Acute Shoulder Instability

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CASE 3

A 22-year-old female snowboard instructor is referred to an outpatient physical therapy clinic from a medical center with a diagnosis of right shoulder pain. She fell while snowboarding 3 days ago and reports that her shoulder "popped out and went back in again." She attempted to teach today but was unable to continue due to pain and a sense that her shoulder would "come out again" if she tried to help one of her fallen clients stand up. Plain film images taken at the clinic showed no obvious bony abnormality; no additional imaging was performed. The patient's medical history is otherwise unremarkable. Signs and symptoms are consistent with anterior shoulder dislocation. The patient's goal is to continue snowboarding and teaching for the rest of the season.

- What examination signs may be associated with this diagnosis?
- What are the most appropriate examination tests?
- What precautions should be taken during physical therapy examination and interventions?
- What are the most appropriate physical therapy interventions?
- What referral may be appropriate based on her condition?
- What is her rehabilitation prognosis?

KEY DEFINITIONS

ALPSA LESION: Acronym for anterior labroligamentous periosteal sleeve avulsion; an anteroinferior labral detachment associated with a stripped, but continuous glenoid periosteum

BANKART LESION: Avulsion of the labrum and inferior glenohumeral ligament from the anteroinferior glenoid rim[1]

HAGL LESION: Acronym for humeral avulsion of the anterior glenohumeral ligament

HEMARTHROSIS: Bleeding into a joint

HILL-SACHS LESION: Impression fracture of the posterosuperior articular surface of the humeral head caused by translation of the humeral head over the glenoid rim[2]

SHOULDER DISLOCATION: Complete disruption of the humeral head from the glenoid fossa due to a force that overcomes the joint's static, capsulolabral, and dynamic restraints[3]

SHOULDER SUBLUXATION: Increased excursion of the humeral head on the glenoid fossa without complete displacement; also known as an incomplete or partial dislocation[3]

SLAP LESION: Tear of the superior labrum, anterior to posterior

Objectives

1. Describe the mechanism of injury and the resulting pathoanatomy associated with an anterior shoulder dislocation.
2. Identify the risk factors for primary and secondary dislocations.
3. Describe the benefits and risks related to conservative treatment and surgical intervention following a first-time anterior shoulder dislocation.
4. Prescribe an appropriate therapeutic exercise program for a patient who elects conservative treatment following a first-time anterior shoulder dislocation.

Physical Therapy Considerations

Physical therapy considerations during management of the individual with a diagnosis of acute anterior shoulder instability:

- **General physical therapy plan of care/goals**: Decrease pain; minimize loss of neuromuscular control and strength; restore functional joint stability
- **Physical therapy interventions**: Patient education regarding functional anatomy and injury pathomechanics; patient education regarding treatment options; sling for comfort; modalities and manual therapy to decrease pain; periscapular and rotator cuff neuromuscular retraining; resistance exercises to increase muscular endurance and strength; functional bracing for return to activity

- **Precautions during physical therapy:** Initial avoidance of shoulder abduction and external rotation (ER) to prevent continued anterior instability
- **Complications interfering with physical therapy:** Impaired neurovascular status; reoccurrence of dislocation

Understanding the Health Condition

The shoulder is designed to maximize mobility, and as a result, it possesses the greatest range of motion of any joint in the human body.[2] However, this freedom comes at a price. The glenohumeral joint is also the body's most commonly dislocated joint.[4,5] Approximately 70,000 shoulder dislocations present to hospital emergency departments annually, and many more are seen by primary care physicians and orthopedic specialists.[6] Overall, shoulder dislocations occur in 1.7% of the general population[7] though the occurrence among athletes and military personnel is significantly higher.[8,9] Shoulder dislocations can be traumatic or atraumatic and can occur in either the anterior or posterior direction, but traumatic, anterior dislocations are the most common, occurring in 96% and 98% of all cases, respectively.[10]

Sports and recreation-related injuries account for nearly half of all shoulder dislocations in the United States.[6,7,11-14] Between one-quarter and one-third of all reported upper extremity injuries occurring in football, soccer, basketball, and wrestling are shoulder dislocations.[6,15] Nontraditional sports like surfing, skiing, and snowboarding also result in a significant number of shoulder dislocations.[16,17] Contact between competitors and contact with the playing surface are responsible for 75% of these dislocations, with the classic mechanism of injury described as a forceful twisting of the arm into abduction and ER at or above shoulder level.[15] However, falls on an outstretched arm, forced end-range shoulder flexion, or a direct blow to the shoulder are also causes of anterior dislocation in athletes.[3,9,11,13,18] Males are two to three times more likely to incur a shoulder dislocation than females,[6,7,10] and younger athletes appear to be at the highest risk with 20% to 27% of dislocations occurring before 20 years of age.[10,13] College athletes are also at substantial risk: 47% of all shoulder dislocations occur among individuals 15 to 29 years of age.[6]

The glenohumeral joint's inherent instability is due to a lack of bony congruency and the disparity in size between the articulating surfaces of the large humeral head and the small, shallow glenoid fossa. Consequently, the joint is reliant on the support of both static and dynamic elements that function together to provide the shoulder stability necessary for function.[19]

The static stabilizers of the shoulder include the glenoid fossa, labrum, joint capsule, and ligaments. The glenoid labrum is a fibrocartilage ring that deepens the glenoid fossa and provides a vacuum seal to help center the head of the humerus on the glenoid fossa.[2,3] In addition, the labrum serves as the attachment site for the joint capsule and glenohumeral ligaments. The glenohumeral ligaments are thickenings of the joint capsule and are divided into individual superior, middle, and inferior entities, each with a slightly different stabilizing role.[20] The superior glenohumeral ligament originates from the superior glenoid tubercle, the upper part

of the labrum, and the base of the coracoid process and inserts between the lesser tuberosity and anatomical neck of the humerus. It assists in preventing inferior displacement of the humeral head when the upper extremity is in a neutral position. The middle glenohumeral ligament is a wide ligament that lies under the tendon of the subscapularis muscle. It originates from the anterior glenoid rim and passes laterally to attach to the anatomic neck and lesser tuberosity of the humerus. The middle glenohumeral ligament works along with the subscapularis tendon to reinforce the anterior glenohumeral joint and limit ER of the humerus in mid-ranges of abduction. Finally, the inferior glenohumeral ligament, formed by anterior and posterior bands separated by a redundancy known as the axillary pouch, reinforces the anterior and inferior aspects of the joint capsule, particularly in the upper ranges of abduction.[2,3] The coracohumeral ligament adds stability to the joint. It originates from the coracoid process and passes inferolaterally to the humerus, blending with the supraspinatus muscle and joint capsule. It separates into two bands that attach to the greater and lesser tuberosities of the humerus, providing a tunnel through which the long head of the biceps tendon passes. It reinforces the superior joint capsule and stabilizes the tendon of the long head of the biceps brachii.[2,3]

The dynamic stability of the glenohumeral joint is provided by the compressive forces generated during co-contraction of the rotator cuff muscles. The force-couple created by co-contraction of supraspinatus, subscapularis, infraspinatus, and teres minor compresses the humeral head into the glenoid fossa, stabilizing the joint during activation of the shoulder's prime movers including the deltoid, pectoralis major, and latissimus dorsi muscles. Activation of a second force couple consisting of the upper, mid, and lower portions of the trapezius, along with the serratus anterior produces upward rotation of the scapulothoracic joint during upper extremity elevation. This activation also helps maintain the humeral head more centrally within the glenoid fossa, further increasing glenohumeral stability during functional movements above shoulder height.[21]

Acute anterior shoulder dislocations are caused by forceful disruptions of the joint's static and dynamic stabilizers that are observed either via diagnostic imaging or through arthroscopic evaluation. The aggressive anteroinferior translation of the humeral head associated with anterior dislocation may result in damage to the labrum, joint capsule, and ligaments, as well as to the bony surfaces of the humerus and glenoid fossa. When these injuries occur, a hemarthrosis develops more than 90% of the time and may interfere with healing.[11,22-25]

There are several common concomitant bony and soft tissue lesions associated with anterior shoulder dislocations. The most frequently observed lesion occurring in an acute anterior dislocation (68%-100% of cases) is called a Bankart lesion.[9,11,14,18,22-24,26] A Bankart lesion is also the predominant pathology in those who experience recurrent dislocation.[27] The ALPSA lesion involves the anteroinferior labrum and capsuloligamentous complex. In this injury, the anterior band of the inferior glenohumeral ligament, labrum, and the anterior scapular periosteum are stripped and displaced in a sleeve-type fashion, medially on the neck of the glenoid fossa. In a study by Antonio *et al.*,[28] the ALPSA lesion was found in roughly 40% of all anteroinferior labral avulsions. Lateral detachment of the anterior band of the inferior glenohumeral ligament from the humeral neck is called a HAGL lesion.

In the late 1990s, Taylor *et al*.[23] reported that HAGL lesions are associated with only 1.6% of acute anterior shoulder dislocations. However, Liavaag and colleagues[1] have suggested HAGL lesions are more common, occurring in almost a quarter of individuals following anterior dislocation. In addition to soft tissue injuries, bony lesions can also occur during anterior glenohumeral disruption. The "bony Bankart lesion" is an avulsion of the anterior inferior glenoid that occurs in 11.4% of traumatic anterior dislocations.[5] This injury can lead to a reduced resistance to anterior translation of the humeral head on the glenoid, much like a golf ball attempting to rest on a broken tee.[29] The most common bony lesion is the Hill-Sachs lesion. This is an impression fracture on the posterior humeral head resulting from a collision with the anterior glenoid rim as the humeral head comes to rest in the subcoracoid position following displacement. Hill-Sachs lesions occur in 38% to 100% of all traumatic anterior shoulder dislocations.[9-11,14,18,22-24,26] Despite being a near pathognomonic indicator of an anteroinferior glenohumeral dislocation, a Hill-Sachs lesion typically does not contribute significantly to the joint instability normally experienced following injury because this lesion occurs in the superior posterior aspect of the humeral head. However, when the glenohumeral joint is in the end range of combined abduction and ER, the superior posterior aspect of the humeral head comes into contact with the anterior glenoid; if there is also bone loss of the anterior glenoid that is ≥25% of the inferior glenoid diameter, the Hill-Sachs lesion can become an "engaging" or "off-track" lesion that contributes to anterior instability.[30]

Other pathologies associated with acute anterior shoulder dislocation include SLAP lesions, glenoid rim fractures, greater tuberosity fractures, rotator cuff tears, long head of the biceps tears, capsular tears, and nerve injuries. These injuries are less common, presenting in less than a quarter of all cases but can substantially increase glenohumeral instability in the presence of an anteroinferior labral lesion.[10,11,14,18,22-24]

Physical Therapy Patient/Client Management

Recurrent instability is common after anterior shoulder dislocation. The recurrence rate in patients without stabilization surgery is between 66% and 95% for those less than 20 years of age and between 40% and 74% for those between 20 and 40 years old.[7,8,10,13,14,18,22-24,26,27,31-35] Further, in those individuals less than 20 years of age whose initial dislocation occurred while participating in a sport, the recurrence rate can jump to greater than 80%.[36] These same individuals also demonstrate a shorter time period between the first and second dislocation compared to nonathletes.[5] **Age and activity level are two of the most important factors that predict recurrence**: athletes less than 30 years old at the time of their first dislocation are at greatest risk.[5,13,31,32] Clearly, the primary goal following anterior shoulder dislocation is to decrease the likelihood of recurrence while allowing a return to normal activity with as few restrictions as possible.

Traditionally, conservative care following acute shoulder instability has involved dislocation reduction, sling immobilization, and physical therapy to restore range of motion and strength.[37,38] Given the high rates of recurrence, this approach has not been particularly successful. As a result, **surgical intervention is considered an**

appropriate alternative for first-time dislocators. Almost 30 years ago, Jobe and Jobe suggested that throwing athletes with a history of even one dislocation should undergo surgical repair to restore normal anatomy.[39] In a 2004 Cochrane Review, Handoll *et al.*[40] examined five studies comparing surgical and conservative treatment for acute anterior shoulder dislocation and reported a relative risk reduction of 68% to 80% for recurrent instability in those treated surgically. In addition, they noted that half of those initially treated nonoperatively eventually sought surgical intervention. They concluded that surgical stabilization was warranted for young, active individuals following first-time traumatic shoulder dislocation.[40] This conclusion is supported by a review published in 2009. Brophy and Marx[41] described that at 2-year follow-up, surgically treated patients showed a significantly lower rate of recurrent instability (7%) compared to those that received nonoperative care (46%). This trend was consistent at a 10-year follow-up, with recurrence of 10% to 58%, respectively.[41] Based on these findings, a treatment algorithm has been proposed in which surgery is advocated for patients 15 to 25 years of age and a trial of physical therapy is recommended for patients 25 to 40 years of age with surgical intervention reserved to address recurrent dislocation. Finally, nonoperative care is endorsed for patients over 40 years of age secondary to low recurrence rates in this age group.[37]

Despite this evidence-based algorithm, controversy regarding immediate surgical care for the first-time dislocator persists. Hovelius *et al.*[42] have shown that out of 229 anterior shoulder dislocations followed over 25 years, 49% of shoulders did not experience a second dislocation, and 20% of those who were 12 to 22 years old at the time of primary dislocation had one or fewer subluxations or dislocations. Thus, if the proposed treatment algorithm was followed, 30% to 50% of patients would have endured unnecessary surgery. A frequently cited work by Aronen and Regan[43] reported a 75% rate of stabilization at 3-year follow-up after patients completed a regimented conservative treatment protocol combining activity modification with focused strengthening of the shoulder internal rotators and adductors.

Though the outcomes of the Aronen and Regan[43] protocol have not been duplicated and recurrence rates seem to respond favorably to early surgical intervention, the debate regarding surgical or nonsurgical stabilization for first-time traumatic shoulder dislocation continues. As a result, providing education to the patient about the cost/benefit ratio for surgery versus conservative intervention is a large component of the physical therapist's role in managing a patient following an episode of acute anterior shoulder instability. Understanding the patient's lifestyle, including work responsibilities, recreational pursuits, and functional goals in the context of risk factors and prognosis following shoulder dislocation, allows the physical therapist to accurately counsel a patient and create an appropriate, individualized plan of care.

Examination, Evaluation, and Diagnosis

The examination of a patient who has experienced an anterior glenohumeral dislocation depends on how recently the injury occurred. If a physical therapist is providing medical coverage for a sporting event and the athlete presents with significant

pain and is holding the arm in slight abduction and neutral rotation, diagnosis is relatively apparent and the examination may be brief. The mechanism of injury was likely witnessed, and an obvious deformity may be visible and palpable over the athlete's anterolateral chest just inferior to the coracoid process. Deformation or a "flattening/squaring off" of the deltoid musculature can also be appreciated as the acromion process becomes the most lateral structure of the shoulder. After an anterior dislocation, traction and compression of chest and shoulder soft tissue can compromise the neurovascular status of the upper extremity. A rapid, but thorough evaluation of sensation and motor function is imperative. Radial and brachial pulse identification,[44,45] dermatomal assessment of sensation to light touch or sharp/dull differentiation, with special attention given to the C5 region supplied by the often affected axillary nerve,[3,44,46] and a distal myotome strength evaluation of wrist and intrinsic finger strength should be performed and compared bilaterally. Joint reduction should then be attempted by a physician.[18] Restoration of normal anatomic alignment should be done within an hour of dislocation to decrease the chance for neuropraxia or vascular trauma.[16] Following reduction, the neurovascular examination should be repeated,[44,45] the arm stabilized using a sling, and the patient referred to a physician for definitive care, including plain film imaging to assess for bony and capsulolabral injury. If reduction cannot be successfully performed at the event, the shoulder should be stabilized in the position found, and the patient should be rapidly transported to an emergency department for additional medical evaluation and treatment.

Occasionally, a dislocated shoulder spontaneously reduces, and a patient may be unsure of exactly what happened. If a patient presents to the clinic with a spontaneously relocated shoulder several days after a traumatic event, a thorough subjective history and physical examination helps differentially diagnose an anterior shoulder dislocation or subluxation[1] versus a shoulder separation or acromioclavicular joint disruption. When patients describe the mechanism of injury involving the provocative position of abduction and ER, indirect forces applied to the distal upper extremity increasing torque at the shoulder joint,[3,16] and/or report a "dead-arm," generalized shoulder pain, and limitations in motion due to fear, the physical therapist should strongly suspect anterior instability.[3,47] On physical examination, tenderness to palpation through the deltopectoral interval and over the bicipital groove, decreased active motion above 90° in flexion and abduction, plus pain and/or weakness with manual muscle testing of the shoulder rotators further suggests an anterior dislocation.

Several special tests can be selected to help confirm the presence of anterior instability following dislocation or subluxation. First, the physical therapist assesses the presence of a sulcus sign bilaterally with the upper extremity in a neutral position to assess general laxity and competency of the superior glenohumeral and coracohumeral ligaments (Fig. 3-1). To assess the integrity of the middle glenohumeral ligament, the rotator interval, and the glenoid rim, the therapist performs an anterior/posterior load and shift test.[48] Here, the therapist applies a force to centralize the humeral head in the glenoid fossa. Then, the therapist applies anteromedial and posterolateral directional stresses to the humeral head with the scapula stabilized. The amount of translation is noted and again compared bilaterally. Patients with

Figure 3-1. Sulcus sign to assess general laxity and competency of the superior glenohumeral and coracohumeral ligaments. Therapist grasps proximal to elbow and produces an inferior traction force. This assessment may also be performed in the supine position.

anterior shoulder instability may demonstrate increased anterior translation on the affected side.[49] Finally, apprehension, relocation, and anterior release tests may be performed on the involved upper extremity. Table 3-1 describes the three most common tests and their corresponding diagnostic accuracy statistics to help distinguish shoulder dislocation/subluxation versus impingement.

The psychometric properties listed in Table 3-1 represent the test results when a "positive" test is operationally defined as apprehension. Apprehension can be defined by verbal acknowledgement of the shoulder "shifting, moving, dislocating"[54] as well as by facial grimacing or a reluctance to assume the test position.[55] It is critical to note that the presence or absence of pain alone does not accurately predict anterior shoulder instability.[50,51,54] Individually, the apprehension and anterior release tests appear to be most effective for ruling in the diagnosis of anterior shoulder dislocation or subluxation. The physical therapist must be careful because the anterior release test can dislocate the glenohumeral joint by replicating the original mechanism of injury. If the therapist chooses to perform the anterior release test, it should be performed *after* the apprehension and relocation tests so the therapist has an impression of the patient's shoulder instability and possibility for dislocation.[50] However, when the **apprehension and relocation tests** are performed consecutively and their results are clustered, the sensitivity is reported at 68% and specificity increases to 100% with a positive predictive value of 100%.[54] Thus, the results of this test cluster make the additional inclusion of the anterior release test difficult to justify.

If the physical therapist suspects a diagnosis of post-traumatic anterior shoulder dislocation/subluxation, referral to a physician is warranted for imaging. Plain film

Table 3-1 DESCRIPTION OF SPECIAL TEST PERFORMANCE AND PSYCHOMETRIC PROPERTIES[a]

Test	Positioning	Findings	Psychometrics[50,51]
Apprehension (Fig. 3-2)	Patient is supine (or sitting) with scapula on treatment table for stabilization. Upper extremity is passively moved into 90° abduction and maximum external rotation. Therapist applies anteriorly directed force to posterior humeral head.[39,47,52]	*Apprehension*: positive for dislocation/subluxation[39] *Pain*: positive for impingement[39]	Sen: 53%-72% Spec: 96%-99% PPV: 98% NPV: 73% +LLR: 20.2
Relocation (Fig. 3-3)	Patient is supine with scapula on treatment table for stabilization. Upper extremity is passively moved into 90° abduction and maximum external rotation. Therapist applies posteriorly directed force to anterior humeral head.[52]	If the *apprehension* caused by increased external rotation is relieved by the posteriorly directed force: positive for dislocation/subluxation[52] If the *pain* caused by increased external rotation is relieved by the posteriorly directed force: positive for impingement[52]	Sen: 32%-81% Spec: 54%-100% PPV: 44% NPV: 56% +LLR: 10.4
Anterior release or "Surprise" (Fig. 3-4)	Patient is supine with scapula on treatment table for stabilization. Upper extremity is passively moved into 90° abduction and maximum external rotation. Therapist applies posteriorly directed force applied to anterior humeral head. External rotation is passively taken to end range and pressure is released from humeral head.[53]	Return of *apprehension*: positive for dislocation/subluxation[50]	Sen: 64% Spec: 99% PPV: 98% NPV: 78%

[a]LLR, likelihood ratio; NPV, negative predictive value; PPV, positive predictive value; Sen, sensitivity; Spec, specificity.

images including three anteroposterior views: one in neutral (Grashey view), and one each in internal and ER. In addition, a transscapular (scapular "Y" view) and an axillary view are commonly obtained. These images help confirm dislocation and identify the presence of bony abnormalities of the humeral head or glenoid rim.[2,56] A Striker Notch view can also be beneficial to specifically diagnose the Hill-Sachs lesion and the bony Bankart lesion that commonly accompany anterior dislocations.[56] Magnetic resonance imaging (MRI) is often performed to determine the presence

Figure 3-2. Apprehension test originally described with the application of an anterior force to the posterior humeral head. Care must be taken to protect a patient's shoulder from re-dislocation during performance of this test; therefore, the therapist may forego the anterior force if apprehension is appreciated with the positioning alone.

and extent of the anterior inferior labral lesions associated with 73% of glenohumeral dislocations.[1,28] MRI images also allow the inspection of the integrity of the rotator cuff musculature that is frequently compromised in individuals over 40 years of age who experience an anterior dislocation.[3,28] Reviewing these images and radiologist reports can help the physical therapist counsel the patient and establish an appropriate plan of care.

Figure 3-3. Relocation test.

Figure 3-4. Anterior release test. This test should only be performed after the apprehension and relocation tests (if at all) secondary to potential for re-dislocation.

Plan of Care and Interventions

If a patient elects to pursue conservative treatment following an episode of acute anterior shoulder instability, the physical therapist's first goal is to protect the healing tissue. This is usually accomplished through sling immobilization, customarily with the shoulder positioned in internal rotation (IR). There is no consensus regarding the proper duration or positioning for upper extremity immobilization following dislocation. A timeframe of 6 weeks is often proposed based on physiologic healing times of soft tissue, but evidence suggests this may be too long. Hovelius *et al.*[35] compared a group of first-time dislocators immobilized in IR for 3 to 4 weeks with a group instructed to wear a sling as needed for up to 1 week. At 2- and 5-year follow-ups, recurrent dislocation was the same in both groups. A meta-analysis of level I and II evidence compared dislocation recurrence rates for individuals younger than 30 years immobilized for ≤1 week with those immobilized for ≥3 weeks and concluded there was no benefit to conventional sling immobilization for longer than 1 week.[38]

As far as position of immobilization, shoulder IR is typically selected for patient comfort and compliance. Nevertheless, a cadaveric study, several MRI studies, and a preliminary clinical trial suggest that **shoulder immobilization** with the shoulder in abduction and 10° of *external* rotation provides tension on anterior soft tissue structures, decreases hemarthrosis, and increases approximation of the labrum and capsule to the glenoid rim.[25,57-61] A meta-analysis and a randomized controlled trial comparing internal and external immobilization indicate that immobilization in ER is superior to IR at reducing recurrence of dislocation.[38,62] In 2009, McNeil *et al.*[63] recommended that immobilization in

ER be included in the standard of care for first-time traumatic anterior shoulder dislocations. However, a clinical investigation by Finestone and colleagues[46] in the same year contradicted this suggestion, reporting that those immobilized in ER experienced recurrence rates similar to those immobilized in IR. A 2019 Cochrane Review concluded that current evidence is insufficient to inform the choice of immobilization in ER versus IR to prevent recurrent anterior shoulder dislocation.[64] Regardless of time and position selected for immobilization, the physical therapist must address range of motion and strength impairments of the patient with anterior shoulder instability following immobilization. **Reactivation of the dynamic stabilizers of the glenohumeral joint**, including both the rotator cuff and periscapular musculature is essential.[3,43,52,65,66] Initially, isolated submaximal isometric exercises and closed chain activities that promote rotator cuff and periscapular muscle co-contraction performed below 90° of shoulder elevation are appropriate.[65,67] The therapist needs to closely monitor the patient's performance of these exercises. Until the patient has developed appropriate neuromuscular control, the therapist needs to provide verbal and tactile feedback to minimize the recruitment of the prime movers (pectoralis major, latissimus dorsi, upper trapezius) that may contribute to further joint destabilization (Figs. 3-5 and 3-6). An early emphasis on posture and scapular positioning is also important to promote normal muscular firing patterns during upper extremity movement.

As range of motion normalizes, patients can be advanced to progressive isotonic resistance training. Some therapists may be tempted to focus on strengthening the subscapularis muscle at this time as a way to reinforce the anteroinferior glenohumeral capsulolabral complex and prevent recurrent dislocation. However, a cadaveric study by Werner *et al.*[68] demonstrated that although the subscapularis

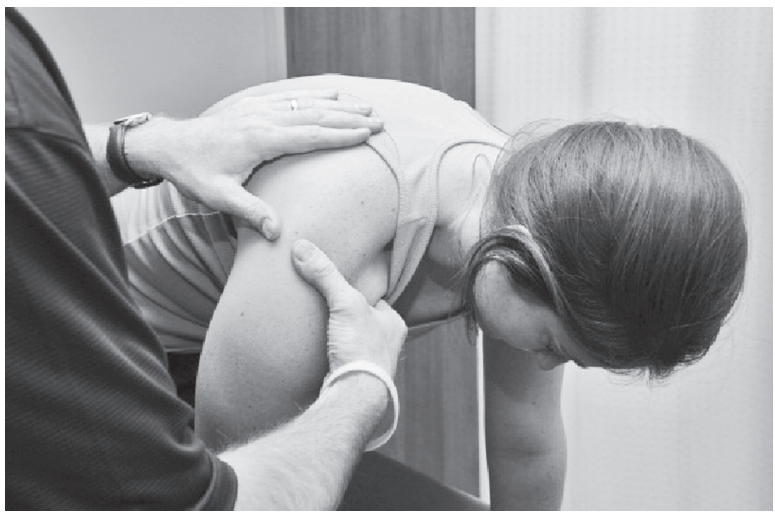

Figure 3-5. Isometric closed chain shoulder protraction for activating the serratus anterior in quadruped. Patient is cued to protract scapula while therapist provides tactile cueing to prevent compensatory pectoralis major contraction.