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REVIEW ARTICLE

ANTERIOR SHOULDER INSTABILITY IN THE THROWING ATHLETE

PRZEDNIA NIESTABILNOŚĆ BARKU U ZAWODNIKÓW RZUCAJĄCYCH

Brandon DuBose Bushnell
Department of Orthopedic Surgery, Harbin Clinic/Atrium Health, Rome, GA, USA
Assistant Clinical Professor Department of Orthopedic Surgery, Medical College of Georgia/ Augusta University, Augusta, GA, USA

ABSTRACT
Instability in the shoulder of the throwing athlete differs significantly from that of the collision athlete or the everyday non-athlete populations. The pathogenesis, clinical presentation, workup, diagnosis, and management of instability for the thrower have unique features and require a deeper understanding of the continuum from beneficial adaptive laxity to pathologic instability. Success rates for return to play after both non-operative and surgical management are much lower for throwers than for other athletes, due in no small part to the need to balance stabilization against over-constriction of the glenohumeral joint. Multiple nonoperative and surgical techniques exist and continue to evolve for management of this challenging condition.

Keywords: anterior shoulder instability, throwing athlete; bankart tear, SLAP tear, posterior labral tear, posterosuperior internal impingement (PSI)

STRESZCZENIE
Niestabilność barku u zawodników rzucających znacząco różni się od tej występującej u sportowców uprawiających sporty kontaktowe oraz osób nieaktywnych fizycznie. Patogeneza, obraz kliniczny, diagnostyka oraz leczenie niestabilności u zawodników rzucających mają unikalne cechy i wymagają dogłębnego zrozumienia kontinuum od korzystnej adaptacyjnej wiotkości do patologicznej niestabilności. Wskaźniki powrotu do gry po leczeniu zachowawczym i operacyjnym są znacznie niższe u tej grupy sportowców niż u innych, głównie z powodu konieczności znalezienia równowagi między stabilizacją a unikaniem nadmiernego ograniczenia ruchomości stawu ramienno-łopatkowego. Istnieje wiele metod leczenia, zarówno zachowawczego, jak i operacyjnego, które nadal są udoskonalane w celu skuteczniejszego zarządzania tym wymagającym schorzeniem.

Słowa kluczowe: przednia niestabilność barku, zawodnik rzucający, uszkodzenie Bankarta; uszkodzenie SLAP, tylne uszkodzenie obrąbka, tylno-górny, wewnętrzny konflikt (PSI)

Introduction

Shoulder instability represents a common condition in younger, active populations. Amongst collision athletes, shoulder dislocation or separation events cause the vast majority of subsequent instability complaints. In-season injury management can be more

Author responsible for correspondence:
Brandon DuBose Bushnell, MD, MBA
1825 Martha Berry Boulevard
Rome, GA, 30161
Phone: +1-762-235-2700
Fax: +1-706-378-2495
Email: brad.bushnell.md@gmail.com

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conservative in cases of collision athletes, with many sports medicine professionals opting to allow patients to continue to play after an injury, even through the end of the season (Owens *et al.,* 2012, Ward & Bradley, 2013). When appropriate, operative management usually focuses on repair or reconstruction of the capsule and labrum, with bone-based techniques such as the open and arthroscopic Latarjet and distal tibial allograft procedures becoming more popular in recent years.

The pathogenesis of instability and its subsequent management, however, differ significantly in the shoulder of a throwing athlete. Instability can sometimes originate in a singular traumatic event, but often it finds its roots in overuse and attritional laxity over time. A certain amount of laxity actually helps throwers attain higher velocities in their throws, but it can insidiously lead to chronic pathologic changes and even overt injury. Once it reaches a critical point, instability renders overhead athletes and throwers unable to perform their required tasks, even if nonoperative in-season management is attempted (Owens *et al.,* 2012, Ward & Bradley, 2013). Unlike with collision athletes, "finishing out the year" therefore usually does not work with throwers. Because of the differences in etiology, surgical treatment of instability in the throwing athlete also proves much more complex and nuanced than in the collision athlete or the non-athlete. Likewise, multiple studies have shown that rates and times for return to play after surgical treatment tend to be much lower for throwing athletes as opposed to collision athletes (Gouveia *et al.,* 2023, Gowd *et al.,* 2021).

Surgeons must understand the unique features of instability in the thrower's shoulder in order to provide effective treatment. Appropriate history, exam, workup, and treatment varies on an individual basis. Management techniques for this condition continue to evolve.

Etiology of instability

For a thrower, more laxity generally means a faster throw. Rotational velocity translates into linear velocity as the shoulder moves from cocking through release, and the thrower can generate higher velocity with a larger arc of rotation. Since the release point of the throw generally remains fixed, a larger arc originates from increased external rotation during wind-up and cocking. Increased external rotation finds its roots in adaptive capsular laxity of the glenohumeral joint, and sometimes even in acquired retroversion of the bony glenoid itself. As such, many successful high-level throwers have an impressive level of capsular laxity and external rotation (Figure 1).

Figure 1. Excessive External Rotation in an American Baseball Pitcher (c/o Tread Athletics, 2016)

Laxity in a thrower, however, represents a proverbial double-edged sword. As the level of shoulder laxity increases, the athlete may experience higher rates and levels of arm pain – even if the patient has no history of an instability event nor overt instability symptoms (Wardell *et al.,* 2022). Increased laxity can cause imbalances such as a glenohumeral internal rotation deficit (GIRD) that predispose the athlete to injury. Likewise, overuse in the setting of laxity can lead to multiple attritional and degenerative conditions that affect performance. Dynamic sensorimotor changes can also occur that predispose the thrower to micro-instability and its sequelae, especially with fatigue. Muscular imbalances combined with posterosuperior instability (PSI) can lead to tearing of the labrum and/or of the rotator cuff (Mornieux *et al.,* 2018).

Instability in a thrower thus occurs along a spectrum, and multiple diagnoses should be kept in mind – as they are distinct but also not mutually exclusive (Table 1). Gelber, Soloff, and Schickendantz have proposed that "injuries to the shoulder of the overhead athlete can be generally classified into three groups: internal impingement, internal impingement with acquired secondary anterior instability, and primary anterior or multidirectional instability" (Gelber *et al.,* 2018). Savoie and O'Brien, meanwhile, have suggested two classifications: "traumatic anterior instability that happens to occur in a throwing athlete and excessive anterior subluxation because of overuse that occurs in conjunction with the disabled throwing shoulder" (Savoie & O'Brien, 2014). Other diagnoses in the differential must also be considered and ruled out when appropriate, including vascular and neurological pathology such as cervical radiculopathy, peripheral neuropathy or entrapment, and Paget-Schroetter Syndrome (effort thrombosis) (Bushnell *et al.,* 2009).

Table 1. Specific diagnoses associated with instability in the throwing shoulder.

• Adaptive hyperlaxity
• Acquired excess external rotation
• Acquired bony glenoid retroversion
• Glenohumeral internal rotation deficit (GIRD)
• Posterioinferior glenohumeral ligament ossification (Bennett lesion)
• Posterosuperior internal impingement (PSI)
• Superior labral tear from anterior to posterior (SLAP)
• Anteroinferior capsulolabral tear (Bankart tear)
• Posterior labral tear
• Pan-labral tear
• Bicipital tendinitis/tendinopathy/subluxation
• Posterior articular-sided partial-thickness rotator cuff tear (PASTA lesion)
• Posterior bursal-sided partial-thickness rotator cuff tear
• Full-tickness posterosuperior rotator cuff tear

Clinical presentation

Categorization of an instability situation as either chronic or traumatic can usually be easily determined by the presence or absence of a singular event in the patient's history. Other features such as pain, loss of velocity or control, "dead arm" sensation, tingling and numbness, and even swelling can characterize overuse or impingement cases. Anterior instability can prove more subtle in throwers as proposed to non-throwers. When reporting an actual event, throwing athletes tend to present clinically with subluxation events instead of overt dislocation events (Wibur *et al.,* 2022). Posterior instability cases will frequently present with pain rather than classic instability complaints (Kercher *et al.,* 2019). In such cases, it remains critical to distinguish between adaptive capsular laxity and labral

injury with pathologic instability (Sheean *et al.,* 2020). Pain may sometimes localize directly to the anatomic area of involvement, but not always. Biceps pathology can also contribute to instability symptoms and pain, and it can be more common in non-overhead throwers such as cricket bowlers and windmill-pitch softball players (Boden *et al.,* 2024).

Imaging

Various predictable and identifiable patterns of injury and pathology can be noted in throwing athletes with instability on imaging workup, which usually includes plain radiographs, computed tomography (CT), and magnetic resonance imaging (MRI) (Wo *et al.,* 2017). Ultrasound can have some utility as well, especially as a dynamic study, but it is completely user-dependent. Radiographs will show acute dislocation events and residual subluxation. MRI in PSI often reveals cysts in the humeral head and "kissing" lesions of the posterosuperior cuff and adjacent labrum (Goes *et al.,* 2023). Ossification of the posteroinferior glenohumeral ligament is known as a Bennett lesion, and can be seen on radiographs for CT. It is usually caused by repetitive traction microtrauma to the area (Goes *et al.,* 2023). In both cases, increased laxity of the anteroinferior capsule can contribute to the formation of these lesions (Wo *et al.,* 2017). Tears of the labrum are usually readily identified by MRI with arthrogram. Throwers with instability complaints tend to have injury patterns more consistent with PSI, posterior labral tears, and SLAP lesions rather than "pure" anteroinferior Bankart tears (Funakoshi *et al.,* 2023). MRI, both with and without arthrogram, will usually reveal tears of the rotator cuff.

Treatment options and outcomes

Treatment of instability in the thrower's shoulder should always begin with attempted conservative management (Owens *et al.,* 2012, Ward & Bradley, 2013, Gelber *et al.,* 2018, Savoie & O'Brien, 2014, Sheean *et al.,* 2020, Boden *et al.,* 2024). Rest, anti-inflammatory medications, and even occasional injections can help reduce the pain and inflammation of certain conditions. Physical therapy can also help, and therapists should focus on the structures most involved in each individual case. For example, posterior capsular stretching in cases of GIRD can help to re-balance the glenohumeral motion arc (Sheean *et al.,* 2020). Likewise, strengthening of the rotator cuff can improve sensorimotor deficits and also improve dynamic stabilization during the throwing motion (Mornieux *et al.,* 2018, Gelber *et al.,* 2018, Savoie & O'Brien, 2014).

Nonoperative treatment, however, often proves unsuccessful – especially as an athlete advances further along the spectrum of injury. The size and location of lesions strongly influence the chances of success. Smaller labral tears, especially in the Bankart area, may respond well to conservative treatment. Tears in the posterior labrum and in the SLAP area, however, have proven notoriously resistant to nonoperative treatment (Kercher *et al.,* 2019, Waterman *et al.,* 2023). When conservative treatment fails, appropriately-indicated surgical intervention can improve the athlete's chances of returning to play. The surgery must focus on the specific structure(s) involved in each individual case, and surgeons must be prepared for the need to address more than one pathology at a time. For example, many cases of worsening symptomatic PSI will require treatment of both a labral tear and a rotator cuff tear.

Kvitne and Jobe described one of the first techniques for surgical treatment of symptomatic anterior shoulder instability in throwers – the open anteroinferior capsulolabral reconstruction with a subscapularis split (Kvitne *et al.,* 1995, Kvitne *et al.,* 1995). In the decades since then, operative techniques have evolved into mostly arthroscopic approaches that begin with meticulous analysis of the joint and diagnosis of all pathology, followed by repair or reconstruction of the affected structures.

Arthroscopic Bankart repair with a concomitant remplissage procedure has seen reported return to play rates of 46%–79% in throwers

(Gouveia *et al.,* 2023). Park, *et al.,* have reported 82% return to play rates for baseball players with anterior instability who underwent standard Bankart repair (Park *et al.,* 2019). These rates of return to play lag behind those of non-throwers, which have been reported to exceed 90% in many cases Gouveia *et al.,* 2023, Gelber *et al.,* 2018, Savoie & O'Brien, 2014, Waterman *et al.,* 2023). Several studies have shown risk factors for failure or persistent symptoms to include older age, male sex, higher BMI, large Hill-Sachs lesions, and certain positions within a sport (e.g., backcourt in handball or pitching in baseball) Gowd *et al.,* 2021, Gelber *et al.,* 2018, Savoie & O'Brien, 2014, Waterman *et al.,* 2023). While it seems intuitive, research has also confirmed that players with injuries to the throwing arm are less likely to return to play than throwing athletes with injuries to the non-throwing arm (Park *et al.* 2019). Even when appropriate surgical management and postoperative rehabilitation does succeed, throwing athletes take significantly longer to recover and return to play after surgery in comparison to collision athletes and non-athletes (Ward & Bradley, 2013, Gouveia *et al.,* 2023, Gowd *et al.,* 2021).

Certain instability-related problems seem to respond better to surgery than others. SLAP tears have historically shown terrible success rates with attempted labral repair, but recent studies have reported significant improvement in return to play and often excellent results in cases of biceps tenodesis rather than repair (Waterman *et al.,* 2023). Posterior labral injury likewise has seen reliable surgical outcomes. In 2019, Kercher and colleagues reported 94% patient satisfaction and 94% return to sport for baseball players of various skill levels who underwent posterior labral repair (Kercher *et al.,* 2019). Most of these players reported pain as their primary pre-operative complaint, rather than instability. As posterior capsular tightness can hinder the athlete's ability to throw, surgeons should take great care not to over-constrain the shoulder when repairing the posterior labrum (Skeean *et al.,* 2020).

Researchers continue to seek out additional techniques that optimize the athlete's chances of returning to play – especially in cases of anterior capsulolabral injury. In the last several years, bone-based procedures have become quite popular – especially in collision athletes – but the literature about their success in throwers remains sparse. Bauer and colleagues reported good results in professional handball players using an open Latarjet-Patte procedure to stabilize the shoulder. In their 2024 study, they found a high level of both return to play (85%) and return to play at the same level (80%) in this high-risk sport involving both overhead throwing and collision demands on the shoulder (Bauer *et al.,* 2024). Other surgeons have shown reluctance to pursue bone-based procedures out of concern for over-tightening the shoulder and sacrificing motion (and thus velocity) in favor of more stability.

Maiotti, *et al.,* performed a multi-center study of several different surgical techniques for anterior shoulder stabilization in 2023. They found that soft-tissue augmentation of standard Bankart repair procedures (remplissage and subscapularis augmentation) can improve results to those similar to bone-based procedures such as the open or arthroscopic Latarjet technique (Maiotti *et al.,* 2023). Funakoshi, *et al.,* have described the use of hamstring autograft for anteroinferior glenohumeral ligament reconstruction in symptomatic overhead throwers with anterior instability and posterosuperior internal impingement (Funakoshi *et al.,* 2022).

Other surgeons have taken the approach of changing the arm position for repair rather than trying to alter or add to the repair technique itself. Mitsui and colleagues have proposed performing anterior stabilization in an intra-operative position of abducted external rotation that mimics the late cocking phase of the throwing motion (Mitusui *et al.,* 2024, Mitsui *et al.,* 2024). This "dynamic anterior glenohumeral capsular ligament tensioning (DAGHT) procedure" has shown improved

outcomes for throwers in terms of better external rotation, better clinical outcomes, and better return to play at the same level (Mitsui *et al.,* 2024).

Conclusion

Instability in the thrower's shoulder remains a daunting clinical problem. The inherent need for maximum range of motion to generate velocity in throwing makes over-tightening of the shoulder a cardinal sin. Excess instability, likewise, can start the shoulder on an irreversible downhill slide of pathologic progression. Return to play rates and times for throwers therefore lag behind those of other instability patients, as finding the perfect balance between "too loose" and "too tight" proves exceptionally difficult. In the ongoing quest to maximize outcomes, surgeons have added soft-tissue supplementation such as remplissage, subscapularis augmentation, tendon grafting, and selective-positional tightening to the classic surgical techniques of capsulolabral repair and reconstruction, with varying results. Since each and every specific case of instability in a thrower represents a unique challenge, surgeons must pursue an individualized approach to care from presentation through resolution.

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REFERENCES

Bauer S, Neyton L, Collin P, Zumstein M. (2024) *'The open Latarjet-Patte procedure for the treatment of anterior shoulder instability in professional handball players at a mean follow-up of 6.6 years.'* J Shoulder Elbow Surg;33(4):924–931. doi:10.1016/j.jse.2023.07.029.

Boden SA, Arner JW, Bradley JP. (2024) *'Understanding Shoulder and Elbow Injuries in the Windmill Softball Pitcher.'* J Am Acad Orthop Surg;32(2):e53–e62. doi:10.5435/JAAOS-D-22-00944.

Bushnell BD, Anz AW, Dugger K, Sakryd GA, Noonan TJ. (2009) *'Effort thrombosis presenting as pulmonary embolism in a professional baseball pitcher.'* Sports Health;1(6):493–499. doi:10.1177/1941738109347980.

Funakoshi T, Furushima K, Takahashi T, Miyamoto A, Urata D, Yoshino K, *et al.* (2022) *'Anterior glenohumeral capsular ligament reconstruction with hamstring autograft for internal impingement with anterior instability of the shoulder in baseball players: preliminary surgical outcomes.'* J Shoulder Elbow Surg;31(7):1463–1473. doi:10.1016/j.jse.2021.12.021.

Funakoshi T, Takahashi T, Shimokobe H, Miyamoto A, Furushima K. (2023) *'Arthroscopic findings of the glenohumeral joint in symptomatic anterior instabilities: comparison between overhead throwing disorders and traumatic shoulder dislocation.'* J Shoulder Elbow Surg;32(4):776–785. doi:10.1016/j.jse.2022.10.005.

Gelber JD, Soloff L, Schickendantz MS. (2018) *'The Thrower's Shoulder.'* J Am Acad Orthop Surg;26(6):204–213. doi:10.5435/JAAOS-D-15-00585.

Goes PK, Flores DV, Damer A, Huang BK. (2023) *'Shoulder and Elbow Injuries in Adult Overhead Throwers: Imaging Review.'* Radiographics;43(12):e230094. doi:10.1148/rg.230094.

Gouveia K, Harbour E, Athwal GS, Khan M. (2023) *'Return to Sport After Arthroscopic Bankart Repair With Remplissage: A Systematic Review.'* Arthroscopy;39(4):1046–1059 e3. doi:10.1016/j.arthro.2022.12.032.

Gowd AK, Liu JN, Polce EM, Agarwalla A, Garcia GH, Nicholson GP, *et al.* (2021) *'Return to sport following Latarjet glenoid reconstruction for anterior shoulder instability.'*

J Shoulder Elbow Surg;30(11):2549–2559. doi:10.1016/j.jse.2021.04.020.

Kercher JS, Runner RP, McCarthy TP, Duralde XA. (2019) *'Posterior Labral Repairs of the Shoulder Among Baseball Players: Results and Outcomes With Minimum 2-Year Follow-up.'* Am J Sports Med;47(7):1687–1693. doi:10.1177/0363546519843070.

Kvitne RS, Jobe FW. (1993) *'The diagnosis and treatment of anterior instability in the throwing athlete.'* Clin Orthop Relat Res 1993(291):107–123.

Kvitne RS, Jobe FW, Jobe CM. (1995) *'Shoulder instability in the overhand or throwing athlete.'* Clin Sports Med;14(4):917–935.

Maiotti M, De Vita A, De Benedetto M, Cerciello S, Massoni C, Di Giunta A, *et al.* (2023) *'Clinical outcomes and recurrence rate of 4 procedures for recurrent anterior shoulder instability: ASA, remplissage, open, and arthroscopic Latarjet: a multicenter study.'* J Shoulder Elbow Surg;32(5):931–938. doi:10.1016/j.jse.2022.10.030.

Mitsui Y, Funakoshi T, Hara K, Higuchi K, Miyamoto A, Nakamura H, *et al.* (2024) *'Dynamic Anterior Glenohumeral Capsular Ligament Tensioning During Arthroscopic Shoulder Stabilization in Overhead-Throwing Athletes.'* Arthrosc Tech;13(10):103069. doi:10.1016/j.eats.2024.103069.

Mitsui Y, Funakoshi T, Miyamoto A, Higuchi K, Hara K, Nakamura H, *et al.* (2024) *'Clinical outcomes and return-to-play in dynamic anterior glenohumeral capsular ligament tensioning procedure for overhead-throwing athletes with traumatic shoulder dislocation on the throwing side.'* J Shoulder Elbow Surg. doi:10.1016/j.jse.2024.09.049.

Mornieux G, Hirschmuller A, Gollhofer A, Sudkamp NP, Maier D. (2018) *'Multimodal assessment of sensorimotor shoulder function in patients with untreated anterior shoulder instability and asymptomatic handball players.'* J Sports Med Phys Fitness;58(4):472–479. doi:10.23736/S0022-4707.17.06874-8.

Owens BD, Dickens JF, Kilcoyne KG, Rue JP. (2012) *Management of mid-season traumatic anterior shoulder instability in athletes.'* J Am Acad Orthop Surg;20(8):518–526. doi:10.5435/JAAOS-20-08-518.

Park JY, Lee JH, Oh KS, Chung SW, Lim JJ, Noh YM. (2019) *'Return to play after arthroscopic treatment for shoulder instability in elite and professional baseball players.'* J Shoulder Elbow Surg;28(1):77–81. doi:10.1016/j.jse.2018.07.006.

Savoie FH, 3rd, O'Brien MJ. (2014) *'Anterior instability in the throwing shoulder.'* Sports Med Arthrosc Rev;22(2):117–119. doi:10.1097/JSA.0000000000000021.

Sheean AJ, Kibler WB, Conway J, Bradley JP. (2020) *'Posterior Labral Injury and Glenohumeral Instability in Overhead Athletes: Current Concepts for Diagnosis and Management.'* J Am Acad Orthop Surg;28(15):628–637. doi:10.5435/JAAOS-D-19-00535.

Ward JP, Bradley JP. (2013) *'Decision making in the in-season athlete with shoulder instability.'* Clin Sports Med;32(4):685–696. doi:10.1016/j.csm.2013.07.005.

Wardell M, Creighton D, Kovalcik C. (2022) *'Glenohumeral Instability and Arm Pain in Overhead Throwing Athletes: A Correlational Study.'* Int J Sports Phys Ther;17(7):1351–1357. doi:10.26603/001c.39800.

Waterman BR, Dean RS, Gregory B, Romeo AA. (2023) *'Surgical Treatment of Superior Labral/Biceps Pathology in the Overhead Thrower.'* J Am Acad Orthop Surg;31(8):e424–e434. doi:10.5435/JAAOS-D-21-01199.

Wilbur RR, Shirley MB, Nauert RF, LaPrade MD, Okoroha KR, Krych AJ, *et al.* (2022) *'Anterior Shoulder Instability in Throwers and Overhead Athletes: Long-term Outcomes in a Geographic Cohort.'* Am J Sports Med;50(1):182–188. doi:10.1177/03635465211059195.

Wo S, Mulcahy H, Richardson ML, Chew FS, Gee A, Hsu J, *et al.* (2017) *'Pathologies of the shoulder and elbow affecting the overhead throwing athlete.'* Skeletal Radiol;46(7):873–888. doi:10.1007/s00256-017-2627-4.