Chapter 3
The Shoulder

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Functional Anatomy

Figures 3.1 and 3.2 illustrate the surface anatomy of the glenohumeral joint of the shoulder. The shoulder is a ball-and-socket joint whose structure allows for an impressive range of motion (ROM) but at a cost. Unlike the very stable hip joint, which has a deep socket, the glenoid fossa is relatively shallow, and the humeral head is oversized with respect to the fossa. The labrum, a rim of cartilage around the glenoid fossa, helps increase the depth and stability of the shoulder joint, but the other soft tissues of the shoulder provide most of the joint's stability. In order for proper functioning to occur, all these tissues (muscles, tendons, ligaments, and the labrum) must be functioning at proper tension. Disruption in any one of these can lead to dysfunctional shoulder motion and subsequent problems [1, 2].

The shoulder is actually composed of four joints: the sternoclavicular (SC) joint, the acromioclavicular (AC) joint, the glenohumeral (GH) joint, and the sternothoracic (ST) joint (see Fig. 3.3). Pathology can occur at any one of these joints, but pathology is most common in the AC and GH joints. The labrum provides some static stability to the GH joint, as does the joint capsule, which is composed of three main ligaments: the anterior, inferior, and posterior glenohumeral ligaments. Injury to these ligaments can allow the humerus to slide out of the glenoid fossa. When this occurs to a minor degree and spontaneously relocates, this is called subluxation; if the humeral head completely leaves the socket, it is true dislocation. Many children and adults have some degree of physiologic subluxation due to natural laxity of these ligaments and do not necessarily have underlying pathology [3].

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J.M. Daniels (ed.), *Common Musculoskeletal Problems: A Handbook*,
DOI 10.1007/978-3-319-16157-0_3

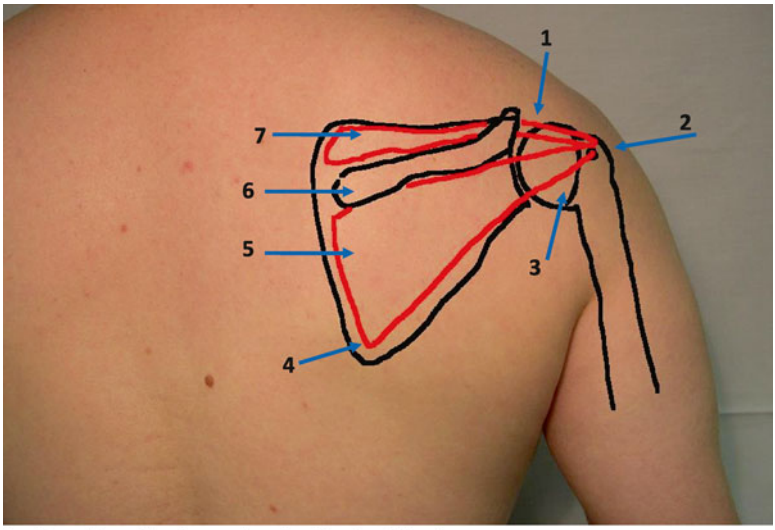


Fig. 3.1 Surface anatomy of the shoulder – posterior view

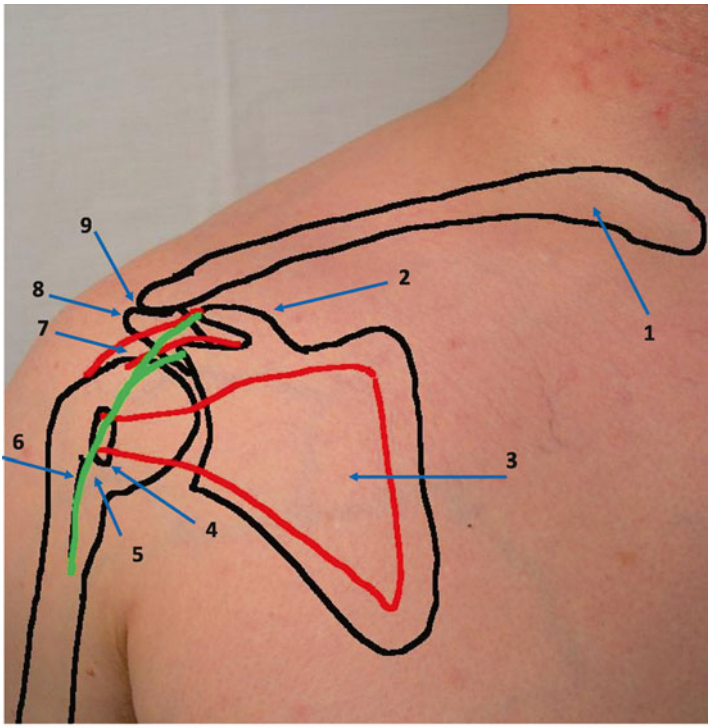
The muscles provide dynamic support to the shoulder joint. The biceps tendon crosses this joint and provides additional dynamic support, but the majority of stability is due to the deltoid muscle, which applies constant upward force on the shoulder, and the muscles of the rotator cuff (supraspinatus, infraspinatus, teres minor, and subscapularis), pulling the "ball into the socket," opposing the deltoid's anterior pull. Due to their location, the supraspinatus and infraspinatus tendons are the most common muscles injured in the rotator cuff [4].

Red Flags

Age of Patient. A very elderly or very young patient complaining of shoulder pain may represent a more serious type of condition. This would include pathological fracture, growth plate injury, and malignancy.

Nonmusculoskeletal Causes of Pain. Symptoms such as shortness of breath, GI upset, cough, rash, weight loss, fever, multiple joint involvement, or morning stiffness should prompt the investigation of metabolic causes of shoulder pain.

Trauma. Patient's trauma to the shoulder should receive a radiographical evaluation to rule out fracture. Additionally, those with major trauma can have visceral pain that is referred to the shoulder (such as lung or chest wall injury or ruptured spleen) and should be carefully evaluated.



1 – Clavicle
2 – Coracoid process of scapula
3 – Subscapularis muscle
4 – Lesser tubercle (insertion of subscapularis)
5 – Bicipital tendon
6 – Bicipitol groove
7 – Supraspinatus
8 – "AC" joint
9 – Acromion process of scapula

Fig. 3.2 Surface anatomy of the shoulder – anterior view

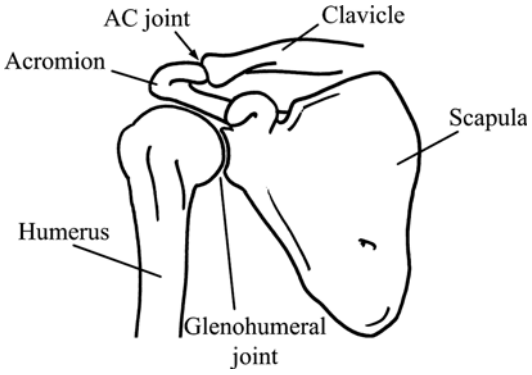


Fig. 3.3 Skeletal anatomy of the shoulder – anterior view

Suspected or Known Dislocation. These patients should have an X-ray to rule out fracture. Posterior shoulder dislocation can be difficult to identify. In patients with a history of seizure disorder or electrocution, consideration for posterior dislocation should be entertained.

General Approach to the Patient

There has been a great deal written about the physical examination of the shoulder. Many physical examination techniques have been described to detect various pathologies of the shoulder. The accuracy of these examination techniques has been called into question. Recent meta-analysis of the available medical literature has not shown a high correlation between physical exam findings and final diagnoses discovered either on MRI or in surgery [5–8]. Shoulder complaints are common, comprising up to 16 % of all musculoskeletal visits to any healthcare provider [9, 10].

The clinician should approach all shoulder complaints with a history and physical examination. Detailed testing can be performed depending on suspected conditions described below.

A basic history should include duration, nature, and location of pain as well as inquiring about any radicular symptoms. Risk factors for nonmusculoskeletal conditions that can present with shoulder pain (such as lung disease, MI, etc.) should be assessed. Patients who appear unstable after trauma or who are suspected to have life-threatening nonmusculoskeletal pathology (such as MI or concern for ruptured viscus) should not be assessed in the primary care outpatient setting and should be transported to an emergency department.

Examination should start with complete exposure of the shoulder, with either the shirt removed or the patient wearing a sleeveless shirt or sports bra. A gown can be tied around the trunk under the arm, if needed for modesty. The skin should be evaluated for any rashes or lesions that might suggest other causes of pain, such as shingles [9].

A brief neurovascular exam is important for ALL patients who present with shoulder pain. The Spurling's maneuver (described in Chap. 2) can be quickly performed and if negative rules down radiculopathy. Hoffman's test (flicking middle finger with resulting flexion of index finger and thumb) may point to an upper motor lesion causing the patient's discomfort. Evaluation of the radial pulse and capillary refill is reassuring for adequate distal circulation.

Palpate the SC and AC Joints. Tenderness over the SC joint usually occurs only after significant direct trauma to the anterior chest and is a cause for concern, as trauma this severe can sometimes be associated with traumatic shoulder dislocations. Palpate the AC joint for tenderness.

Next, have the patient abduct the arm from the side to the overhead position, noting pain or limitations of ROM. From behind the patient, evaluate the scapula for

winging or abnormal movements with shoulder abduction, which may indicate damage to the long thoracic nerve [10].

Common Clinical Presentations

Rotator Cuff Pathology

With age, most patients get some degree of external impingement of the tendons of the rotator cuffs, causing rotator cuff tendinopathy. These patients will complain of generalized anterolateral shoulder pain that may radiate toward the deltoid. Examination of these patients involves impingement testing, which can be accomplished with Hawkins and Neer testing (shown in Fig. 3.4). Negative findings on *both* these tests have an LR− of 0.1 for impingement, nearly ruling out this pathology [5].

Continued impingement or a traumatic event can lead to rotator cuff injury, in which the tendon is completely torn. In addition to the impingement testing, the supraspinatus and infraspinatus strength should be tested. Supraspinatus weakness is tested by having the patient extend the elbows, abduct the arms to 90°, and forward flex about 45°. The patient then makes a fist with "thumbs down" and then resists the examiner putting downward pressure on the arms. Infraspinatus weakness is tested by having the patient keep the elbows at the sides with the elbow flexed 90°. The patient then pushes out (externally rotating) against resistance from the examiner. The supra- and infraspinatus tests are depicted in Fig. 3.5. It is important to understand that an abnormal test result is one that demonstrates true *weakness* of the movement, not just lack of effort due to pain [4]. These three tests together (impingement testing, supraspinatus weakness, and infraspinatus weakness) can be very useful in predicting rotator cuff tears. If no abnormal results are present, a tear is basically ruled out. Presence of only one is not predictive, but the presence of two of these has an LR+ of 5 for tear, and the presence of all three has an LR+ of 48 for rotator cuff tear [5, 6].

Patients with suspected impingement or tendinopathy without tear can be safely referred to PT for a month and reassessed. Older adults with continued symptoms after a month of PT whose exam is unchanged are still likely to benefit from conservative therapy and can be treated with another month of PT and/or can be offered a steroid injection. If their pain persists beyond 2–3 months, referral and/or MRI evaluation should be considered for possible missed rotator cuff tear [8, 11]. Younger patients with continued symptoms after a month of PT, however, should be referred to a specialist or have an MR arthrogram performed, which can demonstrate a labral tear.

All patients with suspected or diagnosed complete rotator cuff tear should be referred, although many times, these patients can be managed with PT and do not require surgery [9, 11].

Fig. 3.4 Hawkins (**a**) and Neer (**b**) testing

AC Joint Pathology

The AC joint can be injured during trauma or a fall directly, or it can be chronically injured by repetitive overloading activities such as weight lifting. If pain complaints localize to the AC joint area and primary exam revealed tenderness to palpation,

Fig. 3.5 Supraspinatus (**a**) and infraspinatus (**b**)

further testing of the AC joint can be done with the squeeze test (Fig. 3.6). This stresses the AC joint and will reproduce pain but can also be confused with a distal clavicular fracture, so any patient with trauma and AC pain should have X-rays performed [6, 7].

Once fracture is ruled out, most patients with AC joint pathology can be managed conservatively with the use of ice and NSAIDs or other pain control. In

Fig. 3.6 Squeeze test

noncomplex cases, a sling may be used for patient comfort but should be limited to 1–2 weeks at most. In patients with osteoarthritis of the AC joint, it can be injected with steroid. Sometimes this may be technically difficult as the joint space is very small. Usually no more than 0.5 ml can be injected into the joint. If the bones of the AC joint are displaced enough to override each other on X-ray or if distal clavicle fracture is suspected, the patient should be referred. Persistent AC joint pain can indicate underlying rotator cuff pathology that can be managed through physical therapy [11].

Shoulder Instability

Patients with shoulder instability (laxity of one or more of the three glenohumeral ligaments) tend to be younger and more active than those with impingement. Although young patients with instability of the shoulder may have impingement symptoms and findings, they often have underlying instability that needs to be addressed. In these patients, it is important to evaluate the integrity of the shoulder capsular ligaments and the labrum [6, 11].

On the other hand elderly patients usually have more pathology-related to impingement than instability.

The internal rotation resistance strength test (IRRST) has been advocated as a way to differentiate intraarticular (OA labral pathology, capsular tears) and extraarticular issues such as rotator cuff pathology with impingement. In the literature, the IRRST demonstrated that it has both a high and negative predictive value along with high sensitivity and accuracy up to 94.5 % [11, 12]. To perform this test, have the patient hold their effected shoulder at 90° of abduction with approximately 80° of external rotation. The patient then resists internal rotation. If there is weakness with internal rotation, it indicates intraarticular pathology. Weakness with external rotation indicates extraarticular pathology. This test can also be helpful in elderly patients who are being treated for presumed rotator cuff tendinopathy. If resisted internal rotation consistently reproduces some of their symptoms, consideration for the diagnosis of osteoarthritis of the glenohumeral joint may be considered. Younger, more active patients with shoulder symptoms should be evaluated for instability (capsular pathology).

Instability can be divided into two categories. The first consists of patients with generally lax joints. The ligaments in these patients allow for some subluxation of the humeral head from the glenoid fossa. This can be demonstrated using the sulcus sign (see Fig. 3.7). Patients who have multidirectional instability have a positive sulcus sign and may have capsular laxity of the glenohumeral joint in all directions (inferior, anterior, posterior). These patients may present with pain caused by repetitive activity without any history of trauma. They often are unlikely to have significant pathology that needs surgical intervention. These patients are said to have AMBRI lesions (*A*traumatic, *M*ultidirectional, *B*ilateral, *R*ehabilitation is helpful, surgery *I*nfrequently needed). Patients with AMBRI lesions can be managed with physical therapy and activity modification [3, 13].

Fig. 3.7 Sulcus sign

The second kind of instability involves unidirectional instability (the patient has a negative sulcus sign indicative of stiffer ligaments) that is often traumatic, such as overthrowing or wrenching of the arm. A significant anterior force on the humerus can cause stretching of the anterior glenohumeral ligament, which can tear off a piece of the labrum, referred to as a "Bankart lesion." These patients are said to have TUBS lesions (*T*raumatic, *U*nidirectional, *B*ankart, require *S*urgery).

Additional testing of the capsule and labrum can be performed using the apprehension and posterior capsule tests. The apprehension test is used to assess the anterior ligament; this is depicted in Fig. 3.8. Pain with this test is not necessarily an abnormal finding, but if it reproduces the feeling that brought the patient in or makes the patient feel as if the shoulder is going to "pop out," it is a positive (abnormal) result. Evaluation of the posterior capsular ligament is similar but is performed having the patient lie prone, with the shoulder hanging over the edge of the table. The examiner grasps the humerus near the head while stabilizing the posterior scapula and then puts posterior force on the humerus. As with the apprehension test, a positive finding is one that reproduces the feeling of "popping out."

If all other testing is negative, integrity of the labrum can be tested by having the patient abduct the affected shoulder completely (180°) and then, as rapidly as possible, circumduct the shoulder (performing a "cranking" type of motion). Pain and clicking indicate pathology. Patients with isolated positive findings on labral or capsular testing should be referred for evaluation. If the capsular and labral tests are negative, a trial of physical therapy is reasonable, but if the patient does not improve, referral should be made [13].

In summary, most patients with shoulder pain can be managed conservatively. Those with fractures, suspected labral tears, or complete rotator cuff tears need

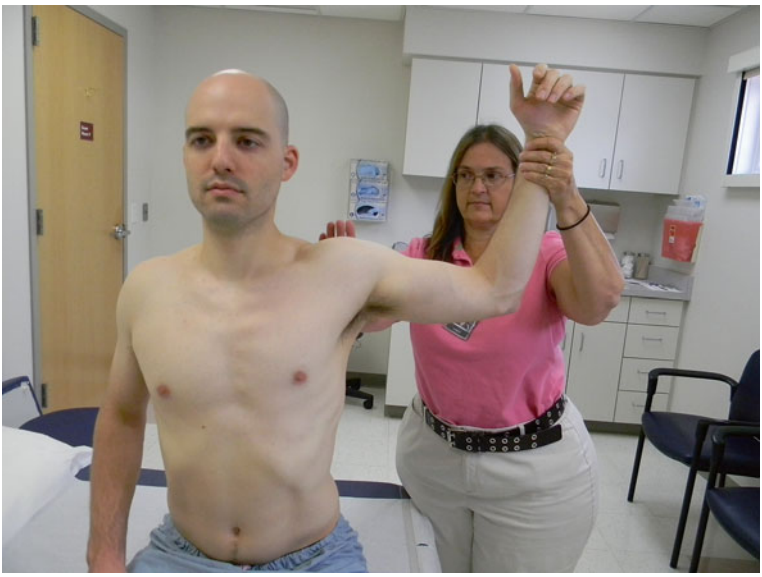


Fig. 3.8 Apprehension test

early referral; others can be treated with the RICE (Rest, Ice, Compression, Elevation) protocol and physical therapy for a month and reassessed. Younger or very active older patients should be more thoroughly evaluated for the possibility of shoulder instability, while older and less physically active patients more commonly deal with impingement, which is less likely to require intervention. Patients with persistent pain or for whom the diagnosis remains obscure should be referred. The flow diagram in the appendix can help the provider work through the appropriate triage and management of common shoulder complaints.

Please refer to Fig. 3.9 for the Shoulder Meaningful Use Form.

CC: ☐ Right ☐ Left ☐ Both

HPI:
Onset: _____
Mechanism of Injury: _____
Relieving Factors: _____
Exacerbating Factors: _____

PMH: Chronic Medical Conditions: _____

Occupation/Sport/Position: _____
Handedness: ☐ Right ☐ Left ☐ Both

Red Flags:
1. Radicular symptoms
2. Trauma
3. Suspected or known dislocation
4. History of malignancy or systemic symptoms

Q1. Is the problem the shoulder?
Radicular symptoms
Spurlings
Symptoms below elbow or posterior aspect of shoulder (may be C-spine)

Q2. Which joint is involved?
Acromioclavicular tender: Squeeze test
Sternoclavicular joint: Palpate
Scapula-Thorax joint: ABduct arms 5 times - observe
Glenohumeral joint: Check cuff, capsule and labrum

Q3. If it is glenohumeral, what is the diagnosis and treatment?
a) Dislocation
b) TUBS lesion
c) AMBRI lesion

Common and Don't Miss Conditions:
- Rotator Cuff Injury
- Shoulder Instability
- A-C Joint Pathology
- Fractured Clavicle
- Labral Tear
- Osteoarthritis

Fig. 3.9 The Shoulder Meaningful Use Form

TREAT APPROPRIATELY	Shoulder Instability (AMBRI) ..... 718.81 Impingement ..... 726.2 Osteoarthritis ..... 715.91 Rotator Cuff Tear ..... 840.4 Dislocation/Subluxation ..... 831.00 AC Joint Separation ..... 831.04 Rotator Cuff Tendinitis (supraspinatus) ..... 726.10 Rotator Cuff Tendinitis (infraspinatus) ..... 726.19 Shoulder pain, nonspecific with negative exam 719.41
TREAT WITH CLOSE FOLLOW-UP (< 1 week f/u)	Status Post dislocation
CALL CONSULTANT THAT DAY	Dislocation Fracture Major Trauma
CONSULT OR REFER	Suspected or Confirmed rotator cuff tear with no response to PT Recurrent dislocations Suspected labral tear Radiculopathy Young/Active patient with no response to 4 wks of PT or treatment TUBS instability

Plan:
- ☐ Xray / Imaging What: _____
- ☐ Laboratory Eval What: _____
- ☐ NSAIDs _____
- ☐ Acetaminophen _____
- ☐ Other _____
- ☐ PRICE Protocol
- ☐ Physical Therapy

Disposition:
- ☐ Treatment initiated: Follow-up _____ weeks
- ☐ Treatment / Work up Initiated: Follow-up ≤ 1 week _____ days
- ☐ Immediate call to Dr. _____
- ☐ Consultation initiated with Dr. _____
- ☐ Referral to Dr. _____

Fig. 3.9 (continued)

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