Review Article

Management of Shoulder Instability in the Skeletally Immature Patient

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Abstract

Several studies have focused on management of shoulder instability in the adolescent and young adult population. However, a paucity of literature exists regarding shoulder dislocation in the skeletally immature population. The presence of an open physis makes the dislocated pediatric shoulder a challenging clinical problem. In general, management includes prompt reduction and sling immobilization. In athletic patients aged ≥14 years with a Bankart lesion, early surgical intervention may be warranted because of the higher risk of recurrent instability. However, the literature on younger skeletally immature patients is less clear in terms of risk of further instability and the necessity of surgical intervention. In the skeletally immature population, a relatively low rate of recurrent instability after primary dislocation has been reported in the recent literature. Surgical intervention should be considered for patients with recurrent instability.

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J Am Acad Orthop Surg 2013;21: 529-537

http://dx.doi.org/10.5435/JAAOS-21-09-529

Participation of children and adolescents in organized sports in the United States has increased substantially in recent years and has resulted in a significant increase in the number of injuries seen in this patient population.[1] Several studies have focused on the management of shoulder instability in the adolescent and young adult patient; however, few studies have focused on shoulder dislocation in the skeletally immature patient. Most studies combine both adult and pediatric patients from a heterogeneous population.[2-5]

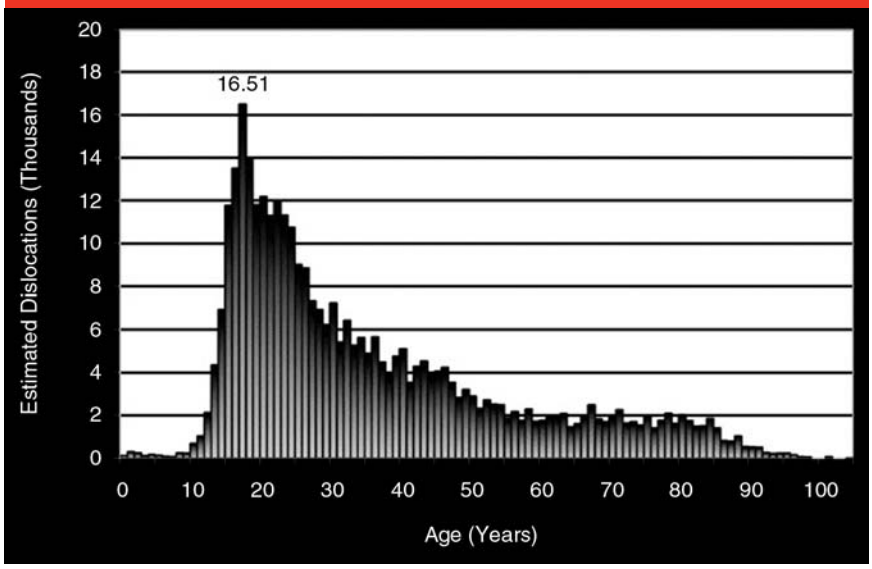
Studies on the natural history of instability in patients who sustain a first-time anterior shoulder dislocation consistently identify age as a predictor for recurrent instability, with re-dislocation over time more likely in younger patients than in older patients.[6-9] This finding has led surgeons to recommend surgical stabilization following initial shoulder dislocations in young patients who are at a high risk for recurrence.[9-12]

However, these studies have focused on older adolescents and young adults, and it is unclear whether treatment methods used in these populations can be extrapolated for use in the skeletally immature population. No consensus exists regarding the appropriate management of glenohumeral dislocation in these patients, and few studies examine outcomes in a homogeneous group of skeletally immature patients.[13-17]

Epidemiology

Approximately 20% of shoulder dislocations occur in persons aged ≤20 years.[18] Most of these are anterior dislocations and occur in the male pop-

Figure 1



Total weighted estimates of all shoulder dislocations in the United States between 2002 and 2006 from the National Electronic Injury Surveillance System demonstrating the overall distribution by age. (Reproduced with permission from Zacchilli M, Owens BD: Epidemiology of shoulder dislocations presenting to emergency departments in the United States. *J Bone Joint Surg Am* 2010;92[3]:542-549.)

Figure 2

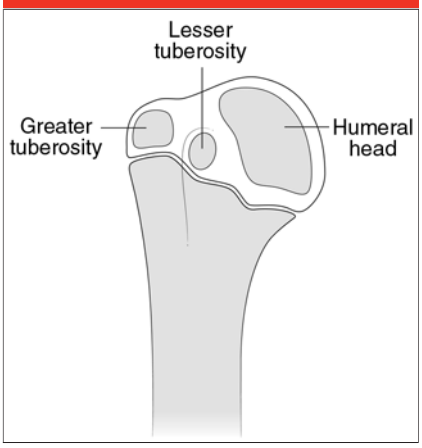


Illustration demonstrating the centers of ossification in the proximal humerus. The ossification center of the humeral head is typically identified after age 6 months. The ossification centers of the greater tuberosity and lesser tuberosity are identified by age 7 months to 3 years and by age 2 to 5 years, respectively. Fusion occurs between ages 5 and 7 years to compose the proximal humeral epiphysis. (Adapted with permission from O'Brien SJ, Voos JE, Neviaser AS, Drakos MC: Developmental anatomy of the shoulder and anatomy of the glenohumeral joint, in Rockwood CA, Matsen FA, Wirth MA, Lippitt SB, Fehringer EV, Sperling JW, eds: *The Shoulder*, ed 4. Philadelphia, PA, Saunders, 2009, pp 1-31.)

ulation.[13,19] Traumatic glenohumeral dislocations are rare in persons aged ≤10 years, accounting for <2% of traumatic dislocations.[13] The overall estimated incidence of shoulder dislocation in the United States is 23.9 per 100,000 person-years, with substantially more dislocations occurring in the 20- to 29-year age group than in the zero to 9-year age group, with 47.8 versus 0.92 per 100,000 person-years, respectively (Figure 1).[13]

Normal Versus Pathologic Anatomy

The proximal humeral physis has great ability to remodel and contributes to most of the longitudinal growth of the humerus, which is composed of three primary centers of ossification: the humeral head and the greater and lesser tuberosities (Figure 2). These ossification centers close between age 5 and 7 years to form a single proximal humeral physis that fuses to the humeral shaft between the ages of 14 and 17 years.[20]

Static and dynamic stability of the shoulder is provided by the capsuloligamentous and muscular structures of the shoulder. Different structures contribute to the stability of the glenohumeral joint based on the position of the arm. The anterior and posterior bands of the inferior glenohumeral ligament provide stability in both the anterior-posterior and inferior planes with the arm in 90° of abduction and external rotation. The middle glenohumeral ligament contributes to stability in the anterior-posterior plane, with the arm in the midrange of abduction and external

Dr. Gulotta or an immediate family member is a member of a speakers' bureau or has made paid presentations on behalf of and serves as a paid consultant to Biomet. Dr. Dines or an immediate family member has received royalties from Biomet; serves as a paid consultant to ConMed Linvatec and Tornier; and has received research or institutional support from BioMimetic Therapeutics. Dr. Owens or an immediate family member serves as a paid consultant to DePuy Mitek and the Musculoskeletal Transplant Foundation and serves as a board member, owner, officer, or committee member of the American Orthopaedic Society for Sports Medicine and the Society of Military Orthopaedic Surgeons. None of the following authors or any immediate family member has received anything of value from or has stock or stock options held in a commercial company or institution related directly or indirectly to the subject of this article: Dr. Li, Dr. Ma, and Dr. Nielsen.

rotation. The superior glenohumeral ligament and rotator interval contribute to shoulder stability in the inferior direction with the arm in the adducted position.[21]

The glenohumeral joint permits a wide range of shoulder motion, but it is inherently unstable because the glenoid is much smaller and flatter than the humeral head. Consequently, shoulder stability is primarily conferred by soft-tissue structures, including the muscle tendon units, ligaments, capsule, and labrum. True capsuloligamentous injury in the skeletally immature shoulder is rare.[22,23]

It has been suggested that the capsule of the pediatric shoulder is much more elastic than that of adults, allowing for more resilience.[14,16] Furthermore, the insertion of the capsule on the glenoid is more laterally based in the skeletally immature patient, thereby resulting in a smaller anterior-inferior recess.[24] Once healed, this capsular anatomy would impart increased tension on the anterior capsule, making recurrent instability less likely.[14]

Finally, in the skeletally immature shoulder, the proximal humeral physis is extra-articular, except on the medial aspect of the physis, where the joint capsule attaches more distally along the humeral shaft. The capsular attachment to the epiphysis tends to fail first during dislocation, making physeal fractures possible after shoulder dislocation in skeletally immature patients. Because ligaments are up to seven times stronger than bone in young children, fractures are more common than ligamentous ruptures.[5,11] Types of fracture include Salter-Harris type II epiphyseal separations in patients older than age 10 years and metaphyseal fractures in those younger than age 10 years.[22]

In pediatric patients, the exact pathoanatomy of glenohumeral dislocation has not been defined. However, Bankart lesions (ie, an injury to the anteroinferior glenoid labrum of the shoulder secondary to anterior shoulder dislocations) are not encountered in this population at the rate found in the young adult patient population.[25] Postacchini et al[16] reported on 33 patients aged 12 to 17 years with anterior dislocation and found only 1 Bankart lesion among the seven patients aged ≤14 years. Cordischi et al[26] found no discrete Bankart lesions in 14 skeletally immature patients who sustained an anterior dislocation; however, humeral avulsion of the glenohumeral ligaments was found in 3 patients who underwent surgical intervention. In a study of 63 young persons aged 17 to 23 years (average age, 19.6 years) with documented anterior shoulder instability treated arthroscopically, Taylor and Arciero[25] reported that 61 patients (97%) had Bankart-Perthes lesions, 57 (91%) had Hill-Sachs lesions, and only 1 had a humeral avulsion of the glenohumeral ligaments.

Natural History

Following nonsurgical management, the reported rate of shoulder re-dislocation in skeletally immature patients with an open proximal humeral physis ranges from 0% to 100%.[2-5,14,16,17,27-29] In a study of 21 adolescent patients (mean age, 13 years; age range, 4 to 16 years) with an open physis and a traumatic anterior dislocation, Marans et al[28] reported that the re-dislocation rate was 100%. In a series of 9 patients (mean age, 13.5 years; age range, 12 to 16 years) with open growth plates, Wagner and Lyne[17] reported an 80% re-dislocation rate (8 of 10 shoulders) after treatment with immobilization and physical therapy. In contrast, Deitch et al[14] reported a recurrence rate of only 53% in skeletally immature patients aged <13 years compared with 88% in the skeletally mature group. In 14 patients (age range, 10 to 13 years) with an open physis who underwent nonsurgical treatment for an anterior shoulder dislocation, Cordischi et al[26] reported a 21% rate of recurrence. Postacchini et al[16] found that only 1 in 3 patients (33%) younger than age 13 years had recurrent dislocation. In a European multicenter analysis of 54 patients with anterior dislocation, no recurrence was reported in patients aged <14 years compared with a recurrence rate of 69% in patients aged ≥14 years.[5]

Clinical Evaluation

Shoulder instability in the adolescent population can be traumatic or atraumatic in etiology. This distinction is crucial for proper management. Patients with traumatic shoulder dislocation often present with an obvious deformity, pain, and limitations in shoulder range of motion. To develop a treatment plan, the surgeon must determine the mechanism of injury and the position of the arm at the time of trauma and consider the patient's sports participation and expected goals.

Typically, the inciting event is either a translational event without true subluxation, a subluxation event with spontaneous reduction (transient subluxation),[30] or complete dislocation that requires manual closed reduction. The patient may report a history of shoulder "slipping" or "coming out, then going back in," which may indicate a subluxation event. In a true dislocation, the injured arm is typically adducted and internally rotated in an anteroinferior dislocation. Because many skeletally immature patients are thin, the humeral head may be palpable in the axilla. The acromion may appear prominent, with an infe-

rior cavity present where the humeral head would normally sit.

Clinical examination should always begin with a thorough inspection for deformity and atrophy as well as an evaluation of scapular dynamics.[30] A thorough neurovascular examination of the injured extremity should be performed and documented. The axillary nerve is the most commonly injured neurovascular structure; injury to this nerve is reported in up to 42% of traumatic anterior shoulder dislocations.[31] Injuries to other nerves also have been reported, including injury to the suprascapular nerve (14%), radial nerve (7%), musculocutaneous nerve (12%), median nerve (4%), and ulnar nerve (8%).[32,33]

The mainstay of the instability examination is the load and shift test, which is performed in the anterior, posterior, and inferior directions with the patient in the supine or seated position. The humeral head is first centered in the glenoid fossa and the test is performed and graded as 0 (normal translation); 1+ (translation to the rim and back); 2+ (translation over the rim followed by spontaneous reduction); or 3+ (translation over the rim without spontaneous reduction).

The sulcus sign is the dimpling along the lateral border of the acromion when the humeral head is inferiorly subluxated on the glenoid. This sign is used to assess for glenohumeral instability, and it is important to differentiate between unidirectional instability and multidirectional instability.

Generalized joint laxity also should be assessed using the Beighton scoring system (0 to 9 point scale).[34] In this system, points are assigned for elbow or knee hyperextension (>10°), ability to put both hands flat on the floor while standing with the knees straight, ability to touch the thumb to the forearm, and ability to bend the metacarpophalangeal joint of the fifth finger >90°. Patients with normal laxity typically score between 0 and 2 points, whereas a score >4 points indicates hypermobility or joint laxity.

Anterior apprehension and relocation signs have also been shown to be important for diagnosis of anterior traumatic subluxation or dislocation events, which can result in a high rate of labral and Hill-Sachs lesions.[30]

Radiographic Evaluation

Initially, plain radiographs of the shoulder are obtained when dislocation is suspected. Orthogonal views of the shoulder, including AP and supine axillary or West Point axillary views, are obtained after reduction to visualize and localize the humeral head relative to the glenoid cavity. The axillary view is particularly important because it can confirm whether the humeral head is centered within the glenoid. The proximal humeral physis should be evaluated closely because it can be injured at the time of dislocation and/or during reduction. Similar to the adult shoulder, postreduction views of the pediatric shoulder may reveal a posterolateral humeral head impaction (Hill-Sachs lesion) following an anterior inferior shoulder dislocation. Other associated pathology includes osseous Bankart lesions or glenoid rim fractures.[25]

Although MRI is typically not necessary or practical in the acute setting, it does provide specific details regarding concomitant soft-tissue injuries following a shoulder dislocation. Furthermore, unlike radiography and CT, MRI does not expose the skeletally immature patient to additional radiation.[35] MRI is best used to evaluate the injury to the shoulder capsule and labral tissue that often accompanies a shoulder dislocation.

Magnetic resonance arthrography is useful for classification of acute and chronic anteroinferior ligamentous injuries to the labrum; this imaging modality has a sensitivity of 77% and specificity of 91%.[36] A skeletally immature patient typically will not have a capsulolabral disruption, and the anatomy of the physis may be mistaken for a Hill-Sachs lesion (Figure 3). The status of the labral tissue and presence of a bony or soft-tissue Bankart lesion may affect treatment decisions for the skeletally immature patient with a shoulder dislocation (Figure 4).

Injury Classification

Because no specific classification exists for shoulder dislocation in the skeletally immature population, these injuries are classified based on criteria for adult shoulder dislocation: degree of stability, chronicity, frequency, direction, volition, and etiology. The degree of stability, specifically whether the shoulder is truly dislocated or subluxated, should be considered when classifying the injury. Also, the chronicity (acute versus chronic dislocation) and frequency (recurrent) of the dislocation as well as whether the dislocation is locked should be noted. The surgeon should evaluate the direction of the dislocation (eg, subcoracoid, subglenoid, intrathoracic) and should note whether the patient voluntarily contributed to the dislocation. The mechanism of injury also should be considered and may be described as atraumatic or traumatic. In patients with multidirectional instability, assessment of ligamentous laxity is important.

Management of Shoulder Dislocation

Initial

Following physical examination and standard radiographic assessment of the shoulder, closed reduction is per-

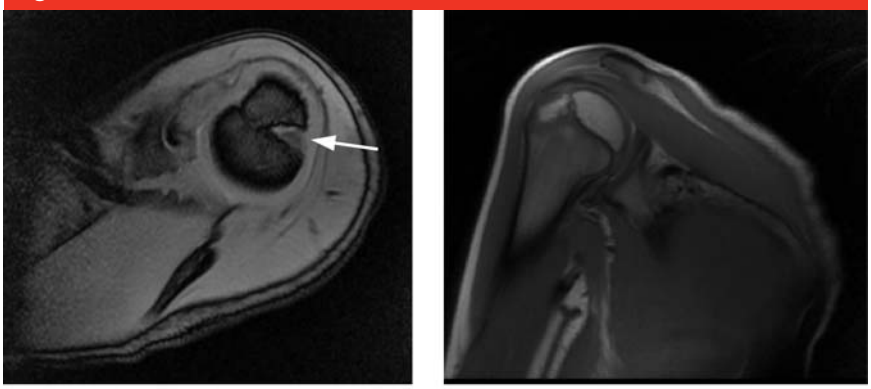
formed. Several reduction techniques have been described in the literature.[37] Gentle constant traction rather than a forceful jerking motion should be used to minimize iatrogenic injury, especially injury to the proximal humeral physis. In an acute setting, a shoulder dislocation may be reduced without the use of anesthesia. However, in the setting of prolonged dislocation with significant shoulder pain and muscle spasm, the use of sedation is important to reduce the shoulder in a controlled fashion. Most reductions can be performed in the emergency department if the medical staff can provide adequate sedation in that setting.

Once reduction is achieved, the neurovascular examination should be repeated and postreduction imaging should be performed. Reduction of the humeral head within the glenoid fossa must be verified on axillary radiographs. With regard to more definitive management of anterior shoulder instability in the skeletally immature patient, we recommend the use of the treatment algorithm shown in Figure 5.

Nonsurgical

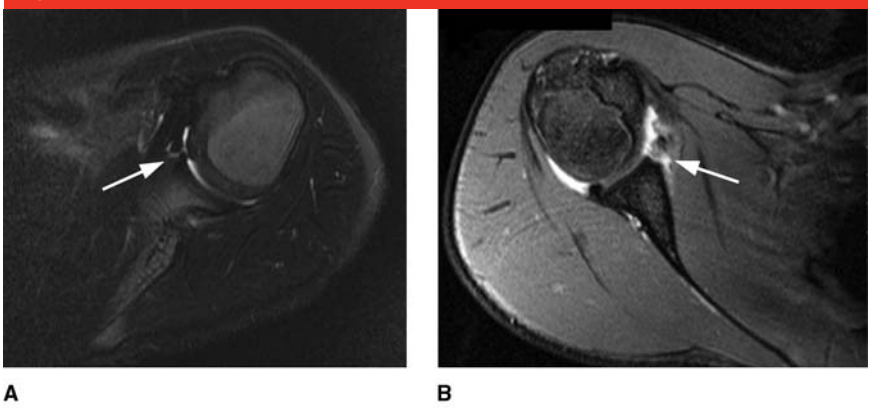
Following reduction of a primary anterior shoulder dislocation, management consists of immobilization, physical therapy, and/or surgical stabilization. The anatomic differences between skeletally immature and mature patients may influence the choice of initial treatment. Skeletally immature patients have greater elasticity of the capsular structures, which may reduce trauma to the capsulolabral complex or bone structures secondary to the dislocation event.[11] This increased tissue laxity may have clinical relevance. In a study of 28 adolescent patients aged 12 to 17 years at the time of dislocation, Postacchini et al[16] performed a radiographic evaluation at a mean of 7 years after dislocation. In patients aged 14 to 17 years at the time of dislocation, the recurrence rate was 92% and, in each of these patients, the authors observed a Bankart lesion on imaging that required subsequent surgical intervention. However, in the ≤13-year age group, no Bankart lesions were seen on MRI, and all patients were successfully treated nonsurgically. The authors concluded that the shoulders of patients in the younger age group had little tendency to redislocate, which may be secondary to the elasticity of the capsule. This elasticity may help prevent permanent changes to the

Figure 3



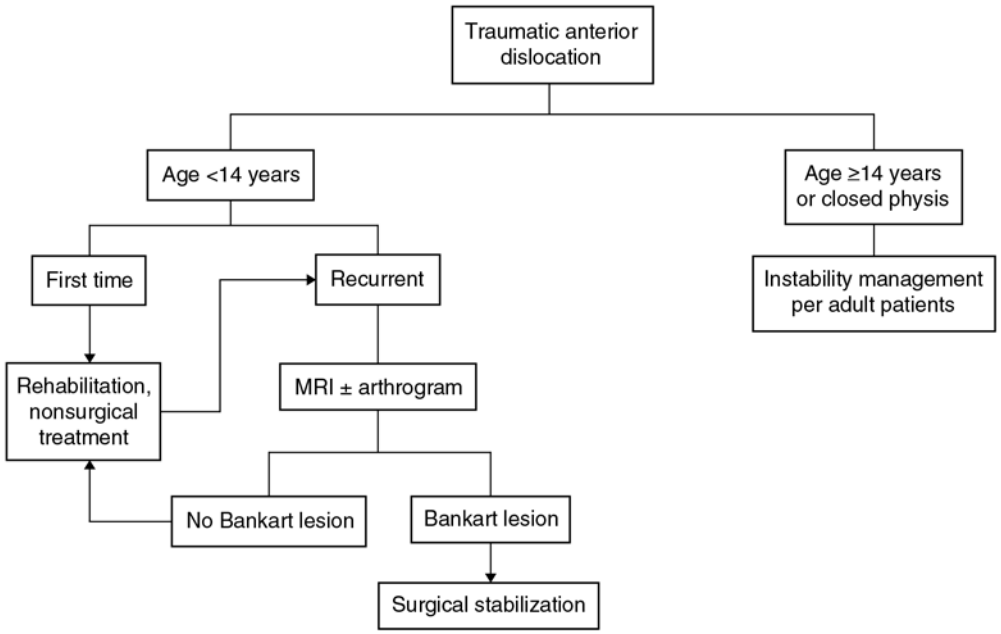
Axial (**A**) and coronal (**B**) T1-weighted magnetic resonance images of the shoulder in a 9-year-old boy. The images were obtained 1 week after reduction of an anterior glenohumeral dislocation was performed in the emergency department. The axial view demonstrates what appears to be a Hill-Sachs lesion at the proximal humeral physis (arrow). This lesion is not visible on the coronal view.

Figure 4



A, Postreduction axial T2-weighted magnetic resonance image of the shoulder in a 9-year-old boy who had an anterior glenohumeral dislocation. The reduction was performed in the emergency department. The anteroinferior capsulolabral tissue (arrow) was intact, with no evidence of a Bankart lesion in all views. **B,** Postreduction axial T2-weighted magnetic resonance image of the shoulder demonstrating a bony Bankart lesion (arrow) in a 14-year-old boy with an anterior glenohumeral dislocation. The reduction was performed in the emergency department.

Figure 5



The authors' recommended treatment algorithm for anterior shoulder instability in the skeletally immature patient.

capsulolabral complex after the primary dislocation.

After a primary shoulder dislocation, most pediatric patients are treated with a period of sling immobilization. Compliance with immobilization can be a matter of concern in this population, particularly when shoulder pain subsides. Duration of immobilization and the position of the arm during immobilization remain topics of debate. Several studies have reported shoulder immobilization ranging from 1 to 6 weeks;[2,3,11,16,17] however, no studies have directly evaluated the relationship between duration of immobilization and recurrence of instability in the skeletally immature population. Most of the literature on pediatric shoulder dislocation describes the arm immobilized in an adducted and internally rotated position. Potential beneficial effects of immobilization with the shoulder in external rotation have been reported in the adult population after anterior shoulder dislocation,[32,33] but a recent study has called this finding into question.[38] Immobilization of the arm in external rotation has been found to be a more physiologic position for healing in patients with anteroinferior glenoid labrum tears.[35]

Following a period of immobilization, physical therapy remains one of the mainstays of treatment for shoulder dislocation in pediatric patients. A gradual strengthening program is generally advocated.[18] In a study of 66 patients (70 shoulders) with the first episode of instability occurring at age ≤16 years, Lawton et al[39] reported that physical therapy was the initial form of treatment in 67% of first-time shoulder dislocations and remained the final form of treatment in 42 shoulders (60%). The remaining 28 shoulders (40%) underwent a variety of surgical interventions; this rate of surgical intervention is similar to that reported in other shoulder studies that focus on the pediatric/adolescent population.[18] Although physical therapy is commonly prescribed for the skeletally immature patient after a shoulder dislocation, it is probably of limited benefit in preventing recurrent instability events. Furthermore, physical therapy may not be necessary or practical following a shoulder dislocation in very young patients, such as toddlers.[11]

Surgical

In the skeletally immature patient, the goal of surgical management of shoulder instability is to minimize the risk of recurrent instability episodes. Several surgical approaches have been described, including open, arthroscopic, and arthroscopic-assisted open procedures. The advantages of arthroscopy include improved visualization and assessment of the glenohumeral joint with less soft-tissue disruption and potentially faster recovery. Surgical principles for treatment of skeletally immature patients are similar to those for adult patients.

If pathologic laxity or multidirectional instability exists, repair of a Bankart lesion along with an anterior capsulorrhaphy is essential. Favorable outcomes have been reported following surgical fixation of labral lesions in skeletally immature patients. Kraus et al[37] reported on a small case series of adolescents with an average age of 12 years (age range, 11 to 15 years) who were treated with open or arthroscopic labral repair using suture anchors. Average follow-up was 26 months. At final follow-up, the subjective and objective outcomes were excellent, with mean Constant scores of 92 and Rowe scores of 97.5. Furthermore, no additional redislocation events were reported among the patients who underwent surgical treatment. Jones et al[15] reported similar results in a study of arthroscopic Bankart repair performed in 30 pediatric patients aged 11 to 18 years. The average follow-up was slightly more than 2 years. The authors reported excellent functional outcome scores and successful reduction in the number of instability episodes in this age group.

Outcomes

The choice of surgical versus nonsurgical management of primary shoulder dislocation, and the appropriate timing of surgical intervention in the skeletally immature patient population, remain topics of debate. The question whether anatomic differences between skeletally immature patients and those of older adolescents and young adults result in lower rates of recurrent instability episodes without surgery is central to the debate. For young active adults, early surgical stabilization after an initial dislocation may be beneficial.[9,10] In a systematic review, Brophy and Marx[40] examined studies that compared surgical and nonsurgical management of traumatic anterior shoulder instability. The authors reported a significantly lower rate of recurrent instability in patients (mean age, 24 years) treated with surgical stabilization compared with nonsurgical treatment (7% versus 46%).

Unlike the literature on shoulder dislocations in young adults, the literature on primary shoulder dislocations in skeletally immature patients is less clear with regard to the use of surgical versus nonsurgical methods. Wagner and Lyne[17] reported on 10 recurrent shoulder dislocations in nine pediatric patients (mean age, 13.5 years; age range, 12 to 16 years) with an open physis. All shoulders were initially treated with immobilization and physical therapy; however, 8 of 10 shoulders ultimately required surgery secondary to recurrent instability. Deitch et al[14] reported similar results in a study of 32 adolescent patients (age range, 11 to 18 years) with anterior shoulder dislocation. Analysis of a subgroup of 15 patients with an open proximal humerus physis at the time of dislocation, revealed a recurrence rate of 53% (8 of 15 patients) after nonsurgical management. Although this rate is significant, it was substantially lower than that reported in patients with a closed proximal humerus physis (88% [14 of 17 patients]).

Successful nonsurgical treatment of primary shoulder dislocation in skeletally immature patients has been described, as well. In a multicenter retrospective analysis, Lampert et al[5] reviewed a series of 54 young patients, 12 of whom were younger than age 14 years and were skeletally immature. The recurrent instability rate in this subset of younger patients was zero after nonsurgical management. Similarly, the rate of recurrent instability in patients younger than age 14 years has been reported to be <5% in the European literature.[5,41] More recently, Cordischi et al[26] reported on outcomes of nonsurgical and surgical management of anterior traumatic shoulder dislocation in 14 skeletally immature patients (age range, 10 to 13 years). The authors reported that patients treated nonsurgically fared better at final follow-up, with higher Western Ontario Shoulder Instability scores than their surgical counterparts.[13] Furthermore, only 3 of 14 patients (21%) had recurrent instability after nonsurgical treatment.

Based on current evidence, treatment of primary shoulder dislocation in patients younger than age 14 years should be nonsurgical (Table 1). Recent literature supports a markedly lower rate of recurrent instability associated with nonsurgical management than that reported in the older literature. This difference could be the result of different definitions of "recurrent instability." Both apprehension/transient subluxation and dislocation that require reduction may have been classified into a single category, resulting in the higher reported rates. Moreover, most of the studies have inherent limitations based on patient numbers, mixed patient population, and study design. Additional studies on shoulder instability in skeletally immature patients are needed to further elucidate clinical outcomes and recurrent instability following primary anterior shoulder dislocation in this particular patient population.

Summary

Pediatric shoulder instability after primary glenohumeral dislocation can be a challenging clinical problem. Unlike older adolescents and adults, primary shoulder dislocation is rare in the skeletally immature patient. Proper management includes prompt reduction and sling immobi-

Table 1

Nonsurgical Treatment Outcomes in Skeletally Immature Patients With Open Physes and Anterior Glenohumeral Instability

Study	No. of Patients	Other Pathology	Management	Nonsurgical Recurrence Rate
Cordischi et al[26]	14 (age, ≤13 y)	8 GT fractures, 3 HAGL	Sling, NWB × 4 wk	21%
Marans et al[28]	11 (age, ≤13 y)	NR	No immobilization (6 patients); sling or Velpeau dressing × 4 wk (1 patient), sling or Velpeau dressing × 6 wk (4 patients)	100%
Postacchini et al[16]	3 (age, ≤13 y)	NR		33% in ≤13 y age group 92% in 14–17 y age group
Deitch et al[14]	15 total (6 aged ≤13 y)	NR	All patients had 1–8 wk immobilization, 15 had physical therapy after immobilization	53% (8 patients)[a]
Wagner and Lyne[17]	9 total (6 aged ≤13 y; 10 total shoulders)	No Hill-Sachs lesions on radiographs	Velpeau immobilizer × 4 wk, sling × 2 wk	67% (4 of 6 patients aged ≤13 y had recurrences) 8 of 10 shoulders (80%) had recurrences[b]
Lampert et al[5]	12 (age ≤14 y)	None (patients with concomitant fracture or nerve lesions were excluded)	Immobilization with Gilchrist bandage × 2–3 wk	None
Total	64 (65 shoulders)	8 GT fractures, 3 HAGL, none reported in 5 of 7 studies	NA	48% (31 of 64 patients) overall in the literature

GT = greater tuberosity, HAGL = humeral avulsion of the glenohumeral ligaments, NA = not applicable, NR = not reported, NWB = non–weight bearing

[a] The surgical recurrence rate was not reported by age group. Sixteen of 32 patients went on to surgical intervention.

[b] Seven of 10 shoulders (70%) went on to surgical intervention.

lization. Because of the high risk of recurrent instability, early surgical intervention may be warranted in athletic patients aged ≥14 years with evidence of a Bankart lesion on MRI. However, the literature on younger skeletally immature patients is less clear in terms of risk of further instability and the necessity of surgical intervention. Because a markedly lower rate of recurrent instability after primary dislocation has been recently reported in the skeletally immature population, nonsurgical management with either sling immobilization and/or physical therapy remains the mainstay of treatment in patients younger than 14 years without a Bankart lesion. Patients who have recurrent instability after prolonged nonsurgical management may benefit from surgical intervention.

References

Evidence-based Medicine: Levels of evidence are described in the table of contents. In this article, references 6 and 32 are level II studies. References 3, 5, 9, 33-35, and 39 are level III studies. References 2, 4, 8, 10, 12-17, 19, 23, 25, 26, 28-31, and 36-38 are level IV studies.

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