Current Approach to the Diagnosis and Management of Shoulder Dislocation in Children

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Abstract: Shoulder dislocations are a common presentation to the emergency department. Although many cases may be diagnosed by history and clinical examination alone, imaging may help diagnose more challenging cases. Three-view radiographs are important for identifying subtle posterior dislocations, and ultrasoundography has been gaining evidence as an alternate diagnostic modality. Intra-articular lidocaine and nerve blocks may improve pain control and reduce the need for procedural sedation. Multiple, evidence-based reduction techniques are described including tips for improving success. Immobilization strategies and follow-up are also discussed.

Key Words: shoulder, dislocation, pediatric

TARGET AUDIENCE

This CME activity is intended for practitioners who care for pediatric patients presenting with possible shoulder dislocation, which may include general pediatricians, pediatric emergency physicians, general emergency physicians, orthopedic surgeons, and sports medicine specialists.

LEARNING OBJECTIVES

After completion of this article, the practitioner should be better able to:

1. Interpret the current diagnostic modalities and findings on x-ray in pediatric patients with suspected shoulder dislocation.
2. Compare the different reduction techniques for acute shoulder dislocation.
3. Evaluate the disposition and follow-up recommendations for patients after reduction of a shoulder dislocation.

Anterior dislocations are the most common type of shoulder dislocation due to the angle of articulation, as well as the mechanism required to induce the injury.1,6 Anterior dislocations typically occur when the shoulder undergoes excessive abduction and external rotation, most commonly due to a fall on an outstretched arm.1,7 Posterior dislocations occur 2% to 5% of the time and are associated with falling with the arm in an adducted, flexed, and internally rotated position.1,8,9 These may also occur with diffuse muscular contractions, such as seizures or electrical injuries, in which the powerful internal rotators overwhelm the much weaker external rotators.1,10 Inferior dislocations (ie, luxatio erecta) are rare, occurring in 0.5% of all cases.11,12 These injuries are caused by falls or axial pulling in extreme hyperabduction, such as with rock climbing.1

Differential Diagnosis

The differential diagnosis of glenohumeral dislocation includes acromioclavicular (AC) separation and humeral fracture. Acromioclavicular separation typically occurs because of a fall onto the shoulder of an adducted arm. The patient will have point tenderness of the AC joint on examination with normal range of motion and ability to touch the contralateral shoulder with the affected side's hand. Radiographs may be normal or demonstrate widening of the AC joint. Humeral fracture can present with pain and limited range of motion. However, there will typically be a palpable deformity and significant swelling present. Radiographs will assist with this diagnosis. Finally, one should be cognizant that septic arthritis may mimic shoulder dislocation on radiographs. This is because of the inferior displacement of the humerus due to the intra-articular infection. However, clinical history and physical examination should help to differentiate this condition.

History and Physical Examination

Patients will typically present with arm pain and limited range of motion after a fall or direct trauma to their shoulder. The shoulder may have a “squared-off” appearance, wherein the arm loses the normal contour on the affected side with a flat deltoid appearance and a prominent acromion process. In some patients, the humeral head may be palpable anterior or inferior to the coracoid process. The arm will often be held in slight abduction and external rotation, and the patient will be unable to touch the contralateral shoulder with his or her affected hand. Inferior dislocations present differently, with the arm locked in hyperabduction and the elbow held above the patient’s head due to inability to lower the arm.

As with all orthopedic injuries, it is important to perform a neurovascular assessment. Although vascular injuries are rare, axillary nerve injury is a common complication associated with shoulder dislocations.13,14 The axillary nerve provides sensation to the deltoid area of the arm and assists with abduction at the glenohumeral joint. Motor testing is preferred when assessing for injury, as sensory testing may be inaccurate because of overlapping cutaneous nerve root dermatomes. Deltoid function can

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be evaluated by having the patient attempt shoulder abduction while feeling for contraction of the deltoid muscle group.

Imaging

Studies have demonstrated that providers can clinically detect shoulder dislocations with excellent accuracy and that clinically significant fractures are rare.13–18 However, many practitioners still obtain imaging both before and after the reduction. Reid et al9 demonstrated that clinically-significant fractures are also uncommon in pediatric patients after shoulder dislocations. In addition, Orloski20 demonstrated that the risk of fractures increases with age, with less than 1% of fractures identified in the second and third decades of life. However, one should maintain a lower threshold for imaging before reduction in skeletally immature patients (ie, younger than 14 years).3

Radiography is the most commonly utilized diagnostic modality and should include 3 views: anteroposterior, scapular “Y,” and axillary views (Fig. 1). Studies have demonstrated that obtaining an anteroposterior and scapular view alone may be insufficient for diagnosing posterior dislocations.21,22 If the patient cannot tolerate a standard axillary view, a Velpeau axillary or angle-up view may be performed instead.9,23

In an anterior shoulder dislocation, the humerus will appear anterior, medial, and inferior to its normal location within the glenoid fossa (Fig. 2). Posterior dislocations may be subtler on x-ray and may be misdiagnosed in 60% to 79% of cases.8,9 However, there are several radiographic signs to assist with diagnosing a posterior shoulder dislocation. The lightbulb sign refers to the rounded appearance of the internally rotated humeral head giving it the appearance of a lightbulb (Fig. 3).1,9 The trough line sign is a dense vertical line seen in the medial humeral head, which represents a reverse Hill–Sachs lesion seen with posterior dislocations (Fig. 4).1,24,25 The rim sign refers to glenohumeral joint widening greater than 6 mm. Finally, there can be loss of the Moloney’s line.9 Moloney’s line is a horizontal line connecting the inferior aspect of the glenoid rim to the inferomedial aspect of the humeral head and neck.9 Although often apparent clinically, inferior shoulder dislocations can be identified by an inferiorly displaced humeral head with the humerus fully abducted superiorly in all images (Fig. 5).

Several studies suggest that ultrasound may be a valuable tool for the diagnosis of shoulder dislocation with sensitivities and specificities approaching 100% when compared with 3-view radiographs in most studies.26–29 Protocols vary between studies with some utilizing the posterior approach to assess the glenohumeral distance,26,27 whereas others use a combination of the anterior (ie, coracohumeral distance) and lateral approaches (ie, acromiohumeral distance).28,29 Unfortunately, no studies were performed specifically within the pediatric population. Although further studies are needed to determine the optimal approach and specific accuracy within the pediatric population, this modality has the potential to save time, radiation exposure, and the potential need for resedation.

Management

Reduction should be performed expeditiously because neurovascular complications increase with time.13 When performing a reduction of the shoulder, it is important to ensure that the patient has sufficient analgesia.

This may be performed with systematic analgesics, as well as intra-articular lidocaine injections. Studies have demonstrated that intra-articular lidocaine may be safer than systematic analgesics for acute shoulder dislocations but has not been associated with improved reduction success.30,31 This is performed by palpating for the sulcus inferior to the acromion process, where the humerus would normally reside. The needle is inserted in the center of the sulcus (approximately 2 cm inferior to the midline of the acromion process). Hematoma will typically be aspirated and 20 mL of 1% lidocaine can be injected into the intra-articular space. Ultrasound guidance may be a valuable adjunct to improve accuracy of the inject, especially in patients with more difficulty anatomy.32–34 Regardless of the technique, it is important that the injection be performed with sterile technique to avoid causing a septic joint.

Another approach for analgesia is to perform a nerve block of the interscalene portion of the brachial plexus. This can provide complete analgesia to the shoulder without the risks associated with procedural sedation. A number of studies have demonstrated that this technique is effective, can be performed by emergency department providers, and results in a significantly decreased length of stay when compared with procedural sedation.35–38

In some cases, procedural sedation may be required to ensure adequate pain control and muscular relaxation. When performing reductions, it is essential that the procedure is performed slowly and in a controlled fashion to avoid muscle spasm and reduce the trauma associated with the reduction attempt.

There are numerous techniques described for the reduction of acute shoulder dislocation. Although a complete list of every reduction technique is beyond the scope of this article, the most commonly utilized approaches have been included below. This will provide the reader with a variety of different techniques, because no single technique is universally successful.

The external rotation method of Leidelmeyer involves placing the patient supine and gently rotating the arm externally.39 Reduction will typically occur at 70 to 110 degrees of external rotation. Despite common misconception, no longitudinal traction...
is applied with this technique.\textsuperscript{40} External rotation has been suggested to be successful in 81\% to 91\% of patients.\textsuperscript{41,42}

The Milch technique involves gently abducting the arm over the patient’s head while applying in-line longitudinal traction and rotating externally. The operator’s other hand provides gentle pressure to the humeral head. If reduction does not occur, the externally rotated upper arm is lifted in the sagittal plane and then internally rotated to bring the patient’s hand to the opposite shoulder. Successful reduction with the Milch technique has been demonstrated to occur in 69\% to 100\% of patients.\textsuperscript{43–47}

The Stimson technique involves placing the patient in a prone position and hanging a 5- to 10-lb weight from the hand of the affected arm. The shoulder will gradually reduce as the muscles fatigue, allowing for reduction without the need for the provider to apply any traction. This may be valuable for the busy provider, as the reduction may occur without the need for the primary provider to remain in the room. However, studies have suggested poor success rates ranging from 25\% to 83\% when this technique is used in isolation.\textsuperscript{45,48} It has been suggested that flexing the patient’s elbow to 90 degrees to allow relaxation of the biceps tendon may facilitate reduction with this technique.\textsuperscript{49,50}

The Spaso technique is similar to the Stimson technique in that slow and steady force is applied to the flexed shoulder. With the Spaso technique, the patient lies supine while a provider provides in-line traction to the shoulder, lifting it toward the ceiling. The arm is gently oscillated back and forth while maintaining the arm in external rotation. This technique may be modified by bending the elbow and using the epicondyles to elevate the arm.\textsuperscript{51} This approach has been suggested to be 88\% to 95\% successful.\textsuperscript{52–54}

Scapular manipulation is a technique focused on repositioning the glenoid fossa rather than the humeral head and requires less force than other techniques. With this approach, the provider stabilizes the superior aspect of the scapula and applies a medially directed force to the inferior tip, allowing the scapula to rotate into a more favorable alignment with the humeral head. Studies have demonstrated success rates ranging from 79\% to 100\%.\textsuperscript{55–58} This technique is often combined with the Stimson approach in the prone position or with external rotation in the seated position. The latter technique is commonly referred to as the “best of both” technique.\textsuperscript{59}

The FARES (FAst, RELiable, and Safe) technique is performed in the supine position with the provider holding the arm with the elbow extended and in a neutral wrist position. The provider slowly abducts the arm while applying steady longitudinal traction. While maintaining the longitudinal traction, the provider performs continuous short vertical (ie, perpendicular to the patient) oscillations to assist with muscular relaxation. Studies have demonstrated a success rate of 89\% to 95\% with this technique.\textsuperscript{62,60}

The traction-countertraction technique involves 2 clinicians applying opposing forces to the glenohumeral joint. One sheet is

\begin{figure}[h]
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\includegraphics[width=\textwidth]{figure2.png}
\caption{A, Anteroposterior; B, Y-view; and C, axillary view of an anterior dislocation of the shoulder.}
\end{figure}

\begin{figure}[h]
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\includegraphics[width=\textwidth]{figure3.png}
\caption{Lightbulb sign of posterior dislocation. (Image courtesy of Dr Anupam Basu).}
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\begin{figure}[h]
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\includegraphics[width=\textwidth]{figure4.png}
\caption{Trough line sign of posterior dislocation. (Image Courtesy of Dr. Anupam Basu).}
\end{figure}
wrapped around the patient’s axilla and the first provider’s waist, while a second sheet is wrapped around the patient’s flexed elbow and the second provider’s waist. The 2 providers slowly lean backward, providing steady, opposing forces until the shoulder is relocated. Gentle internal and external rotation of the patient’s arm may facilitate reduction. This technique has been demonstrated to be highly successful but is associated with a longer time to reduction and significantly more pain that the other techniques listed above.61

The Cunningham technique is a newer reduction method based on a combination of humeral and scapular repositioning combined with specific massage of the biceps muscle to reduce spasm. The provider sits across from the patient and provides gentle downward traction on the humerus while massaging the biceps muscle at the midhumerus. The patient is asked to elevate and retract the shoulders helping to realign the glenohumeral articulation. The current data on the efficacy of this technique are limited to case reports, and further data are needed to compare this approach with the other techniques listed.40,62,63

Because of the positioning of the humerus with inferior dislocations, most of the previously described reduction techniques are not effective. For these types of dislocations, in-line traction and countertraction should be performed to disengage the humerus and convert the inferior dislocation into a simpler anterior dislocation.64 Then, one of the strategies mentioned may be used to reduce the anterior dislocation.

Complications

Complications associated with acute shoulder dislocation can include fractures, rotator cuff tears, and neurovascular injuries. The most common fractures are humeral head compression deformities (ie, Hill–Sachs lesion), glenoid rim defects (ie, Bankart fracture), and greater tuberosity avulsion fractures. Each of these injuries increases the risk of recurrent dislocations.65 Humeral neck or shaft fractures are rare and occur more commonly in older patients.66

Rotator cuff injuries are also more common in older adults. These injuries are difficult to detect immediately after the injury and are best identified at follow-up after the inflammation has resolved.

As previously mentioned, the axillary nerve is at highest risk of injury due to its location near the proximal humerus.67 Other neurologic or vascular injuries are much less common but do occur.67 Neurologic injuries are most commonly due to traction neurapraxia and improve with reduction of the humerus.14 Vascular injuries, when they occur, most commonly involve the axillary artery and can present with an absent radial pulse, axillary or lateral chest wall hematoma, or axillary bruit.67 Any signs of circulatory compromise should prompt rapid reduction.

Although small fractures are frequently associated with the initial injury, clinically significant fractures associated with modern reduction attempts are very rare.15–18

Disposition

All pediatric patients with dislocations should be provided with orthopedic surgery follow-up, because younger age is associated with significantly increased risk of recurrent dislocations.68–74 Limited evidence suggests that young, active patients older than 14 years may benefit from surgical intervention after a first-time dislocation.69,72 However, because of the greater elasticity of the capsular structures in skeletally immature patients, surgery may not be necessary after a first-time dislocation in younger patients.2,70

Patients may be immobilized using a sling and swathe or sling alone while awaiting orthopedic surgery follow-up. Conventionally, it was recommended that the shoulder be immobilized for 3 to 6 weeks.8 However, current evidence suggests that immobilization beyond 1 week is not associated with improved outcomes.72 Immobilization in external rotation has not been demonstrated to reduce rates of occurrence and may be more inconvenient for the patient.70 Therefore, it is reasonable to keep the patient in a sling in internal rotation for the first week until evaluated by a specialist. Regardless of whether surgery is necessary, it remains important to ensure follow-up to facilitate physical therapy and rehabilitation.2

REFERENCES


