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**Posterior shoulder instability in the athletic population: Variations in assessment, clinical outcomes, and return to sport**

DeLong JM *et al*. Posterior shoulder instability in the athletic population

**Jeffrey M DeLong, James P Bradley**

**Jeffrey M DeLong,** Medical University of South Carolina, Charleston, SC 29403, United States

**James P Bradley,** Burke and Bradley Orthopedics, University of Pittsburgh Medical Center, Pittsburgh, PA 15215, United States

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**Correspondence to: Dr. James P Bradley,** Burke and Bradley Orthopedics, University of Pittsburgh Medical Center, St. Margaret 200 Medical Arts Building, Suite 4010 200 Delafield Road, Pittsburgh, PA 15215, United States. bradleyjp@upmc.edu

**Telephone:** +1-412-7845770

**Fax:** +1-412-7845776

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**Abstract**

Posterior instability of the shoulder is becoming an increasingly recognized shoulder injury in the athletic population. Diagnostic elements, such as etiology, directionality, and degree of instability are essential factors to assess in the unstable athletic shoulder. Concomitant injuries and associated pathologic lesions continue to be a significant challenge in the surgical management of posterior shoulder instability. Return to sport and previous level of play is ultimately the goal for every committed athlete and surgeon, thus subpopulations of athletes should be recognized as distinct entities requiring unique diagnostic, functional outcome measures, and surgical approaches.

**Key words:** Posterior shoulder instability; Contact athletes; Overhead throwing athletes

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**Core tip:** This article focuses on important posterior shoulder instability diagnostic criteria, effects of concomitant injuries, discussion of variations in athletic subpopulations and effects of return to sport, surgical management and advantages of arthroscopic versus open techniques.

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**INTRODUCTION**

Posterior instability of the shoulder represents a unique entity among athletic shoulder injuries. Accurately diagnosing and treating posterior instability of the shoulder is often challenging due to the numerous confounding variables existing on the shoulder instability injury spectrum. However, despite diagnostic and surgical challenges, posterior shoulder instability is becoming increasingly recognized as a treatable shoulder injury.

Posterior shoulder instability is multifactorial and the etiology varies widely within the athletic population. Primary mechanisms of injury may include: (1) an acute traumatic posteriorly directed shearing force along the glenoid face between the posterior labrum and glenoid articular surface, resulting in capsulolabral detachment[1-3]; (2) repetitive microtrauma to the posterior capsule, ultimately leading to capsular attenuation and labral tears[4]; or (3) insidious onset of laxity of the posterior capsule and associated passive stabilizers[5-7]. Other causes of posterior instability often result from (1) excessive glenoid or humeral retroversion; (2) an engaging reverse Hill-Sachs lesion; and (3) and glenoid hyperplasia[1,5].

**DIAGNOSIS OF INSTABILITY**

Essential elements, such as etiology, directionality, and degree of instability are critical to assess in order to adequately manage posterior instability and prevent recurrence. Thus, it has been shown that unrecognized instability in more than a single isolated direction may be a significant contributing factor leading to poor patient outcomes. A level 2 study performed by Bradley *et al*[8] evaluated 100 athletes undergoing posterior shoulder stabilization procedures reported 62.5% (5 of 8) of their recurrences may have been a direct result of failure in diagnosis of bi-directional or multi-directional instability at the time of the index procedure. Furthermore, an earlier retrospective investigation by Wolf *et al*[9]identified similar findings in their cohort of 14 patients, in which the 1 reported failure was noted to have pronounced inferior laxity accompanying posterior instability at the time of the revision procedure.

It is also well known that patients with recurrent subluxation and/or dislocation frequently have osseous defects of the posterior glenoid rim or humeral head, which may contribute to the degree of instability. Operative intervention to address such cases may involve more aggressive and invasive procedures, such as reverse Hill-Sachs, humeral head or posterior bone allografts[10,11]. Ultimately, the degree of instability is one of many variables that should be considered in order to determine the most appropriate operative management in order to ensure successful patient outcomes.

Patients with a voluntary component to their posterior shoulder instability should also be recognized as a unique entity with the potential for less predictable outcomes. In a case series of 33 patients, Provencher *et al*[12] demonstrated that patients with voluntary instability resulted in worse outcomes. Specifically, they identified recurrent instability to be specific to patients with a voluntary instability component, whereas, all patients with involuntary instability were stable at follow-up (*P* = 0.025). Similarly, a case series of 20 shoulders reported by McIntyre *et al*[13] observed that 4 of 5 of their patients with a recurrence had a voluntary component to their instability.

Ultimately, failure to accurately access posterior instability both preoperatively via clinical examination, magnetic resonance imaging, as well as, intraoperative arthroscopic assessment to identify potential excessive capsular laxity, concurrent soft-tissue or osseous lesions, and bi- or multi-directional instability may result in unfavorable patient outcomes[8].

**CONCOMITANT INJURIES**

Posterior shoulder instability rarely occurs in isolation, often accompanied by microtrauma resulting from repetitive shearing forces, macrotraumatic events, prior dislocations, scapulothoracic dysfunction, and various osseous and soft-tissue abnormalities[4]. Concomitant injuries and procedures pose additional challenges in the management of posterior shoulder instability, which may lead to varied and less favorable outcomes[14]. In a retrospective case series of 14 patients, Bahk *et al*[15]reported that patients with concurrent injuries had less reliable outcomes (*e.g.,* higher pain scores (*P* = 0.001), lower ASES scores (*P* < 0.001), lower University of California, Los Angeles Shoulder Rating Scale (UCLA) scores (*P* < 0.001), higher subjective instability scores (*P* < 0.001), higher Western Ontario Shoulder Instability (WOSI) scores (*P* = 0.0002), or lower score for WOSI percentage of normal (*P* = 0.0002) at an average follow-up of 66 months (range, 24-149 mo). Additionally, the senior author (JPB) has determined approximately 40% of his cohort of 389 patients that underwent surgical management of posterior shoulder instability had concomitant pathology at the time of the index stabilization procedure (James P. Bradley, personal communication, June 1, 2015). Furthermore, an advanced understanding of biomechanics and pathoanatomy of the posterior capsulolabral complex and all static and dynamic structures, such as the rotator interval, the anterior-superior labrum and its attached superior glenohumeral ligament, the coracohumeral ligament, the inferior glenohumeral ligament complex, and infraspinatus are also critical for precise patient evaluation and surgical management.

Higher rates of failures and less favorable patient outcomes may result from poor quality posterior capsular tissue as a consequence of prior surgical intervention. In particular, thermal capsulorrhaphy has been shown to result in failures and revisions. For instance, the level 4 retrospective case series of 33 patients by Provencher *et al*[12]determined that 71% (5 of 7) of their failures had undergone prior surgical procedures, such as thermal capsulorrhaphy (*n* = 3) and anterior stabilization (*n* = 2) and resulted in a higher chance of failure. Additionally, the level 4 retrospective investigation of 20 shoulders performed by McIntyre *et al*[13]utilized a multiple suture technique and reported 60% (3 of 5) of their recurrences had also undergone prior surgery. Additional evidence of the effect of prior surgery having an effect on revision rates is supported by the level 2 cohort study of 100 athletic shoulders by Bradley *et al*[8]in which they reported 25% (2 of 8) of their revisions had undergone a prior thermal capsulorrhaphy procedure. Thus, prior surgery resulting in poor quality capsular, especially as a result of thermal shrinkage of capsular tissue may weaken the capsulolabral complex, resulting in unsatisfactory patient outcomes leading to further revision and failure[16].

**CONTACT ATHLETES VS. THROWING ATHLETES**

Athletic clinical outcomes for posterior shoulder instability are summarized in Tables 1 and 2.

Posterior shoulder instability injuries can occur in contact or collision athletes via a single macrotraumatic episode with the shoulder in an internally rotated, flexed and adducted position (*e.g.,* wrestler takedown with outstretched arm) causing in direct shearing forces that result in capsulolabral injury[1-3]. Additionally, repetitive microtrauma can also result in posterocapsular injuries in the contact athletes with continuous posteriorly directed axial loading of the glenohumeral joint (*e.g.,* football lineman)[10,17].

Return to sport and return to previous level of play have been shown to be higher for contact athletes versus throwing athletes. A level 2 prospective cohort of 200 athletes by Bradley *et al*[18] underwent arthroscopic posterior shoulder stabilization procedures and outcomes were based on ASES scores, stability, pain, function, strength, return to sport and return previous level of play. The investigators reported no difference in the Contact Athlete subgroup compared to entire cohort for any outcome measure. An additional study conducted by the same group performed a level 2 study of 107 patients and also determined that was no difference in the Contact Athlete subgroup compared to entire cohort as well as no difference in functional outcome between traumatic versus atraumatic injuries[19]. Ultimately, less dynamic glenohumeral demands of contact athletes compared to the throwing athlete may allow them to have higher rate of return to sport and previous level of play.

Throwing athletes should be recognized as a unique subset of athletes requiring unique diagnostic, operative intervention and shoulder outcome measures due to increased demands on the glenohumeral joint[20]. Repetitive microtrauma occurring with throwing athletes may put them at increased risk for developing posterior labral injuries versus other athletes[19,21]. For instance, in elite baseball pitchers, it has been reported that internal rotation of the humerus can approach velocities as high as 7000 deg/s[22]. Large compressive and distractive forces generated at the extreme ranges of motion in the late cocking phase and the high distraction forces occurring during the follow-through phase have been reported to cause weakening and contractures in the posterior inferior capsule, placing the glenoid capsulolabral complex and associated stabilizers at great risk for injury[23].

The largest study to date comparing surgical management of posterior instability in throwing athletes (*n* = 27) versus non-throwing athletes (*n* = 80) was a prospective level 2 study performed by Radkowski *et al*[19]. The investigators reported throwing athletes had nearly equal postoperative pain, stability, function, range of motion, strength and American Shoulder and Elbow Scores (ASES) post-operatively as non-throwing athletes. However, a lower percentage of throwers were able to return to their previous level of play (55%) compared to non-throwing athletes (71%).

Advanced understanding of biomechanics and pathoanatomy, as well as awareness of throwing athletes requiring a more distinct functional shoulder outcome measure to assess the athletes true postoperative functioning is critical elements to consider during evaluation and treatment. Thus, although throwing athletes achieve similar improvements in pain, stability, and function compared to non-throwing athletes, experts have advised counseling the throwing athlete pre-operatively of the high probability that they are less likely to return to their previous level of play[19].

**SURGICAL MANAGEMENT**

Arthroscopy has evolved from being utilized strictly as a diagnostic tool to replacing many open techniques. Minimally invasive arthroscopic techniques have potential benefits and advantages compared to open procedures for posterior instability of the shoulder[18,24]. Intraoperative assessment allows for visualization of subacromial and intraarticular space and identification of abnormalities, such as rotator cuff pathology and intraarticular capsulolabral lesions. Anatomy can be restored more precisely to resemble native anatomy[14]. Concomitant injuries, such as SLAP and glenohumeral ligament complex lesions often missed during pre-operative evaluation may be identified during intraoperative arthroscopic assessment and can be addressed in the same operative setting[18,20]. Additionally, shoulder arthroscopy has been recognized as both a diagnostic and therapeutic technique with a low incidence of complications[25]. Post-operatively, increased range of motion, shorter rehabilitation, and less pain and morbidity have been reported in arthroscopic procedures compared to more invasive techniques[24]. A recent metaanalysis for the treatment of unidirectional posterior shoulder instability conducted by DeLong and colleagues evaluated 27 arthroscopic studies and 26 open studies and identified a trend in the current literature of arthroscopic techniques having superior outcomes compared to open techniques for stability, recurrence, patient satisfactions, return to sport and previous level of play[26]. Ultimately, less comorbidity associated with arthroscopic  surgical procedures may allow athletes to return sport faster and with less complications[24].

Recognition of pathoanatomy and choice of technique and repair to restore posterior shoulder stability is also important to consider. Appropriate evaluation of capsular laxity with or without an intact labrum and adequate capsular shift with the use of anchors has been shown to result in more favorable outcomes. The level 2 study of 200 athletes by Bradley *et al*[18]reported a significantly higher return to play in athletic shoulders that received suture anchors. The investigators concluded that techniques that utilized suture anchors increased stability and function of the posteriolabral complex and contributed to their favorable clinical outcomes and high rate of return to sport. The same group also reported an earlier study of 100 athletic shoulders in which 88% (7 of 8) of failures that had undergone capsulolabral plication without the use of suture anchors[6] and a study of 107 athletic shoulders in which 73% (8 of 11) of failures had undergone a capsulolabral repair without suture anchor[19]. Similarly, the retrospective level 4 investigation of 20 athletic shoulders by McIntyre *et al*[11] utilized an anchorless suture technique reported a high failure rate of 25% (5 of 20 shoulders). An additional level 4 report of 33 patients by Provencher *et al*[12] concluded that capsular plication rather than labral suture anchor repair had a higher chance of failure among their 7 reported failed cases (*P* = 0.10). Thus, arthroscopic posterior stabilization procedures utilizing suture anchors to address capsular pathology may provide the most consistent and favorable outcomes and return to sport[13,18,27,28].

**CONCLUSION**

Efforts should be made to identify the precise etiology, directionality, and degree of instability in the athlete with posterior shoulder instability. Isolated posterior instability is uncommon and rarely occurs in isolation and numerous and varied concomitant osseous and soft-tissue injuries create challenges in diagnosis and surgical management. However, awareness of these pathologic variables and knowledge of variances in athletic populations (*i.e.,* contact athletes compared to throwing athletes) may allow for a more precise approach to management. Finally, surgical intervention utilizing minimally invasive arthroscopy and suture anchors for capsulolabral repair may provide a significant advantage in assessment and post-operative recovery, ultimately, providing the best possible outcomes and return to sport.

**REFERENCES**

1 **Dreese JC,** Bradley JP. Posterior shoulder instability repair. In: ElAttrache NS, Harner CD, Mirzayan R, Sekiya JK, editors. Surgical Techniques in Sports Medicine. Philadelphia, PA: Lippincott Williams and Wilkins, 2007

2 **Mair SD**, Zarzour RH, Speer KP. Posterior labral injury in contact athletes. *Am J Sports Med* 1998; **26**: 753-758 [PMID: 9850774]

3 **Pennington WT**, Sytsma MA, Gibbons DJ, Bartz BA, Dodd M, Daun J, Klinger J. Arthroscopic posterior labral repair in athletes: Outcome analysis at 2-year follow-up. *Arthroscopy* 2010; **26**: 1162-1171 [PMID: 20615650 DOI: 10.1016/j.arthro.2010.01.006]

4 **Fronek J**, Warren RF, Bowen M. Posterior subluxation of the glenohumeral joint. *J Bone Joint Surg Am* 1989; **71**: 205-216 [PMID: 2918005]

5 **Provencher MT**, LeClere LE, King S, McDonald LS, Frank RM, Mologne TS, Ghodadra NS, Romeo AA. Posterior instability of the shoulder: diagnosis and management. *Am J Sports Med* 2011; **39**: 874-886 [PMID: 21131678 DOI: 10.1177/0363546510384232]

6 **Servien E**, Walch G, Cortes ZE, Edwards TB, O'Connor DP. Posterior bone block procedure for posterior shoulder instability. *Knee Surg Sports Traumatol Arthrosc* 2007; **15**: 1130-1136 [PMID: 17370061 DOI: 10.1007/s00167-007-0316-x]

7 **Wolf BR**, Strickland S, Williams RJ, Allen AA, Altchek DW, Warren RF. Open posterior stabilization for recurrent posterior glenohumeral instability. *J Shoulder Elbow Surg* 2005; **14**: 157-164 [PMID: 15789009 DOI: 10.1016/j.jse.2004.06.008]

8 **Bradley JP**, Baker CL, Kline AJ, Armfield DR, Chhabra A. Arthroscopic capsulolabral reconstruction for posterior instability of the shoulder: a prospective study of 100 shoulders. *Am J Sports Med* 2006; **34**: 1061-1071 [PMID: 16567458 DOI: 10.1177/0363546505285585]

9 **Wolf EM**, Eakin CL. Arthroscopic capsular plication for posterior shoulder instability. *Arthroscopy* 1998; **14**: 153-163 [PMID: 9531126 DOI: 10.1016/S0749-8063(98)70034-9]

10 **Tannenbaum EP**, Sekiya JK. Posterior shoulder instability in the contact athlete. *Clin Sports Med* 2013; **32**: 781-796 [PMID: 24079434 DOI: 10.1016/j.csm.2013.07.011]

11 **Barth J,** Grosclaude S, Ladermann A, Denard PJ, Graveleau N, Walch G. Arthroscopic posterior bone graft for posterior instability: the transrotator interval sparing cuff technique. *Techn Shoulder Elbow Surg* 2011; **12**: 67-71 [DOI: 10.1097/BTE.0b013e31822bd5e9]

12 **Provencher MT**, Bell SJ, Menzel KA, Mologne TS. Arthroscopic treatment of posterior shoulder instability: results in 33 patients. *Am J Sports Med* 2005; **33**: 1463-1471 [PMID: 16093530 DOI: 10.1177/0363546505278301]

13 **McIntyre LF**, Caspari RB, Savoie FH. The arthroscopic treatment of multidirectional shoulder instability: two-year results of a multiple suture technique. *Arthroscopy* 1997; **13**: 418-425 [PMID: 9276046 DOI: 10.1016/S0749-8063(97)90118-3]

14 **Savoie FH**, Holt MS, Field LD, Ramsey JR. Arthroscopic management of posterior instability: evolution of technique and results. *Arthroscopy* 2008; **24**: 389-396 [PMID: 18375269 DOI: 10.1016/j.arthro.2007.11.004]

15 **Bahk MS**, Karzel RP, Snyder SJ. Arthroscopic posterior stabilization and anterior capsular plication for recurrent posterior glenohumeral instability. *Arthroscopy* 2010; **26**: 1172-1180 [PMID: 20810077 DOI: 10.1016/j.arthro.2010.06.016]

16 **D'Alessandro DF**, Bradley JP, Fleischli JE, Connor PM. Prospective evaluation of thermal capsulorrhaphy for shoulder instability: indications and results, two- to five-year follow-up. *Am J Sports Med* 2004; **32**: 21-33 [PMID: 14754720 DOI: 10.1177/0095399703258735]

17 **Tjoumakaris FP,** Kropf E, Sekiya JK. Osteoarticular allograft reconstruction of a large glenoid and humeral head defect in recurrent shoulder instability. *Techn Shoulder Elbow Surg* 2007; **8**: 98-104 [DOI: 10.1097/bte.0b013e318057fb1a]

18 **Bradley JP**, McClincy MP, Arner JW, Tejwani SG. Arthroscopic capsulolabral reconstruction for posterior instability of the shoulder: a prospective study of 200 shoulders. *Am J Sports Med* 2013; **41**: 2005-2014 [PMID: 23804588 DOI: 10.1177/0363546513493599]

19 **Radkowski CA**, Chhabra A, Baker CL, Tejwani SG, Bradley JP. Arthroscopic capsulolabral repair for posterior shoulder instability in throwing athletes compared with nonthrowing athletes. *Am J Sports Med* 2008; **36**: 693-699 [PMID: 18364459 DOI: 10.1177/0363546508314426]

20 **Bradley JP**, Forsythe B, Mascarenhas R. Arthroscopic management of posterior shoulder instability: diagnosis, indications, and technique. *Clin Sports Med* 2008; **27**: 649-670 [PMID: 19064149 DOI: 10.1016/j.csm.2008.06.001]

21 **Altchek DW**, Dines DM. Shoulder Injuries in the Throwing Athlete. *J Am Acad Orthop Surg* 1995; **3**: 159-165 [PMID: 10790664]

22 **Fleisig GS,** Dillman CJ, Andrews JR. Biomechanics of the shoulder during throwing. In: Andrews JR, Wilk KE, editors, editors. The Athlete's Shoulder. New York: Churchill Livingstone, 1994: 360-365

23 **Seroyer ST**, Nho SJ, Bach BR, Bush-Joseph CA, Nicholson GP, Romeo AA. Shoulder pain in the overhead throwing athlete. *Sports Health* 2009; **1**: 108-120 [PMID: 23015861 DOI: 10.1177/1941738108331199]

24 **Treuting R**. Minimally invasive orthopedic surgery: arthroscopy. *Ochsner J* 2000; **2**: 158-163 [PMID: 21765685]

25 **Ogilvie-Harris DJ**, Wiley AM. Arthroscopic surgery of the shoulder. A general appraisal. *J Bone Joint Surg Br* 1986; **68**: 201-207 [PMID: 3958003]

26 **DeLong JM**, Jiang K, Bradley JP. Posterior Instability of the Shoulder: A Systematic Review and Meta-analysis of Clinical Outcomes. *Am J Sports Med* 2015; **43**: 1805-1817 [PMID: 25862038 DOI: 10.1177/0363546515577622]

27 **Abrams JS**, Savoie FH, Tauro JC, Bradley JP. Recent advances in the evaluation and treatment of shoulder instability: anterior, posterior, and multidirectional. *Arthroscopy* 2002; **18**: 1-13 [PMID: 12426526 DOI: 10.1016/S0749-8063(02)00235-9]

28 **Badge R**, Tambe A, Funk L. Arthroscopic isolated posterior labral repair in rugby players. *Int J Shoulder Surg* 2009; **3**: 4-7 [PMID: 20616949 DOI: 10.4103/0973-6042.50875]

29 **Schwartz DG**, Goebel S, Piper K, Kordasiewicz B, Boyle S, Lafosse L. Arthroscopic posterior bone block augmentation in posterior shoulder instability. *J Shoulder Elbow Surg* 2013; **22**: 1092-1101 [PMID: 23337111 DOI: 10.1016/j.jse.2012.09.011]

30 **Wanich T**, Dines J, Dines D, Gambardella RA, Yocum LA. 'Batter's shoulder': can athletes return to play at the same level after operative treatment? *Clin Orthop Relat Res* 2012; **470**: 1565-1570 [PMID: 22350656 DOI: 10.1007/s11999-012-2264-0]

31 **Lenart BA**, Sherman SL, Mall NA, Gochanour E, Twigg SL, Nicholson GP. Arthroscopic repair for posterior shoulder instability. *Arthroscopy* 2012; **28**: 1337-1343 [PMID: 22705299 DOI: 10.1016/j.arthro.2012.03.011]

32 **Bottoni CR**, Franks BR, Moore JH, DeBerardino TM, Taylor DC, Arciero RA. Operative stabilization of posterior shoulder instability. *Am J Sports Med* 2005; **33**: 996-1002 [PMID: 15890637 DOI: 10.1177/0363546504271509]

33 **Bisson LJ**. Thermal capsulorrhaphy for isolated posterior instability of the glenohumeral joint without labral detachment. *Am J Sports Med* 2005; **33**: 1898-1904 [PMID: 16157851 DOI: 10.1177/0363546505278258]

34 **Goubier JN**, Iserin A, Duranthon LD, Vandenbussche E, Augereau B. A 4-portal arthroscopic stabilization in posterior shoulder instability. *J Shoulder Elbow Surg* 2003; **12**: 337-341 [PMID: 12934026 DOI: 10.1016/S1058-2746(03)00039-9]

35 **Kim SH**, Ha KI, Park JH, Kim YM, Lee YS, Lee JY, Yoo JC. Arthroscopic posterior labral repair and capsular shift for traumatic unidirectional recurrent posterior subluxation of the shoulder. *J Bone Joint Surg Am* 2003; **85-A**: 1479-1487 [PMID: 12925627]

36 **Williams RJ**, Strickland S, Cohen M, Altchek DW, Warren RF. Arthroscopic repair for traumatic posterior shoulder instability. *Am J Sports Med* 2003; **31**: 203-209 [PMID: 12642253]

37 **Papendick LW**, Savoie FH. Anatomy-specific repair techniques for posterior shoulder instability. *J South Orthop Assoc* 1995; **4**: 169-176 [PMID: 8535888]

38 **Misamore GW**, Facibene WA. Posterior capsulorrhaphy for the treatment of traumatic recurrent posterior subluxations of the shoulder in athletes. *J Shoulder Elbow Surg* 2000; **9**: 403-408 [PMID: 11075324 DOI: 10.1067/mse.2000.108963]

39 **Hawkins RH**. Glenoid osteotomy for recurrent posterior subluxation of the shoulder: assessment by computed axial tomography. *J Shoulder Elbow Surg* 1996; **5**: 393-400 [PMID: 8933462 DOI: 10.1016/S1058-2746(96)80071-1]

40 **Hurley JA**, Anderson TE, Dear W, Andrish JT, Bergfeld JA, Weiker GG. Posterior shoulder instability. Surgical versus conservative results with evaluation of glenoid version. *Am J Sports Med* 1992; **20**: 396-400 [PMID: 1415880 DOI: 10.1177/036354659202000405]

41 **Surin V**, Blåder S, Markhede G, Sundholm K. Rotational osteotomy of the humerus for posterior instability of the shoulder. *J Bone Joint Surg Am* 1990; **72**: 181-186 [PMID: 2303504]

42 **Hawkins RJ**, Koppert G, Johnston G. Recurrent posterior instability (subluxation) of the shoulder. *J Bone Joint Surg Am* 1984; **66**: 169-174 [PMID: 6693442]

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**Table 1 Arthroscopic clinical outcomes of athletes - Posterior shoulder instability *n* (%)**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Ref.** | **Evidence Level** | **Primary Procedure** | **No. total shoulders** | **No. Athletic Shoulders** | **Mean age,**  **y (range)**  **Female/Male** | **Mean Follow-up,**  **mo (range)** | **Recurrence Rate** | **Subjective stability**  **(Stable or E/G)** | **Patient Satisfaction** | **Return to Sport**  **(any level)** | **Return to Sport**  **(pre-injury level)** |
| Bradley *et al*[18] | II | CLR | 200 | Overall:  200  Contact sport: 117  Overhead /Throwers:  60 | Overall:  24.3 (15-65)  42 F/158 M  Contact Sports:  21 (16-28)  NR, F/NR, M | Overall:  36.7 (12-115)  Contact Sports: 35.3 (12-77) | Overall:  12 (6) failures *via* ASES  14 (7) failures *via* stability scale  7 (4) failures *via* both ASES and stability scale  Contact Athlete:  7 (6) *via* ASES  4 (4) *via* stability scale  3 (3) *via* ASES and stability scale | :  Overall:  182 (91)  Contact athlete:  110 (94) | Overall:  187 (93.5)  Contact athlete:  111 (95) | Overall:  180 (90)  Contact athlete:  106 (91) | Overall:  127 (64)  Contact Athlete:  81 (69) |
| Schwartz *et al*[29] | IV | BB | 19  (1 patient Ehlers Danlos) | Overall:18  Contact sport:  13 | 29.85 (15-56)  5 F/13 M | 20.5 ( 13-32) | 3 (6)  (1 bilateral patient with persistent instability of unknown etiology, contralateral shoulder was revised; 1 patient persistent pain due to prominent graft) | 16 (84) | 16 (84) | 16 (89) | 9 (50) |
| Wanich *et al*[30] | IV | 10 CLR  2 DB only | 12 | 12 Baseball  “batters shoulder” | 21 (16-33)  0 F/12 Male | 34 (18-64) | 1 (8) | NR | NR | 11 (92) | 11 (92) |
| Lenart *et al*[31] | IV | CLR | 22 | 19 | NR | NR | 2 (9) | NR | NR | 19 (100) | 19 (100) |
| Bahk *et al*[15] | IV | CLR | 29 | 28 | 26.3 (18.3-43.4  1 F/28 M | 66 (24-149) | 1 (3.4) | 28 (97)  ≥ 30 yr old, lower instability scores (*P* = .041) | 28 (97) | 22 (85) | 17 (68) |
| Savoie *et al*[14] | IV | CLR | 92 | Overall:  81  Throwing sports:  32 | 26 (15-59)  21 F/69 M | 28 (12-132) | 2 (2) | 90 (98) | NR | NR | NR |
| Radkowski *et al*[19] | II | CLR | 107 | Overall:  107  Throwing sports:  27  Nonthrowing sports:  80 | Overall:  23 F/84 M  Throwing Athletes:  21 (range, NR; SD ± 5.5)  7 F/20 M  Nonthrowing Athletes:  23.6 (range, NR; SD ± 9.1)  16 F/64 M | Throwing Athletes:  28 (range, NR; SD ± 11.6  Nonthrowing:  26.7 (range, NR, SD ± 12.5) | 10% (11/107) | No difference between 2 groups for postoperative stability  Overall:  89.72% (96/107)  Throwers:  89% (24/27)  Nonthrowers:  90% (72/80) |  | Overall:  90% (96/107)  Throwers:  85% (23/27)  Nonthrowers:  91% (73/80) | Overall:  (72/107)  Throwers:  55% (15/27)  Nonthrowers: 71% (57/80) |
| Bradley *et al*[8] | II | CLR | 100 | Overall:  100  Contact sports:  51  Overhead/ Throwers:  28 | 23.3 (15-61)  23 F/77 M | 27.7 (12-77) | Overall:  9 (9) failures according to ASES  11 (11) failures according to the standardized stability scale  Contact athlete:  3 (6) failures according to ASES  5 (10) according to standardized stability scale | Overall:  89 (89)  Contact athlete:  43 (84) | Overall:  92 (92)  Contact Athlete:  46 (90) | Overall:  89 (89)  Contact athlete:  44 (86) | Overall:  67 (67)  Contact athlete:38 (74) |
| Bottoni *et al*[32] | IV | CLR  TC | 19 | 17 | NR | 40 (24-63) | 1 (5) | NR | NR | NR | NR |
| Bisson *et al*[33] | IV | TC | 14 | Overall:  14  Contact Sports: 7  Overhead sport:  1  swimmer  Sport NR:  6 | 19 (15-32)  Shoulders:  4 F/10 M  Patients:  4 F/8 M | 36 (26-53) | (3/14)  (1 bilateral) | 11 (79) | 14 (100) | 14 (100) | 6 (43) |
| Goubier *et* al[34] | IV | CLR | 13 | Overall:  11  Contact Sports:  1  Overhead/ Throwers:  3 | 33 (18-47)  5 F/8M | 34 (11-80) | 0 (0) | NR | 13 (100) | NR | 8 (89) |
| Kim *et* al [35] | IV | CLR | 27 | Overall:  27  Contact sports:  9  Overhead /Throwing:  6/6 | 21 (14-33)  2 F/25 M | 39 (24-85) | 1 (4) | 26 (96) | NR | 26 (96) | NR |
| Williams *et al*[36] | IV | CLR | 27 | Overall:  27  Contact Sports:  11  Overhead /Throwers:  5 | 28.7 (15-55)  0 F/27 M | 61 (24-140) | 2 (7) | 25 (93) | 25 (96) | 25 (93) | NR |
| Wolf[9] | IV | CLR | 14 | Overall:  10  Contact Sports:  3  Overhead /Throwers:  2  (1 baseball pitcher, 1 tennis) | 26 (14-54)  3 F/11 M | 33 (24-45) | 1 (7)  traumatic reinjury | 13 (93) | 14 (100) | 10 (100) | 9 (90) |
| McIntyre *et al*[13] | IV | CLR | 20 | Overall:  14  Contact Sports:  5  football (2 resulted in dislocations)  Overhead/ Throwers:  2 baseball pitchers | 22 (15-36)  4 F/15 M | 31 (24-44) | 5 (25)  (2 recurrent dislocations, 3 subluxations) | 17 (85) | NR | NR | 12 (86) |
| Papendick *et al*[37] | IV | CLR PIGHLR | 41 | Overall:  36  Overhead/ Throwers:  21 | 23 (15-42)  NR, F/NR, M | 10 (4-41) | 2 (4.8) recurrence (both recurrent dislocation) | NR | 39 (95) | 36 (100) | NR |

AC: Acromioclavicular; ADL: Activities of daily living; ASES: American shoulder and elbow score; BB: Bone block; CI: Capsular imbrication; CLR: Capsulolabral repair; CP: Capsular plication; CR: Capsular repair; CS: Capsular shift; DB: Debridement; DB: Debridement; E/G: Excellent to good; GHLR: Glenohumeral ligament repair; IGHLR: Inferior glenohumeral ligament repair; LR: Labral repair; MDI: Multidirectional instability; NR: Not reported; PB: Posterior bankart; PHAGLR: Posterior humeral avulsion of the glenohumeral ligament repair; PIGHLR: Posterior inferior glenohumeral ligament repair; PSS: Penn shoulder score; ROM: Range of motion; SAD: Subacromial decompression; SANE: Single assessment numeric evaluation; SF-36: Short form health survey; SST: Simple shoulder test; TC: Thermal capsulorrhaphy; UCLA: University of California Los Angeles shoulder score; UCLA: University of California Los Angeles; VAS: Visual analog scale; WD: Walch-Duplay; WOSI: Western ontario shoulder instability.

**Table 2** **Open clinical outcomes of athletes - Posterior shoulder instability *n* (%)**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Ref.** | **Evidence Level** | **Primary Procedure** | **No.**  **Total Shoulders** | **No.**  **Athletic Shoulders** | **Mean Age, y (range)** | **Mean Follow-up, mo (range)** | **Recurrence Rate** | **Stability Subjective**  **(E/G)** | **Patient Satisfaction**  **(S or E/G)** | **Return to Sport (any level)** | **Return to Sport (preinjury level)** |
| Servien *et al*[6] | IV | BB | 21 | 19 | 24.8 (17-40) | 72 (24-228) | 3 (14) | 21 (100) | 21 (100) | 17 (89) | 13 (68) |
| Misamore[38] | IV | Capsulorrhaphy | 14 | 14 | 19.6 (15-26) | 45 (26-90) | 1 (7) | 13 (93) | NR | 13 (93) | 12 (86) |
| Hawkins *et al*[39] | IV | BB | 10 | 8 | 26.4 (20-39) | 61 (32-100) | 1 (10) | 9 (90) | NR | NR | NR |
| Hurley *et al*[40] | IV | Reverse Putti-Platt w/o bony procedure | 22 | 22 | 18.3 (13-30) | 60 (24-132) | 16 (73) | NR | NR | 15 (68) | 1 (45) |
| Surin[41] | IV | Rotational Osteotomy of Humerus | 11 | 6 | 23 (16-30) | 80.73 (24-144) | 0 (0) | 11 (100) | 10 (91) | 4 (100) | 3 (75) |
| Hawkins *et al* [42] | IV | Posterior Glenoid Osteotomy/  Capsulotendinous Plication/ Reverse Putti-Platt | 26 | 26 | 21 (NR) | 86 (24-180) | 13 (50) | NR | NR | 10 (38) | NR |

BB: Bone block; CLR: Capsulolabral repair; NR: Not reported.