



¹The Andrews Institute for Orthopaedics & Sports Medicine, Gulf Breeze, FL, U.S.A.; ²Orlin & Cohen Orthopedic Group, Woodbury, NY, U.S.A.

³Michigan State University, College of Osteopathic Medicine, East Lansing, MI, U.S.A

Since Bankart¹ described recurrent shoulder dislocation in 1923, various treatment options have been proposed to address anterior dislocations and instability. Currently, open and arthroscopic procedures are widely used and considerable debate exists as to which one represents the best option for the patient. In recent years, many studies have emerged to address arthroscopic repairs in athletes, in whom shoulder instability events have been shown to occur at a rate of 0.12 per 1000 exposures.²

The purpose of this study was to review the clinical outcomes after arthroscopic Bankart repair in a group of adolescent athletes participating in collision and contact sports. We sought to identify any demographic, injury, and surgical factors affecting patient-reported functional outcomes. Secondarily, we sought to characterize recurrent instability events and the success of return to sport.

- **Patient Selection**

- Ethics approval was obtained from our local institutional review board prior to initiation of this study
- Retrospective review identified a consecutive series of adolescent patients (≤ 19 years) who underwent primary arthroscopic Bankart repair with a minimum follow-up of 2 years
- All surgical procedures were performed by two fellowship-trained sports medicine surgeons between 2004 and 2012
- All patients had a history of trauma to their shoulder resulting in an anterior glenohumeral dislocation confirmed on history, physical examination, and magnetic resonance imaging (MRI) findings
- Exclusion criteria
 - *Traumatic or multidirectional instability*
 - *Glenoid bone loss greater than 20% as assessed on preoperative MRI*
 - *Engaging Hill-Sachs lesion identified during examination under anesthesia*
 - *Associated full-thickness rotator cuff tear*
 - *Humeral avulsion of the glenohumeral ligament*
- **37 patients (39 shoulders) met selection criteria**

- **Clinical Evaluation**

- Operative and clinical notes were extracted from medical records
- Preoperative assessment included age, mechanism and severity of injury, as well as the number of instability events prior to repair
- Sports were classified as *collision*, *contact*, or *limited contact* according to criteria established by the American Academy of Pediatrics²⁶.
- Postoperative assessment included recurrence of dislocation, and any postoperative complications
- Patient-reported outcomes and functional activity levels were evaluated using the American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form (ASES), Rowe Score for Instability, and Visual Analog Scale (VAS) for pain

- **Statistical Analyses**

- Normality of distribution of dependent variables (ASES and Rowe scores) was tested using the Shapiro-Wilk test. The associations between nominal and dichotomous independent variables and clinical outcomes were analyzed using the Kruskal-Wallis test and Wilcoxon rank-sum test, respectively
- The correlations between continuous independent variables and clinical outcomes were examined using Spearman's rank correlation
- Linear regression analyses were performed to identify variables that were predictive of ASES and Rowe scores
- Independent variables that had a P value of $< .2$ from the univariate analyses were included in each of the 2 multivariate analyses
- Statistical significance was set at $P \leq .05$

•Athlete Characteristics

Table 1. Athlete Characteristics	Data (n = 39 shoulders)
Age at surgery, years	16.9 ± 1.5
Sex	
Male	38 (96.6)
Female	1 (3.4)
Dominant side affected	34 (87.0)
Follow-up, mo	75.2 ± 18.5
Sport classification	
Collision	24 (61.5)
Contact	5 (12.8)
Limited contact	10 (25.6)
Sport	
Football	22 (56.4)
Baseball	10 (25.6)
Basketball	3 (7.7)
Wrestling	2 (5.1)
Hockey	2 (5.1)
Level of competition	
High school	28 (71.8)
College	8 (20.5)
Recreational	3 (7.7)
Mechanism of injury	
Diving for ball	8 (20.5)
Fall	1 (2.6)
Hyperabduction	6 (15.4)
Tackle	24 (61.5)
Preoperative instability episodes	
Single	12 (30.8)
Multiple	27 (69.2)
Time to surgery, mo	8.9 ± 9.6
Instability Severity Index Score (ISIS)	6.6 (0.8)
*Data are reported as mean ± SD or n (%)	

•Arthroscopic Findings

	Data (n = 39 shoulders)
Hill-Sachs lesion, n	33 (84.6)
SLAP repair, n	9 (23.1)
Tear extent, hours	3.9 ± 1.59
Superior anchor position, hour	2 ± 1.34
Inferior anchor position, hour	5.6 ± 0.6
Anchors used (Bankart), n	4.6 ± 1.67
Anchors used (SLAP), n	1.8 ± 0.7
Additional procedures, n	4 (10.3)
*Data are reported as mean ± SD or n (%)	
SLAP, Superior Labrum Anterior Posterior	

- **Recurrent Instability**

- Four shoulders (10.3%) had dislocation events postoperatively; all were traumatic.

- Return to Sports

Return to sports data was available for 36/37 patients (97.3%). A total of 32 patients (88.9%) attempted to return to sports postoperatively. Of those, 25 patients (78.1%) were able to return to sports at the same level for at least one season. Seven patients (21.9%) were unable to return to sports or had to return to a lower level of competition. Three athletes were unable to return to sport due to recurrent instability; one underwent non-operative treatment and elected to quit his sport. The other 2 patients both received surgical treatment with soft-tissue procedures for recurrent instability. The remaining athlete who was unable to return to sport underwent repeat arthroscopy for persistent shoulder pain. All patients who had subsequent surgical intervention cited shoulder limitations as the reason for inability to continue playing sports.

• Outcomes

- Univariate analyses demonstrated that **patient-reported outcomes were negatively correlated with recurrence** (ASES, $P = 0.005$; Rowe, $P = 0.001$) and **failure to return to sport** (ASES, $P = 0.016$; Rowe, $P = 0.004$). Independent variables shown to have no significant relationship to subjective functional outcomes included age, follow-up, number of preoperative dislocations, time to surgery, sport classification, competition level, tear extent, number of anchors, concurrent Hill-Sachs lesions, and repair of a SLAP lesion.
- Multivariate regression analyses were run to evaluate how well independent risk factors predicted ASES and Rowe scores (Table 4). For ASES score, the independent risk factors: injury side, follow-up duration, collision, injury mechanism, number of Bankart anchors, postoperative recurrence, and return to sport significantly predicted score, $F(10,17) = 3.215$, $P = 0.0167$, $R^2 = 0.654$. Within this analysis, only postoperative recurrence added significantly to the prediction, $P = 0.011$. For Rowe score, the independent risk factors: injury side, collision, injury mechanism, slap tear, postoperative recurrence, return to sport, and time to surgery significantly predicted score, $F(10,17) = 10.62$, $P < 0.001$, $R^2 = 0.862$. Within this analysis, only postoperative recurrence added significantly to the prediction, $P < 0.001$. **The results of these analyses indicate that athletes that have postoperative recurrence tend to have lower ASES and Rowe scores.**

Outcome Measure	Data
VAS	0.49 ± 1.01
ASES	92.8 ± 12.6
Rowe	85.0 ± 24.2
Patient satisfaction**	8.9 ± 1.9
Recurrence	
Yes	4 (10.3)
No	35 (89.7)
Return to sport	
Did not attempt return	4 (11.1)
Attempted return	32 (86.4)
Able to return	25 (78.1)
Unable to return	7 (21.9)

*Data are reported as mean \pm SD or n (%).

VAS, Visual Analog Scale; ASES, American Shoulder and Elbow Surgeons

****Measured by a 0- to 10-point subjective scale**

Variable	ASES		Rowe	
	R²	P Value	R²	P Value
Hand dominance				
Non-dominant	-15.92	0.109	-26.41	0.062
Follow-up	0.001	0.741	N/A	N/A
Sport classification				
Contact	3.96	0.691	10.56	0.410
Limited contact	-8.19	0.580	7.71	0.664
Mechanism of injury				
Fall	-2.11	0.911	27.86	0.242
Hyperabduction	-6.79	0.454	-2.47	0.808
Tackle	-6.88	0.648	9.78	0.596
SLAP repair				
Yes	N/A	N/A	-10.73	0.102
Anchors used (Bankart)	-1.3	0.385	N/A	N/A
Recurrence				
Yes	-20.99	0.011*	-55.71	<.001*
Return to sport				
Yes	-1.6	0.777	3.37	0.592
Time to surgery	N/A	N/A	-0.02	0.083

*Statistically significant (P < .05)

DISCUSSION

The principal findings of this study suggest that arthroscopic Bankart repair is an effective surgical option for traumatically induced shoulder instability in adolescents participating in collision and contact sports. At a minimum of 4-year follow-up, shoulder stability was effectively restored in 90% of cases; 80% returned to their preinjury level of sport. Arthroscopic Bankart repair provided excellent subjective functional outcomes. Variables significantly associated with lower ASES and/or Rowe scores were failure to return to sports and recurrence.

In our study, multiple independent risk factors predicted ASES and Rowe scores. Of these factors, postoperative recurrence was the only that contributed significantly to the prediction. Intuitively, it makes sense that a recurrent injury would negatively affect the patient's subjective outcome. To our knowledge, the present study is the first to describe an association between injury to a non-dominant shoulder and subjective outcome after arthroscopic Bankart repair. However, while a non-dominant shoulder injury was associated with lower Rowe scores on univariate analysis, this finding did not significantly contribute to the regression prediction. Adolescent suffering an injury to their non-dominant shoulder should be counseled regarding a higher risk of a lower functional outcome following surgery, especially when other factors that place them at higher risk for failing to return to sport are identified.

REFERENCES

1. Bankart, A. S. B. Recurrent or habitual dislocation of the shoulder-joint. *Br. Med. J.* **2**, 1132–1133 (1923).
2. Owens, B. D., Agel, J., Mountcastle, S. B., Cameron, K. L. & Nelson, B. J. Incidence of glenohumeral instability in collegiate athletics. *Am. J. Sports Med.* **37**, 1750–1754 (2009).
3. Bottoni, C. R. *et al.* A prospective, randomized evaluation of arthroscopic stabilization versus nonoperative treatment in patients with acute, traumatic, first-time shoulder dislocations. *Am. J. Sports Med.* **30**, 576–580 (2002).
4. Owens, B. D. *et al.* Long-term follow-up of acute arthroscopic Bankart repair for initial anterior shoulder dislocations in young athletes. *Am. J. Sports Med.* **37**, 669–673 (2009).
5. Voos, J. E. *et al.* Prospective evaluation of arthroscopic Bankart repairs for anterior instability. *Am. J. Sports Med.* **38**, 302–307 (2010).
6. Larrain, M. V., Montenegro, H. J., Maus, D. M., Collazo, C. & Pavón, F. Arthroscopic management of traumatic anterior shoulder instability in collision athletes. *Arthroscopy* **22**, 1283–1289 (2006).
7. Milvitch, C. *et al.* Outcomes of Bankart repairs using modern arthroscopic technique in an athletic population. *Arthroscopy* (2016). doi:10.1016/j.arthro.2016.01.025