Traumatic anterior shoulder dislocations are common, especially in the young active patient population. It is important to recognize the important factors in the diagnosis and treatment of these injuries to avoid complications.
Incidence/Epidemiology
The incidence of shoulder anterior instability ranges from 0.08–1.69 per 1000 person years,\textsuperscript{26,7,32} and incidence of anterior shoulder dislocation 11.2 to 23.9 per 100,000 person years.\textsuperscript{26,32} Risks associated with recurrent shoulder instability include male sex, age under 30, and activity level (specifically participation in contact/collision sports). Rowe in 1956\textsuperscript{8} reported a recurrence rate was based on age of the patient with 83% recurrence rate in those age 10–20, 63% age 20–40, and 16% age over 40. Hovelius et al.\textsuperscript{17} reported in a 25-year follow-up of patients treated nonoperatively for first time anterior shoulder dislocation and found 87% recurrence rate in those ages 15 to 20 and <23% in those over the age of 30. Several other studies\textsuperscript{1,4,31} examined the risk of recurrent instability in patients treated nonoperatively for first time shoulder dislocation and reported 75%–92% recurrence rate with greater than 67% progressing to require surgical intervention.

Clinical Evaluation
A thorough history often imparts vital information in the initial evaluation of athletes with shoulder instability, including: type of injury (subluxation versus dislocation), mechanism of injury, and chronicity of instability. Initial physical examination following acute presentation, <7 days from injury, should remain limited and primarily focus on neurovascular evaluation.\textsuperscript{21} The incidence of axillary nerve injury has been reported as high as 35% in first-time traumatic shoulder dislocation.\textsuperscript{25} Once patients are able to tolerate shoulder range of motion, typically between 2–6 weeks from injury, further examination should focus on rotator cuff and labrocapsular assessment.\textsuperscript{21} Rotator cuff injuries are more commonly associated with increasing age, however strength testing of the rotator cuff muscles should be performed in all athletes following traumatic dislocation.\textsuperscript{13}

The supraspinatus can be tested with arm abduction to 90 degrees; the infraspinatus with resisted external rotation when the arm is adducted; the subscapularis with either lift-off test or belly press test.\textsuperscript{22} The labrum and glenohumeral ligaments serve as important static stabilizers, and are often implicated in anterior shoulder instability among athletes.\textsuperscript{5} A variety of physical examination tests place stress on these structures and aid in diagnosing anterior shoulder instability.

Anterior Apprehension Test
As described by Rowe,\textsuperscript{28} the anterior apprehension test may be performed with the patient standing or supine. Farber et al.\textsuperscript{10} were able to demonstrate improved sensitivity (72% vs. 50%) and specificity (96% vs. 56%) when apprehension rather than pain was used as the diagnostic criteria for a positive test. Moreover, the likelihood ratio for anterior instability was significantly higher in the presence of apprehension (20.2) versus pain alone (1.1).\textsuperscript{10}

The apprehension test may also serve a role in helping delineate patients who remain at higher risk for recurrent instability following nonoperative management of first time dislocation. Safran et al.\textsuperscript{29} followed a group of men managed nonoperatively after a first-time anterior dislocation. Of the 52 patients, 46% sustained a repeated dislocation at a mean follow up of 39 months. Within the redislocation cohort, a significantly higher incidence of repeat dislocation was demonstrated among patients with a positive (71%) versus negative (37%) apprehension test performed at six weeks.

Relocation Test
Lo et al.\textsuperscript{20} were able to demonstrate improvement in apprehension was more predictive of anterior instability than pain improvement. Removal of the posterior stabilizing force, deemed the “surprise test,” may be performed concurrently with the relocation test. Recurrent apprehension is a positive test and has been shown to accurately support the diagnosis of anterior instability (PPV 98%, 99% specificity).\textsuperscript{20}

Laxity Testing
Recent literature has demonstrated laxity testing is not as accurate as apprehension and/or relocation test in predicting anterior instability. Certainly, the efficacy of laxity testing is contingent upon patient compliance; inability to relax due to anxiety and or pain may inhibit reliable results.\textsuperscript{10}

Imaging
In the acute evaluation of traumatic shoulder instability, imaging is critical to confirm an anatomic reduction and diagnose any related fractures. Routine orthogonal radiographs should include, Grashey (true AP), axillary, and scapulolateral views. CT imaging should be obtained if radiographs suggest glenoid
injury is present. MRI plays an essential role in the diagnosis of concomitant labroligamentous lesions. MRI should be considered in the acute setting (within 10 days of injury), as hemarthrosis serves as a contrast thereby enhancing labral pathology. Assessment of location of bipolar bone loss using CT scan can be performed utilizing the glenoid track method. This allows quantitative prediction if bone loss of the humeral head and/or glenoid will result in engaging lesions which increases the risk of failure of arthroscopic Bankart repair.

Nonoperative Management
Nonoperative management following a traumatic shoulder dislocation consists of a period of immobilization, however, the duration and method have been challenged. Previous studies have demonstrated that 97% of athletes with anterior shoulder instability will often have a Bankart lesion, or disruption of the anterior inferior labrum and contiguous anterior inferior glenohumeral ligament. Itoi et al. used MRI to demonstrate improved coaptation of the Bankart lesion when the arm was immobilized in external rotation compared to a conventional internally rotated position. Following their MRI study, Itoi et al. randomized 189 patients to internal versus external immobilization for nonoperative management of first-time anterior shoulder dislocation. Recurrent instability was significantly lower among patients treated with external (26%) versus internal (72%) immobilization. Despite these results, the clinical superiority of immobilization in external rotation has not been supported by more recent literature.

Finestone et al. conducted a prospective study where 51 patients were randomly immobilized in internal or external rotation. They were unable to demonstrate a significant difference in recurrent instability between patients treated with internal (42%) versus external (37%) immobilization. Similarly, in a recent randomized trial of 188 patients, Liavaag et al. showed immobilization in external rotation does not significantly reduce the incidence of recurrent instability following first-time anterior shoulder dislocation (31% vs. 25%).

The optimal duration of sling immobilization has also been debated, however recent literature would suggest longer duration of immobilization does not decrease the incidence of recurrent instability. Hovelius et al. examined long-term outcomes following conservative management of anterior shoulder dislocation in 255 patients. Patients were grouped according to duration of immobilization: Group 1 were immobilized for a minimum of 21 days; Group 2 were placed in a sling until comfortable, ranging (<5 days to 2 weeks); Group 3 was a “mixed treatment” group. At 25 years follow-up there was no significant difference in recurrent instability with >3 weeks immobilization compared to immediate mobilization. Similarly, Paterson et al. found no significant change in recurrent instability rates among patients immobilized for one week or less (41%) compared to three weeks or longer (37%); thus concluding there is no benefit of immobilization for longer than one week.

The ideal protocol for nonoperative management of anterior instability in the athlete is a continuously changing paradigm. Following a period of immobilization, athletes begin rehabilitation and are typically cleared for sport once they are able to demonstrate symmetric range of motion and strength, to complete sport-specific exercises and have no pain or limitations. Rehabilitation and return to play following first time acute traumatic dislocation has provided mixed results. Although Aronen and Regan reported a 25% recurrence rate among 20 midshipmen following a prolong rehabilitation program, similar studies conducted by Wheeler et al. and Arciero et al. found recurrence rates of 92% and 80% respectively. In their study of nonoperative management of first time traumatic anterior dislocation, Buss et al. found 90% of athletes were able to return to competition after a mean 10 days lost from sport. However, 37% of these athletes demonstrated recurrent instability and nearly half underwent surgical stabilization upon completion of their season. More recently, Dickens et al. prospectively examined the natural history of nonoperative treatment following traumatic anterior shoulder instability in forty-five collegiate athletes. Following an accelerated rehab protocol, 73% of athletes were able to return to sport after a median five days lost from competition. Only 27% of these participants were able to successfully complete the season without a recurrent instability event.

Bracing
Abduction, extension, and external rotation places the shoulder in a vulnerable position for athletes experiencing anterior shoulder instability. Athletic braces would appear helpful by protecting athletes against susceptible positioning, however, their utility in lowering the incidence of recurrent instability has not been supported by recent literature. Bracing inhibits overhead exercise, and therefore is not applicable for all athletes. Buss et al. noted 70% of athletes returning to sport...
adopted a brace and reported subjective improvement in stability, however, recurrent instability rates were not significantly different among those who did and did not wear a brace. Dickens et al. demonstrated similar findings; bracing was used in 61% of athletes returning to sport, however, there was no correlation between brace use and rates of recurrent instability. Although there have not been any prospective randomized trials on the efficacy of brace wear in return to sport in non-operatively managed athletes, the studies that have included brace wear, do not conclusively support reduction in recurrent instability.

**Surgical Management**

Surgical management of recurrent shoulder instability continues to evolve as the number of outcomes studies increase, which provides the treating physician with an evidence base guideline to aid in decision making. The primary goal with surgical treatment is to provide the patient a stable shoulder preventing risk of further injury to the underlying bone and articular cartilage of both the glenoid and humeral head, as well as choosing a procedure that has the lowest risk of recurrent instability. Several factors go into this decision-making, including status of the labroligamentous complex, degree of bone loss on either the glenoid or humerus, as well as number of previous surgeries.

Options for surgical intervention include arthroscopic Bankart capsulorrhaphy, open Bankart capsulorrhaphy/or capsular shift, autograft bone augmentation of the glenoid such as latarjet, or use of iliac crest or distal clavicle, and allograft options such as distal tibial allograft. Choice of which procedure is appropriate is primarily based on patient related factors such as age, activity level, number of dislocations, previous failed instability surgery, and amount as well as location of bone involving either the anterior rim of the glenoid, humeral head (Hill
Sachs) or both. Historically, outcomes studies comparing arthroscopic and open Bankart repair have demonstrated a lower recurrence rate of dislocation with open procedures (5%–9% open capsulorrhaphy; 5%–33% arthroscopic Bankart).3,7,12,14,16,23 A recent meta-analysis16 (level of evidence 4) demonstrated similar clinical outcomes between arthroscopic and open shoulder stabilization procedures. Additionally, the authors found when studies were stratified by publication date that those published from 1995 through 2004 demonstrated a significant difference (P=0.15) in recurrence between open and arthroscopic stabilization favoring open surgery (Odds Ratio 1.964); studies published between 2005 through 2015 found no significant difference (P=0.29) between open and arthroscopic stabilization, but the odds ratio of 1.441 still favored open repair indicating that the arthroscopic group had a 44% higher risk of recurrence. In contrast, a systematic review by Harris et al.15 found no significant difference (P=0.06) in incidence of recurrent instability comparing arthroscopic (11%) to open (8%) stabilization techniques.

Leroux et al.19 performed a systematic review to determine pooled failure rates for stabilization of anterior shoulder instability in contact or collision athletes with additional stratification of failure rates according to modern evidence based surgical indications and techniques. The study design was to address the influence of outdated surgical indications and techniques, poor quality study design, and may not include how patient specific factors affect outcomes. The authors found that glenoid bone loss >20%, engaging Hill Sachs defect, preoperative number of dislocations (>3), age <20, sex, number of suture anchors (<4), and patient positioning for surgery all significantly influenced arthroscopic stabilization failure. The pooled instability recurrence rate following arthroscopic shoulder stabilization was 17.8%. When the authors applied the evidence based patient selection criteria and surgical technique (i.e., minimum of 3 suture anchors, excluded glenoid and/or humeral bone loss, use of the lateral decubitus position) this failure rate was 7.9%. These results indicated with proper patient selection and understanding of the pathology associated with shoulder instability is to the success of arthroscopic stabilization.

Conclusions
Timing of surgical intervention can also provide a challenge especially for the patient with a first time dislocation who is an in season athlete. It is important to make a proper diagnosis, perform thorough history and physical examination of the patient following anterior glenohumeral joint dislocation. Equally important is the counseling of the patient as to risks of recurrence as well as consequences of both nonoperative and surgical treatment. Understanding of the pathology and evaluation of the shoulder following anterior dislocation continues to be a rapidly growing area of research investigation.

REFERENCES