Biceps instability and Slap type II tear in overhead athletes

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Summary

Type II lesions are common lesions encountered in overhead athletes with controversies arising in term of timing for treatment, surgical approach, rehabilitation and functional results. The aim of our study was to evaluate the outcomes of arthroscopic repair of type II SLAP tears in overhead athletes, focusing on the time elapsed from diagnosis and treatment, time needed to return to sport, rate of return to sport and to previous level of performance, providing an overview concerning evidence for the effectiveness of different surgical approaches to type II SLAP tears in overhead athletes.
A internet search on peer reviewed Journal from 1990, first descriprion of this pathology, to 2012, have been conducted evaluating the outcomes for both isolated Slap II tear overhead athletes and those who presented associated lesions treated. The results have been analyzed according to the scale reported focusing on return to sport and level of activity.
Apart from a single study, non prospective level I and II studies were detected.
Return to play at the same level ranged form 22% to 94% with different range of technique utilized with the majority of the authors recommending the fixation of these lesions but biceps tenodesis can lead to higher satisfaction racte when directly compated to the anchor fixation. Associated pathologies such as partial or full tickness rotator cuff tear did not clearly affect the outcomes and complications rate.
There is no consensus regarding timing and treatment for type II SLAP, especially in overhead athletes who need to regain a high level of performance.

Key words: overhead athletes, overhead sport, SLAP, superior labrum.

Introduction

Shoulder with persistent LHB tendon pain is a relatively common symptom in overhead athletes due to overstress of the joint related to repeated throwing motion.
Andrews[1] first detected the SLAP lesions as an injury of the anterior-superior labrum near the origin of the long biceps tendon, who found these lesions in overhead throwing athletes.
Snyder[2] labeled these pattern of injury as “SLAP lesion” (Superior Labrum Anterior to Posterior), describing a lesion of the superior labrum which begins posteriorly and extends, through the anchor, anteriorly ending before or at the mid-glenoid notch.
The cause of SLAP lesions has been well-documented and ranges from repetitive throwing activities to single traumatic event injuries such as falling on an out stretched arm.
The investigation of the pathogenesis of these lesions was started by Andrews[1] who first postulated this labral lesion caused by deceleration injury in the follow-through phase of throwing causing a traction injury to the anterosuperior labrum because of the biceps attachment on it[1].
Burkhart and Morgan[3] described the dynamic “peel-back sign” with the shoulder in abduction and external rotation; create a more vertical angle of the biceps with a twist at its base, which then transmits a torsional force to the posterior superior labrum with rotational forces over the surface of the posterior superior scapular neck. Huber and Putz[4] suggested that the “periarticular fiber system” consisting of the labrum, glenohumeral ligaments, and inserting tendons (biceps, triceps) acted as a “basket” or “tension-brace”, resisting dislocation or subluxation of the humeral head in all directions (“bumper effect”). In addition Lippitt and Matsen[5] showed that a circumferentially intact labrum creates a “suction-cup” effect to further enhance stability.

Materials and methods

We conducted a systematic Internet search of Pubmed and Cochrane database for type II SLAP arthroscopic repairs

in overhead athletes between January 1, 1950, and December 1, 2012. Database search terms included "SLAP athletes" or "SLAP overhead". The initial search generated a total of 27 studies but a larger number of studies have been evaluated retriving the cases of type II Slap tear treated among other type of Slap lesions treated described in the abstracts. All authors independently reviewed all abstracts. Inclusion criteria included: (1) minimum a-year follow-up, (2) report of patient outcome scores and/or return-to-play and/or return-previous-level-of-activity rates, (3) Level IV or higher level of evidence per Centre for Evidence-Based Medicine criteria (CEBM)[6], (5) English language, and (6) published in peer-reviewed journals.

Preoperative setting: clinical evaluation and instrumental exams

A careful history of the patient is mandatory investigation for possible previous trauma, level of activity and type of sport, site and painful arc of motion[7].
Examination should include to palpation of bicipital groove, rotator cuff testing, passive and active ROM (GIRD in throwers), glenohumeral stability, provocative tests for SLAP tear[6-8]. Several tests have been described to elicit pain reproducing overhead throwing position and stressing the biceps anchor, but independent examiners have not been able to prove their accuracy, concluding that clinical examination tests has a variabile lack of sensibility and specificity on detecting SLAP lesions [6,8-10].
Hegedus in a recent meta-analysis, evaluating the main clinical specific signs (O'Brien Active Compression, Speed's, Anterior Slide, Crank, Yergason's, Apprehension-Relocation, Biceps tenderness, Compression-Rotation) has showed that the test with the best sensitivity (52%) was the relocation test; the test with the best specificity (95%) was Yergason's test; and the test with the best positive likelihood ratio (2.81) was the compression-rotation test[11].
MRI represents the best radiographic study for diagnosing SLAP tears and associated lesions with higher sensibility and specificity achieved in coronal images and axial images. The lesion appears as a disruption of the normal broad-based boomerang shape of the biceps anchor. MR arthrography (MRA) can enhance sensibility of this technique and it can help in avoiding unnecessary diagnostic arthroscopy[12]. Jung et al.[13] demonstrated the usefulness of an additional abduction-external-rotation positioning in improving sensibility of the MRA (+ 16%) in the diagnosis of SLAP lesion and in providing information about the stability of the torn labrum.

Treatment and results

Type II lesions are arthroscopically identified or confirmed by the instability of biceps anchor on probing (>5 mm). If this lesion is symptomatic, it needs surgical refixation for most of the authors[2,4].
According to several authors[16,28,31], decision for surgery would mainly rely on failure of conservative treatment consisting in ROM exercises (3 to 6 months), rotator cuff strengthening and scapular stabilization exercises, intra-articular cortisone injection, leading to persistent pain and limitation in daily and sports activities. Other authors[14,18,20,21,23-25,27,29,30,33-35,36] rely surgical criteria are on more consistent findings such as positive trauma or overuse history, pain or click in superior area of the shoulder, subjective instability, mechanical catching interfering with performance of strenuous or sporting activity, positive specific tests for SLAP lesions and a positive MRI or arthro-MRI. Clinical examination and imaging findings must be confirmed by intraoperative arthroscopic assessment (Tab. 1).
Reinsertion of the detached superior labrum and anchor can involve the use of different devices (metal staples, bioadsorbable tacks, suture anchors).
Yoneda et al.[14] reviewed the outcomes of arthroscopic repair of type II SLAP lesions with metal staples in 10 overhead athletes with 7 male patients and a mean age of 17.8 years. Concomitant lesions were treated in 5 cases, including 3 partial rotator cuff tears and 2 subacromial impingement syndrome. After a mean 37.4-months follow-up, patients were evaluated according to Tibone Pain Scale[15], resulting in 5 excellent, 3 good and 1 poor outcomes. Throwing was permitted after 6 months, and 80% of the athletes returned to play, but only 5 patients (50%) regained the previous level of performance.
Pagnani et al.[16] showed improvements in pain, stability and function after arthroscopic SLAP repair with bioabsorbable tacks in 22 patients (13 overhead athletes) using American Shoulder and Elbow Surgeons (ASES)[17] score. All athletes returned to sport after a 6-months rehabilitation period and 92% of the patients returned to previous level of activity.
Morgan et al.[18] retrospectively evaluated suture anchor repair through the portal of Wilmington in 53 overhead athletes with a mean age 24 years. Ten partial-thickness and a full-thickness rotator cuff tears were treated during the same surgical procedure. After a 12-months follow-up there were 87% excellent and 13% good results according to University of California, Los Angeles (UCLA)[19] score. All the athletes returned to sport was allowed after a mean period of 7 months and 87% of them regained previous level of competition.
Samani et al.[20] performed a retrospective case series evaluating the outcomes of arthroscopic stabilization of type II SLAP tears using bioabsorbable tacks, 24 of whom were athletes. Twenty-five patients with a mean age of 36 years were included in the study. As far as concomitant procedures are concern, 13 patients underwent arthroscopic debridement of partial-thickness rotator cuff tears, 19 required subacromial decompression and one had a full-thickness cuff lesion fixed. After a mean 35-months follow-up, patients showed a significant increase in both ASES and UCLA scores; of the 24 athletes, 20 returned the previous level of activity, while two had a lower level of performance for unrelated problems and two for shoulder-related problems.
O'Brien et al.[21] evaluated the outcomes of repair through a trans-rotator cuff approach. Thirty-one patients with 28 males (18 athletes) with the use of an absorbable tack to fix the superior labrum back to the glenoid rim. According to ASES and L'Insalata Shoulder Rating Questionnaire[22]

Table 1. Analysis of preoperative data of the studies.

Authors	pre-op clinical evaluation	Imaging (specific tests)	Decision making criteria
Yoneda et al. 1991 [14]	clunk, sulcus, app.-rel.	arthro-CT	history, clin. ex., arth. find.
Pagnani et al. 1995 [16]	B.T., Sp., Ye., Imp., C-R, O'B.	MRI	failure of conservative treatment (3 mo)
Morgan et al. 1998 [18]	B.T., Sp., O'B., app.-rel.	N/A	history, clin. ex., arth. find.
Samani et al. 2001 [20]	B.T., app.-rel., C-R	MRI	history, clin. ex., imag., arth. find.
O'Brien et al. 2002 [21]	O'B.	MRI	history, clin. ex., imag., arth. find.
Kim et al. 2002 [23]	C-R, Imp., app.-rel., B.L. II	MRI, arthro-MRI	history, clin. ex., imag., arth. find.
Rhee et al. 2005 [24]	B.T., Sp., Ye., Imp., C-R, O'B.	MRI, arthro-MRI	history, clin. ex., imag., arth. find.
Ide et al. 2005 [25]	app.-rel.	MRI	history, clin. ex., imag., arth. find.
Cohen et al. 2006 [27]	O'B.	N/A	history, clin. ex., arth. find.
Coleman et al. 2007 [28]	O'B., Imp.	MRI	failure of conservative treatment (3 mo)
Yung et al. 2008 [29]	O'B., Sp., Ye.	arthro-MRI	history, clin. ex., imag., arth. find.
Park et al. 2008 [30]	O'B., C-R	MRI, arthro-MRI	history, clin. ex., imag., arth. find.
Boileau et al. 2009 [31]	N/A	arthro-CT, arthro-MRI	failure of conservative treatment (at least 6 mo)
Brockmeier et al. 2009 [33]	O'B.	N/A	history, clin. ex., arth. find.
Friel et al. 2010 [34]	O'B.	MRI, arthro-MRI	history, clin. ex., imag., arth. find.

Abbreviation: B.T.: bicipital tenderness, Sp.: Speed test, Ye.: Yergason test, Imp.: impingement test, C-R: compression rotation test, O'B.: O'Brien test, app.-rel-.: Jobe apprehension-relocation test, ant.slide: anterior slide (Kibler) test, Wh.: Whipple test, B.L. II: biceps load II test, arthro-CT: computed tomography arthrogram, MRI: magnetic resonance imaging, arthro-MRI: magnetic resonance arthrogram, clin.ex.: clinical examination, imag.: imaging, arth.find.: arthroscopic findings, mo: months, N/A: not available.

scores, treatment resulted in 74% good-to-excellent with 52% of return to previous level of activity.

Kim et al.[23], in a retrospective case series, examined the results of arthroscopic repair of isolated type II SLAP lesions using metal suture anchors. The study group consists of 34 patients with 18 of them overhead athletes. The time elapsed from the onset of symptoms to surgery was 9 months on average and patients' clinical status was reassessed after a mean follow-up of 33 months according to UCLA score. Patients' postoperative scores significantly increased to 33.4, but overhead athletes showed lower results (32.6 on average). Good-to-excellent results and return to sport were found in 89% of overhead sport athletes, and 76% of whom was able to perform their previous sport without limitations.

Rhee et al.[24] reported 86% good to excellent results in a study including types II, III, and IV SLAP lesions. Athletes (a group of 15) had higher outcomes UCLA scores than non athletes (32.7 vs 31.3) and throwing athletes did significantly better than non-throwing athletes (33.9 vs 31.7).

Ide et al.[25] evaluated the outcomes of suture anchor type II SLAP repair using suture anchor in a group of 40 overhead athletes. Concomitant partial rotator cuff tears were repaired simultaneously in this series. After a mean 41-month follow-up, 90% of the patients scored excellent-to-good according to Modified Rowe grading system[26], but only 75% of the athletes return to play at previous level of performance.

Cohen et al.[27] retrospectively examined the results of arthroscopic repair of isolated type II SLAP tears using bioabsorbable tacks in 37 males with 29 athletes and the mean age was 34 years old. ASES and L'Insalata scores were used to evaluate outcomes at final follow-up. That surgical treatment led to 69% excellent-to-good results, but overhead athletes had a worse L'Insalata score than other patients, and only 38% of them could return to play.

Coleman et al.[28] compared the outcomes of arthroscopic SLAP repair with or without concomitant acromioplasty in retrospective case series. Fifty patients were included in the study: 34 in the isolated repair group (33 athletes) and 16 in the concomitant acromioplasty group (12 athletes). In both groups SLAP repair was performed using bioabsorbable tacks at a mean of 3 months after the onset of symptoms. Outcomes were evaluated using ASES and L'Insalata scores at a average of 3 years in both groups, reporting no statistically significant difference between the two groups. The authors state that 97% of the patients re-

turn to play, but only excellent-to-good results corresponded to a previous level of performance.
In prospective cohort study performed by Yung et al.[29], 16 patients, including 13 overhead athletes, underwent suture anchor SLAP repair within a month from the onset of symptoms and were assessed at a minimum 2-year follow-up. According to UCLA score, results were excellent and good in 76% of the patients, with a mean time of return to sports of 9,4 months and 92% of the athletes returned to previous level of performance.
A retrospective study by Park et al.[30] involved 24 patients, of whom 8 were athletes and 3 overhead athletes who underwent a suture anchor SLAP repair. Concomitant pathologies treated during surgery were subacromial impingement in 1 case and a labral cyst in another case. After a mean follow-up of 33 months all the athletes had excellent-to-good results and returned to play with no detailed level of practice/activity.
Boileau et al.[31] compared the results of type II SLAP suture anchor repair (group I) with that of biceps tenodesis (group II) in a prospective study. The group I consists of ten male patients with a mean age 37 years old (7 overhead sport athletes); the group II had 15 patient with a mean age of 52 (8 overhead sport athletes). Both groups had a mean follow-up of 35 months and were evaluated according to Constant-Murley Score[32], with a significant improvement in both groups, but patient satisfaction was consistently higher in tenodesis group (87% vs. 40%).
Brockmeier et al.[33] prospectively evaluated 47 patients with isolated type-II SLAP tears that were treated with arthroscopic suture anchor fixation patients; 44 were athletes, 28 of whom involved in overhead sports. Exclusion criteria were rotator cuff tears requiring repair or concomitant shoulder instability. The results at a mean 2.7 years of follow-up were good-to-excellent in 87% of cases according to L'Insalata and ASES scores. They reported 74% of full return to pre-injury level of competition and a better prognosis in traumatic cases.
Friel et al.[34] evaluated the difference in outcomes between overhead athletes and non-athlete patients in 48 cases with 23 were overhead athletes treated with bioabsorbable suture anchor fixation. Concomitant shoulder pathologies (Bankart lesions, acromioclavicular arthrosis, labral cysts and chondral lesions) were also addressed. At a mean follow-up of 3.4 years, postoperative UCLA, ASES and SST scores improved significantly, while comparison of postoperative scores, ROM and strength did not reveal any significant differences among the groups. 54% of the overhead athletes returned to their previous level of sport.
Galano et al.[35] presented a percutaneous technique for suture anchor SLAP repair in a case series of 22 patients with 12 overhead athletes. In a case a concomitant chondral injury required chondroplasty and microfractures, while 6 partial-thickness cuff tears were addressed with debridement. After a mean follow-up period of 31.1 months, patients were evaluated showing a significant improvement in ASES and SST scores. At 7 months 92% of the overhead athletes returned to pre-injury level of activity.
Neuman et al.[36] presented a retrospective case series, in which 30 overhead athletes (mean age of 24) underwent a suture anchor type II SLAP repair. Outcomes at a mean 3.5-year follow-up showed excellent results and a high rate of overall satisfaction according to ASES and Kerlan-Jobe Orthopaedic Clinic Shoulder and Elbow score (KJOC)[37]; however, the outcomes were less reliable in throwers.
For more detailed information on outcomes see Table 2.

Rehabilitation protocol

Post-op immobilization in a sling is recommended routinely with a variable period ranging from 1 to 6 week, but most of the authors[16,18,23,24,27,30,31] encourage Codman's pendulum exercises, elbow and wrist range-of-motion exercises during this period. Morgan[18] suggest continuous use of the sling for a week and discontinuing it for passive range of motion (PROM) during the second and third week postoperatively. Restricted passive range of motion program generally begin after 2-3 weeks, but Friel[34] stated that physical therapy was initiated after the first postoperative visit. Range of motion restriction is discontinued after 3 weeks, and passive range of motion is gently progressed to active full range of motion. External rotation in abduction is generally delayed until 4-6 week after surgery. At approximately 5 weeks, the extremity may be used for light activities of daily living[18]. Progressive resistive exercises of the scapular and rotator cuff muscles, interval-throwing program and a general weight-lifting regimen can started at 6-8 weeks[14,18,20,24,29,31,33-35]. With more protective program recommended by others authors starting no prior of 10-12 weeks after surgery. At 6 months, full contacts sports and a final progression to full overhead throwing may begin.[14,16,23,27,31,33,34.] For more detailed information see Table 3.

Failures and complications

In Table 4 we report concomitant pathologies treated by the authors during the index procedure and the complications encountered after treatment.
Several authors[14,18,19,27] described subacromial impingement as the frequent cause of persistent pain after SLAP repair, but it is usually treated conservatively and it rarely required surgical treatment. When subacromial impingement is found during preoperative examination, some authors[28,33,34] recommended to add acromioplasty to SLAP repair to improve outcomes and to decrease the incidence of impingement after surgery.
Another complication reported is stiffness/adhesive capsulitis[16,18,33], which may cause a significant limitation in range of motion and may require manipulation under anesthesia and arthroscopic lysis of subacromial adhesions.
Concomitant shoulder pathologies does not seem to affect the rate of failure and complications on type II SLAP repair. Some authors[34] compared the outcomes of patients who underwent respectively isolated SLAP repairs and concomitant procedures reporting no significant difference between the two groups. Moreover, Galano et al.[35] showed no significant difference in outcome measures between those with rotator cuff tears, treated with debridement, versus those with isolated SLAP lesions.

Table 2. Analysis of the outcomes of the studies.

Authors	patients/groups, gender (M/F)	SLAP Repair device	SCORE	Outcomes
Yoneda et al. 1991 [14]	10 pt., 7 M, 3 F; all overhead athletes	metal staple	Tibone Pain Scale	Pain: 80% successful: 5 ex., 3 good, 1 poor
Pagnani et al. 1995 [16]	22 pt., 19 M, 3 F; 13 overhead athletes	bioabsorbable tack	ASES	improvements in pain, stability, and function; success in 19/22 (86%)
Morgan et al. 1998 [18]	53 overhead athletes	suture anchor (Portal of Wilmington)	UCLA	46 (87%) ex., 7 (13%) good,no fair-poor. 44 baseball pitchers: 84% ex., 16% good.
Samani et al. 2001 [20]	25 pt., 23 M 2 F; 24 athletes	bioabsorbable tack	ASES; UCLA	preop 42 (13-90) postop 92 (47-100); preop 18 (13-27) postop 32 (18-35)
O'Brien et al. 2002 [21]	31 pt., 28 M, 3 F; 18 athletes	absorbable tack (T-RC portal)	ASES; L'Insalata	ASES 87.2, L'Insalata 87; 23/31 (74%) good to ex., 6 fair, 2 poor
Kim et al. 2002 [23]	34 pt., 30 M, 4 F; 18 overhead athletes	metal suture anchor	UCLA	UCLA all pt. 33.4; UCLA overhead 32.6
Rhee et al. 2005 [24]	41 pt., 40 M,1 F; 33 athletes, 15 overhead athletes	bio-tacks, suture anchor	UCLA	67% ex., 33% good
Ide et al. 2005 [25]	40 pt.; all overhead athletes	suture anchor	Modified Rowe	preop 27.5 postop 92.1; 36/40 (90%) good to ex., 4 fair, 0 poor
Cohen et al. 2006 [27]	39 pt., 37 M, 2 F; 29 athletes	bioabsorbable tack	ASES; L'Insalata	L'Insalata all pt. 86,7 overhead 75.9; ASES 86.8; 27/39 (69%) ex.to good
Coleman et al. 2007 [28]	50 pt./2; Gr.1:isolated type II SLAP repair (33M,1F; 33 athletes); Gr.2:concomitant acromioplasty(14M,2F; 12 athletes)	bioabsorbable tack	ASES; L'Insalata	Gr.1: ASES 86.5, L'Insalata 87.1, 22/34 (65%) ex. to good; Gr.2: ASES 85.8 L'Insalata 85.1, 13/16 (81%) ex.to good
Yung et al. 2008 [29]	16 pt., 13 M 3 F; 13 overhead athletes	suture anchor (T-RC portal)	UCLA	ex. 31.3%, good 43.8%, poor 25%
Park et al. 2008 [30]	24 pt., 21 M, 3 F; 8 athletes, 3 overhead athletes	suture anchor	UCLA	preop 22.7 postop 29.9
Boileau et al. 2009 [31]	25 pt./2; anchor group (10 M), tenodesis group (9 M, 6F); 15 overhead sport	suture anchor vs. tenodesis	Constant	anchor: preop 65 postop 83; tenodesis: preop 59 postop 89 pt. satisfaction: Gr.1: 40%,Gr.2: 87%
Brockmeier et al. 2009 [33]	47 pt., 39 M, 8 F; 34 athletes, 28 overhead athletes	suture anchor	ASES; L'Insalata	preop 61.6 postop 92.5; preop 61.9 postop 90.2
Friel et al. 2010 [34]	48 pt., 39 M, 9 F; 23 overhead athletes	suture anchor	UCLA; ASES; SST	postop ex.22%, good 54%, fair 17%; preop 59.5 postop 83.4; preop 7.3 postop 10.2
Galano et al. 2010 [35]	22 pt., 16 M, 6 F; 12 overhead athletes	suture anchor	ASES; SST	preop 49.5 postop 83.6; preop 6.4 postop 11.0
Neuman et al. 2011 [36]	30 pt., 22 M, 8 F, all overhead athletes	suture anchor	ASES; KJOC	87.9, 73.9

Abbreviation: pt.: patient/s; Gr.: group; T-RC: trans-rotator cuff; ex.:excellent; preop: preoperative; postop: postoperative; F-U: follow-up.

Table 3. Rehabilitation protocols.

Authors	Passive ROM	External rotation	Active ROM	Strengthening exercises	Return to sport
Yoneda et al. 1991 [14]	for 2-3 w	after 2-3 w	after 2-3 w	at 6 w	6 mo
Pagnani et al. 1995 [16]	at 4 w	from 4 w	from 4 w	after full ROM	6 mo
Morgan et al. 1998 [18]	2-6 w	at 2-3w passive in add., at 3-6w active abd.	3-6 w	6-16 w	7 mo
Samani et al. 2001 [19]	1-4 w	N/A	1-8 w	after 2 mo	N/A
Kim et al. 2002 [23]	after 3 w	after 3 w in add.	after 3 w	after 4 w	6 mo
Rhee et al. 2005 [24]	after 3 w	after 3 w	after 3 w	after 6 w	N/A
Cohen et al. 2006 [27]	at 4 w	from 4 w	at 4 w	after full ROM	6 mo
Coleman et al. 2007 [28]	after 4 w	N/A	after 4 w	N/A	N/A
Yung et al. 2008 [29]	at 2-3 w	at 2-3 w PROM in add., at 4-6w in abd.	at 4-6 w	at 7-16 w	9.4 mo (4-24)
Park et al. 2008 [30]	after 4 w	after 4 w	after 4 w	after 12 w	N/A
Boileau et al. 2009 [31]	after 3 w	after 3 w	after 3 w	after 6 w	6 mo
Brockmeier et al. 2009 [33]	from 1 w	after 6 w in abd.	after 6 w	after 6 w	4-6 mo
Friel et al. 2010 [34]	from 1 d	N/A	after 4 w	after 8 w	6 mo
Galano et al. 2010 [35]	at 2 w	at 6 w	from 2 w	at 6 w	7 mo

Abbreviation: ROM: range of motion; w: week; mo: month; PROM: passive range of motion; add.:adduction; abd.:abduction; N/A: not available.

Table 4. Concomitant pathology, rate and treatment of complications.

Authors	Concomitant pathology (n. of patients)	Complication (n. of patients)	Treatment of complication
Yoneda et al. 1991 [14]	3 PRCT, 2 SI	1 SI: activity pain	none
Pagnani et al. 1995 [16]	2 Bank., 4 SI	1 of 2 Bank.: stiffness; 2/4 SI: activity pain	manipulation of the shoulder
Morgan et al. 1998 [18]	12 FRCT, 10 PRCT	3/10 FRCT: SI	arthroscopic lysis of adhesions
Samani et al. 2001 [19]	13 PRCT, 19 SI, 1 FRCT	2 SLAP recurrence/unhealed; 1 SI	2 arthroscopic SLAP repair
O'Brien et al. 2002 [21]	6 SI	1 SLAP reinjury	arthroscopic SLAP repair
Kim et al. 2002 [23]	none	2 persistent activity pain	none
Rhee et al. 2005 [24]	none	1 reinjury w/o SLAP tear	arthroscopic debridement
Cohen et al. 2006 [27]	none	1 SLAP failed fixation due to pt. compliance to rehab. restrictions	arthroscopic SLAP repair
Coleman et al. 2007 [28]	16 SI	3 SI	none
Yung et al. 2008 [29]	none	None	none
Park et al. 2008 [30]	1 SI, 1 labral cyst	None	none
Boileau et al. 2009 [31]	none	4 pain in overhead sport activities	4 biceps tenodesis: return to sport
Brockmeier et al. 2009 [33]	24 PRCT, 23 SI, 4 AC arth.	1 SLAP reinjury, 4 refractory stiffness (1/4 adhesive capsulitis)	1 arthroscopic repair, 3/4 conservative, 1/4 lysis of adhesions
Friel et al. 2010 [34]	10 Bank., 5 SI, 2 AC arth., 2 labral cyst, 1 chond. les.	• 1 SLAP retear during rehab., • 1 traumatic dislocation w/o SLAP retear, • 1 recalcitrant biceps tendinitis, • 1 reinjury w/o SLAP: loose boby	• 1 SLAP revision, • 1 ant.inf.stabilization, • 1 biceps tenodesis &bursectomy, • 1 biceps tenodesis & bursectomy
Galano et al. 2010 [35]	1 chond.les, 6 PRCT	no difference between isolated vs. concomitant PRCT	none

Abbreviation: PRCT: partial rotator cuff tear; FRCT: full rotator cuff tear; SI: subacromial impingement; AC arth.: acromioclavicular arthrosis; Bank.: Bankart lesion; chond.les.: chondral lesion; pt.: patient/s; w/o: without; ant.inf.: anterior inferior; rehab.: rehabilitation program.

Discussion

The aim of our study was to evaluate the outcomes of arthroscopic repair of type II SLAP tears in overhead athletes, focusing on the time elapsed from diagnosis and treatment, time needed to return to sport, rate of return to sport compared to previous level of performance. Unfortunately there is no consensus about the management of these lesions and this probably depends on lack of high level studies.

The effectiveness of SLAP repair in athletes has also been questioned due to variable percentage of athletes returning to pre-injury level of sport wich ranged from 20% to 94%. Five studies in our review have focused on isolated arthroscopic SLAP repairs. Kim et al.[23] found that 22% of overhead athletes returned to their pre-injury sport level compared with 63% in non-overhead and non-athletes. Rhee et al.[24], conversely, found that athletes had higher results than non-athletes and throwing ones scored better than non-throwing. The authors noted that the low outcome scores of the non-throwers might be attributed to the fact that gymnasts, who have a higher rate of repetitive injuries, represented more than a half of their non-throwing study group. Cohen et al.[27] found that the outcomes of bioabsorbable tack fixation in throwing athletes were significantly inferior to those in non-throwing athletes (38% vs. 71% good-to-excellent results). This likely depend on the lack of strength of this device, which completely lose its mechanical role after a month, providing no more fixation for the healing of labrum, especially in the posterior superior glenoid where bone may be less dense. Yung et al.[29] pointed out that elite throwing athletes (4/16 patients in this study), although able to return to their pre-injury level, had a longer rehabilitation period before return to sport. Neuman et al.[36] analyzed 30 overhead athletes, who underwent type II SLAP repair, finding 84% of patients were able to return to their previous level of play after less than 12 months with 93% of good-to-excellent results. The authors also showed that KJOC score is a more specific scoring system for throwing athletes and better correlates to return to previous level of play in overhead athletes.

More controversial is the treatment of these lesions in presence of accompanying rotator cuff tears. In the studies reviewed it has not been shown a negative a negative impact of shoulder pathology on type II SLAP tears. Brockmeier et al.[33] reported higher patient satisfaction scores in those who underwent concomitant acromioplasty and SLAP repair compared with those who had only labral repair, while ASES and L'Insalata scores did not significantly change in case of concomitant partial-thickness cuff tear or concomitant acromioplasty. On the other side, Coleman et al.[28] showed a decrease in L'Insalata and ASES scores with concomitant acromioplasty, thus this difference was not statistically significant. Nevertheless, they recommended acromioplasty to be added to SLAP repair to improve outcomes and to decrease the incidence of impingement after surgery.

In the study by Friel et al.[34], the subgroup analysis of overhead athletes vs. non-athletes showed preoperative to postoperative improvements in both groups, with overhead laborers achieving better functional outcomes and non-laborers achieving greater reduction of pain, suggesting that SLAP type II repair is successful independent of the patient's vocation or sport.

According to Boileau et al.[31] arthroscopic biceps tenodesis can be considered an effective alternative to the repair of a type II SLAP lesion, allowing patients to return to a pre-surgical level of activity and sports participation. The results of biceps reinsertion are disappointing compared with biceps tenodesis. Furthermore, biceps tenodesis may provide a viable alternative for the salvage of a failed SLAP repair. As the age of the two study groups was significantly different, these findings should be confirmed by future studies.

A range of surgical methods for SLAP lesions have been introduced to fix the torn superior labrum to the glenoid rim. These include V-shape SLAP repair[38], repair with a bioknotless suture anchor[39] and repair though the trans-rotator cuff portal[21]. In a randomized control trial Silberberg[40] evaluated the outcome of for the repair of isolated type II slap lesion through a single anterior portal using two different configuration (vertical or horizontal suture). The results suggest that the repair doesn't rely on the suture configuration.

Conclusion

There are contradictory evidence to draw firm conclusion about the best management of type II SLAP tears in overhead athletes and their treatment remain controversial. In our review of the literature we found only 1 level 1 study apart from Level III or Level IV evidence studies and the described data for overhead athletes are inconclusive. The successful outcomes can be variable athletes have successful outcomes, the rate is generally much lower in this group. Future studies should be large multicenter prospective trials will be necessary to better explain this issue, and the outcomes must be reported separately for throwing and non-throwing athletes.

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