Norwood, Massachusetts) with 10 lb of traction. A standard posterior viewing portal was established 2 cm inferior and 1 cm medial to the posterolateral edge of the acromion. A diagnostic arthroscopy was performed noting any glenohumeral changes, concomitant labral lesions, and/or rotator cuff pathologic abnormalities. The depth of articular-sided partial-thickness rotator cuff tears was calculated by measuring the exposed footprint lateral to the humeral articular margin, yielding a percentage of medial-lateral involvement. Debridement was performed for tears ranging from 10% to 40%. High-grade (≥50%) partial tears were repaired, and therefore these patients were not included in the study. For labral lesions detached anterior to the biceps anchor, anterosuperior and anteroinferior portals were established through the interval tissue using an outside-to-inside technique. For posteriorly extending lesions, a trans-rotator cuff portal was established medial to the cable at the junction of the supraspinatus and infraspinatus. The superior glenoid was debrided to bleeding bone using a shaver or bur (Arthrex, Naples, Florida) and

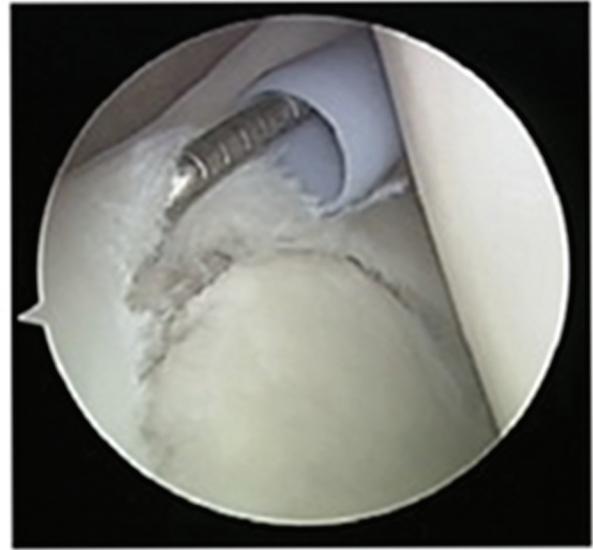


**Figure 1.** Partial-thickness rotator cuff tear ranging from 10% (A) to 40% (B).

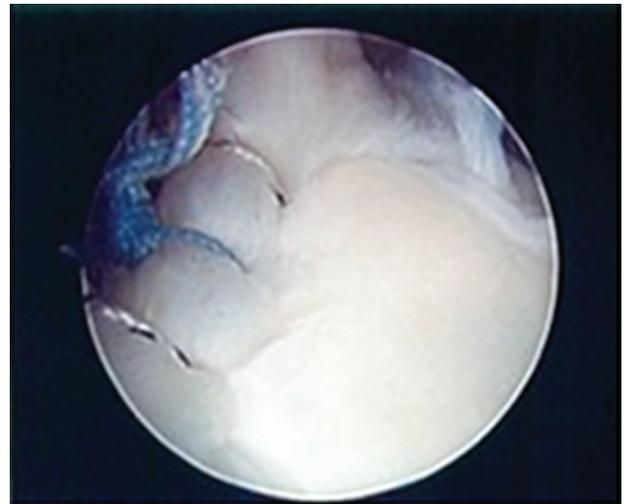
rasp. Next, suture anchors loaded with No. 2 nonabsorbable sutures were placed on either side of the biceps anchor depending on the tear configuration. A suture-passing device (suture lasso) was sent through the anterosuperior cannula and passed through the labral tissue, while the anteroinferior portal was used for suture shuttling. A sliding self-locking knot backed by alternating half-hitches was used for arthroscopic knot tying. Additional suture anchors were placed as needed (Figures 1-3) with a mean of 2.3 anchors used.

#### Postoperative Protocol

Patients were required to use a shoulder immobilizer for 7 to 10 days. Elbow and wrist exercises were allowed during this period. A formal therapy program was initiated at 2 weeks, with gentle pendulum exercises, isometrics, and passive range of motion as tolerated. Active-assisted



**Figure 2.** Type II superior labral anterior posterior (SLAP) tear with glenoid chondral wear.



**Figure 3.** Arthroscopic superior labral anterior posterior (SLAP) repair with suture anchors.

exercises were added at 4 weeks with the goal of full range of motion before initiating rotator cuff and periscapular strengthening program at 6 weeks. Throwing programs were typically initiated at 12 to 16 weeks; however, the program was individualized depending on presence or absence of concomitant rotator cuff injury and how the athlete progressed with range of motion and strengthening. The goal was for full return at 6 months.

#### Subject Demographics and Preoperative Data

The demographics are summarized in Table 1. The mean age of patients was 25 years (range, 18-45 years), all men

TABLE 1  
Preoperative Data

Characteristic	No.
No. of patients	23
Age, y (range)	25 (18-45)
Gender, male/female	23/0
Overhead sport (%)	
Baseball	20 (87)
Volleyball	1 (4)
Tennis	1 (4)
Water polo	1 (4)
Level of sport (%)	
Professional	17 (74)
Collegiate	6 (26)
Mechanism (%)	
Traumatic	5 (22)
Atraumatic	18 (78)
Symptoms (%)	
Pain	22 (96)
Weakness	12 (52)
Clicking	2 (9)

with the dominant extremity affected in all cases. All patients were elite overhead athletes, with the majority being professional baseball players. The remainder included either collegiate or professional athletes from other overhead sports. The majority of patients had an atraumatic history and pain as their chief symptom, whereas weakness or "dead arm" and painful clicking were reported as well. Plain radiographs were unremarkable for all patients, demonstrating no evidence of degenerative changes or bony lesions. Contrast-enhanced MRI revealed SLAP tears in all subjects.

## Evaluation

A study population of 23 elite overhead athletes was evaluated at a mean follow-up of 38 months (range, 12-70 months). Twenty of the 23 were available for detailed clinical assessment and physical examination; 3 patients were unavailable for the clinical examination and completed questionnaires via mail. The remainder of the patients identified through retrospective review as meeting the inclusion criteria were unable to be contacted despite multiple phone attempts/mailings and Internet searches. Range of motion was assessed using handheld goniometers, measuring forward elevation in the scapular plane and internal and external rotation at 90° of abduction.

Each athlete was asked to fill out 2 questionnaires: the ASES score and KJOC shoulder and elbow score. The ASES score was selected because it is an easily validated outcome measure that has been previously used to report surgical outcomes in the upper extremity.<sup>12</sup> The ASES was designed to provide a standard method for evaluation of the shoulder through assessment of pain and activities of daily living and is derived from an equation that incorporates a visual analog pain scale and functional ability questions. Prior reported data from healthy athletic subjects were used as the normative ASES values for

comparison.<sup>18</sup> The ASES healthy cohort consisted of 87% athletes of various sport participation and level, with a mean age of 43 years. The KJOC shoulder and elbow score is a 2-section self-reported subjective questionnaire filled out by the player that has been validated by Alberta et al<sup>1</sup> (see the online Appendix for this article, available at <http://ajs.sagepub.com/supplemental/>). In the first section, the player provides background information and assigns his or her current level of play into 1 of 3 categories: (1) playing pain free, (2) playing with pain, (3) not playing because of pain. The second section consists of 10 questions, each geared toward functional performance of the upper extremity in the overhead athlete. All questions use a visual analog scale. The 10 questions give a total possible score of 100, with higher scores indicating higher function. The KJOC questionnaire was administered to a cohort of 123 uninjured high school and collegiate-level throwing athletes to obtain "normal" values. These data were obtained through preparticipation physicals on our local high school/collegiate athletes. Categorization of scoring was identical for each scoring system, whereby an "excellent" was a score of 90 or greater, "good" 80 to 89, "fair" 70 to 79, and "poor" less than 70.

## Statistical Methods

*P* values were computed using the analysis of variance model. Postoperative ASES scores from subjects were compared with control values obtained from a healthy athletic cohort, as provided by Sallay and Reed.<sup>18</sup> Postoperative KJOC scores were compared with scores obtained from our uninjured cohort population. The relationship between ASES and KJOC was investigated using the linear regression model and was assessed using Pearson correlations. To evaluate the accuracy of the KJOC and the ASES diagnostic scores in separating the category 1 (no pain) and the category 2/3 (pain) outcomes, we used the receiver operating characteristic curve analysis. The Fisher exact test and Wilcoxon rank sum test were used to evaluate the relationship between concomitant factors (eg, rotator cuff tears) and return to play/outcome. All analyses were performed by a trained statistician using JMP statistical software, version 7 (JMP, SAS Inc, Cary, North Carolina).

## RESULTS

The results are summarized in Table 2. Of the 23 athletes in the study, 13 were playing pain free at the time of the questionnaire administration (category 1), 6 were playing with pain (category 2), and 4 were not playing because of pain (category 3). Regarding ASES scores, 22 patients (96%) had good-excellent scores, whereas 1 patient (4%) had a fair score. The KJOC scores revealed 9 excellent (39%), 3 good (13%), 4 fair (17%), and 7 poor (30%) results for the same study group. The mean time to return to full sport was 8.8 months (range, 4-16 months). Of the 23 patients, 13 (57%) had returned to their preinjury levels of competition at final follow-up.

The correlation between the KJOC and ASES scores was statistically significant (correlation, 0.62, *P* = .0022),

TABLE 2  
American Shoulder and Elbow Surgeons (ASES) Score and Kerlan-Jobe Orthopaedic Clinic (KJOC) Results

	ASES	Control	KJOC	Cohort
Overall means <sup>a</sup>	93.7 (90-100); <i>P</i> = .0717	96.4 (SD, 8.3)	76.9 (63.5-92.5); <i>P</i> = .0001	95.5 (94.1-100)
Excellent (%)	18 (78)		9 (39)	
Good (%)	4 (18)		3 (13)	
Fair (%)	1 (4)		4 (17)	
Poor (%)	0		7 (30)	

<sup>a</sup>The parenthetical values represent interquartile (25%-75%) ranges.

and the relationship was intrinsically linear. Specifically, for a 1-unit decrease in KJOC score, the ASES score decreased on average by 0.21 units and was therefore less sensitive to changes in performance. Comparison of KJOC and uninjured cohort scores at final follow-up demonstrated a statistically significant difference (76.9 vs 95.5, *P* = .0001). Comparison of ASES and control scores did not reach statistical significance (93.7 vs 96.4, *P* = .0717). Category comparison between ASES and KJOC scores revealed similar scores for category 1 patients (96.3 vs 86.4); however, there was a large discrepancy for the category 2/3 patients (90 vs 64.8). Receiver operating characteristic curve analysis therefore demonstrated that KJOC has better overall accuracy (85%) than the ASES (70%) (Table 3). The ASES score, as opposed to the KJOC score, did not correlate with follow-up time (correlation, 0.05, *P* = .8404), implying that ASES was less sensitive to change over time.

Partial-thickness rotator cuff tears were identified as concomitant injury in 8 of 23 (35%) athletes. As measured with an arthroscopic calibrated probe, the tears ranged in depth from 10% to 40% and were treated with arthroscopic debridement in all cases. The inability to return to preinjury level of competition significantly correlated with the presence of a partial-thickness rotator cuff tear (*P* = .006). The group of patients with concomitant partial-thickness rotator cuff tear demonstrated a 12.5% return to prior level of play, compared with an 80% return in the group without tears. This discrepancy was supported by the statistically significant difference on KJOC scores between groups without and with tears (82.8 vs 66.0, *P* = .05). The ASES score did not demonstrate a significant difference between groups (95.5 vs 90.4, *P* = .21) (Table 4). No other variable investigated, including demographic data, level of sports participation, arm dominance, or injury pattern, was found to affect outcome.

## DISCUSSION

Despite the high incidence of SLAP lesions in the shoulders of overhead athletes, only a small percentage are symptomatic and require surgical stabilization.<sup>3</sup> Those who fail nonoperative treatment and require surgical stabilization have a goal of returning to their preinjury levels of competition. The return to prior level of sport after SLAP repairs in the overhead athlete has been infrequently investigated,

TABLE 3  
Category Comparison Between American Shoulder and Elbow Surgeons (ASES) Score and Kerlan-Jobe Orthopaedic Clinic (KJOC)<sup>a</sup>

	ASES	KJOC
Category 1 (range)	96.3 (93.3-100)	86.4 (78.5-95.3)
Category 2/3 (range)	90 (85-95)	64.8 (51-81)
Accuracy, %	70 (SE, 8.3)	85 (SE, 6.4)

<sup>a</sup>Comparison of ASES and KJOC scoring to category 1, playing without pain; category 2, playing with pain; and category 3, not playing because of pain.

TABLE 4  
Return to Play and Outcome Scores as Related to Presence/Absence of PTRCTs<sup>a</sup>

	KJOC	ASES	Return to Prior Level of Play, %
All patients	76.9	93.7	57
Without PTRCT	82.8 <sup>b</sup>	95.5 <sup>c</sup>	80
With PTRCT	66.0 <sup>b,d</sup>	90.4 <sup>c,d</sup>	12.5 <sup>d</sup>

<sup>a</sup>ASES, American Shoulder and Elbow Surgeons; KJOC, Kerlan-Jobe Orthopaedic Clinic; PTRCT, partial-thickness rotator cuff tear.

<sup>b</sup>*P* = .05.

<sup>c</sup>*P* = .021.

<sup>d</sup>*P* = .006.

with most studies reporting on mixed populations (athlete/nonathlete, overhead/nonoverhead).<sup>6,7,9,11,15,21</sup> Moreover, return to sport has been poorly defined and usually represents reports of time at initial return rather than percentage of players who return to preinjury levels.<sup>16</sup>

Kim et al<sup>11</sup> reported significantly less favorable results after isolated SLAP repairs in patients who participated in overhead sports than for those who did not. On the basis of a grading system to define level of return to activity, 78% of overhead throwers had limitations (mild-severe) in their sports at a mean follow-up of 33 months, despite 89% good-excellent results. A similar disparity between outcome scoring and return to sport was observed in a study by Cohen et al,<sup>7</sup> in which 60% of overhead athletes were unable to return to their preinjury levels of competition, while mean ASES and L'Insalata scores were 86. Brockmeier

et al<sup>4</sup> found 26% of athletes continued to experience limitations after SLAP repairs at a mean 2.7-year follow-up despite a mean ASES score of 92.6. The only study we are aware of that demonstrated better results for throwing athletes compared with nonthrowing athletes attributed the finding to the poor clinical results of gymnasts composing the majority of the nonthrowing group.<sup>17</sup>

Our results demonstrate that at a mean of 3 years after type II SLAP repairs, 57% of elite overhead athletes have returned to their preinjury levels of competition. An additional 26% of patients have returned to their sports; however, they are limited by pain. The remaining 17% still are unable to return to sport. This finding is consistent with the aforementioned studies and may in part be due to the higher demand elite overhead athletes place on their shoulders compared with the general population. There also exist higher expectations for elite baseball players, composing the majority (86%) of our study group, who do not tolerate subtle changes in velocity, endurance, and control.

Data analysis failed to correlate return-to-play status with any demographic data, level of sports participation, and arm dominance. However, we did find a statistically significant correlation between the presence of a partial-thickness rotator cuff tear and the inability to return to preinjury level of play ( $P = .006$ ). The rotator cuff is subjected to high tensile and compressive loads during the throwing motion and, in some cases, eventual failure leading to articular-sided partial-thickness tears.<sup>8</sup> There is a well-established relationship between superior labral lesions and articular-sided rotator cuff tears initiated, in part, by a shift in glenohumeral range of motion, capsular adaptations, and humeral translation that result in posterior superior glenoid rim-rotator cuff contact, or internal impingement.<sup>13,20</sup>

In our experience, these tears are significant generators of pain and disability in the overhead athlete and likely contributed to our suboptimal results. Studies reported on rotator cuff repairs in professional overhead athletes have demonstrated poor prognosis with significant difficulty in returning these athletes to sport, much less preinjury level of competition.<sup>13,20</sup> Although full-thickness tears are rare in this population, partial-thickness tears are quite common and present a treatment challenge when measuring less than 50% and in the presence of a concomitant SLAP lesion.<sup>8</sup> Morgan et al<sup>14</sup> reported rotator cuff tears in 31% of patients with SLAP lesions. Ide et al<sup>10</sup> found grade 1 partial-thickness tears in 75% of the patients being treated for SLAP lesions. These 8 partial-thickness tears recognized in our study group measured between 10% and 40% and were treated with debridement alone. Whether more aggressive treatment of these lesions would have resulted in a higher return to preinjury level is unknown.

We have recognized that traditional scoring systems developed to evaluate outcome after shoulder surgery are targeted at activities of daily living and therefore do not detect the subtle changes in the performance of the elite overhead athlete. Kim et al<sup>11</sup> report good-to-excellent results in 89% of overhead athletes using the University of California, Los Angeles scoring system; however, only 22%

of these patients returned to preinjury levels of sport. Cohen et al<sup>7</sup> also observed that despite high ASES scores, a normal physical examination, and minimal pain, only 40% returned to their preinjury levels of sport. Similarly, Brockmeier et al<sup>4</sup> reported a mean ASES score of 92.6 in an athletic population in which only 74% returned to preinjury level.

The discrepancy in the scoring systems used in our study is best exemplified by comparison of the category 2/3 scores for ASES and KJOC scores. One would expect category 2 and 3 players, those playing with pain or not playing because of pain, respectively, to score low on a self-administered questionnaire heavily weighted toward pain and function. In our study, the mean ASES score was 90, considered excellent; however, the mean KJOC score for this group was 64.7, which is considered a poor result. This difference is statistically translated into lower accuracy for the ASES score (70%) compared with the KJOC score (85%). Furthermore, the ASES score was not sensitive to the presence of associated partial-thickness rotator cuff tears and the negative correlation with return to play. The ASES score was also found to be less predictive, with more overlap between category groups, and found to be less sensitive to changes in performance than was the KJOC score. These findings confirm our observation that the traditional scoring system is less accurate in detecting subtle changes in the performance of high-level overhead athletes and predicting level of return to play.

The limitations of this study are significant and include the retrospective nature of data collection, small sample size, and suboptimal follow-up. We believe this was in large part due to the migratory tendencies of the study population, which was composed of mainly young (mean age, 25 years) professional athletes (74%) who tend to relocate frequently. Certainly, a prospective study with greater numbers of subjects would be helpful in addressing the questions arising from the results of this study.

Overall, we found that the return to preinjury level of competition for elite overhead athletes after type II SLAP repairs is 57% despite high ASES scores. The presence of a partial-thickness rotator cuff tear correlated with inability to return to preinjury level status (12.5% vs 80%) after SLAP repairs. Finally, the KJOC score is a more accurate assessment tool designed specifically for the evaluation of the overhead athlete.

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