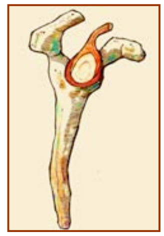


Chapter 2: THE SHOULDER

The shoulder just might be the most incredible joint of all. Although we often admire an athlete's brilliant hand-eye coordination, what we are really witnessing is hand-shoulder-eye coordination. In sports, the shoulder is the primary platform for the hand.

At a glance, the shoulder's improbable construction challenges what we observe—an unrivaled combination of precision and amazing strength. Consider the 183-pound man who can lift and support 500 pounds overhead; consider the precision and power of the ultimate game of the shoulder—baseball. Consider that the shoulder coordinates the acceleration of a baseball to speeds of 100 miles per hour with the accuracy of a pistol. This is even more amazing if you consider that at the shoulder, the arm's bone on bone relationship to the body is similar to a spider clinging to a wall.

THE 2 MINUTE DRILL

- The shoulder joint is a complex mechanical system made up of multiple interdependent parts: bone, muscle, tendon and ligament. An injury to one part can lead to damage of another.
- Multiple component injury happens.
- The shoulder joint permits more movement than any other joint.
- Some injuries occur because some sports demand the arm operate in a position that is at the extreme limit of normal motion—where the joint is most susceptible to injury.
- This specific position is "abduction and external rotation" as seen in: (a) a pitcher's arm motion and (b) a tennis serve.
- Overuse shoulder injuries can cause damage to tendons, ligaments and joint surface structures (labrum and cartilage).

- Another category of shoulder injury is contact trauma or acute overload; these can produce injury to several elements but are often ligament injuries. Examples are:
  - dislocation
  - AC joint separation
- The most common tendon injury involves the rotator cuff tendons.
- General rules of treatment are:
  - RICE immediately after injury: Rest, Ice, Compression and Elevation;
  - avoid painful motion; pain is a protective signal after injury;
  - for minor injuries, gradually begin painless exercises for strengthening and flexibility.

SHOULDER-SPEAK

ARTHROSCOPY—a surgical procedure using a telescope-like viewing instrument inserted into the joint; other instruments to manipulate internal joint structures are also inserted (see Chap. 7: Arthroscopy, page 195).

AC JOINT—acromioclavicular joint; consisting of the acromion of the shoulder blade (scapula) and the clavicle (see Fig. 2-13).

ACROMION—an extension of the shoulder blade (scapula) that projects outward above the shoulder joint and forms one half of the AC joint (see Fig. 2-1 and 2-7).

BICIPITAL GROOVE—a longitudinal groove on the upper humerus bone; it holds a segment of the biceps tendon.

CLAVICLE—the collar bone.

CORACOID—a part of the scapula (shoulder blade) that projects forward like a post from the front surface of the scapula; it as an attachment site for muscles and ligaments (see Fig. 2-13).

DISLOCATION—an injury in which the humeral head is moved off the glenoid surface (see Shoulder Dislocation, page 50, Fig. 2-12).

GH—abbreviation for glenohumeral used in this book for simplicity and convenience. This is not a standard medical abbreviation.

GLENOID—the shoulder socket; located on the side of the scapula (shoulder blade; see Figs. 2-3 and 2- 4).

GLENOHUMERAL JOINT (GH JOINT)—the shoulder joint (see Figs. 2-3 and 2-4).

GLENOHUMERAL LIGAMENTS—three ligaments incorporated into the front and lower rear of the shoulder joint capsule: superior, medial, and inferior ligaments (see Fig. 2-5).

HILL SACHS—a type of humeral head fracture caused by shoulder dislocation.

HUMERAL HEAD—top end of upper arm bone; a part of the gleno-humeral joint (the ball of the joint, see Figs. 2-1, 2-3 and 2-4).

HUMERUS—the upper arm bone.

INFERIOR GLENOHUMERAL LIGAMENT—the lowest of the three GH ligaments; made up of a front and a rear "strap' (see Fig. 2-5).

JOINT CAPSULE—a tough sack which envelops a joint.

LABRUM—a ring of fibrous cartilage attached to the perimeter of the glenoid (see Figs. 2-3 and 2-11).

REDUCTION—repositioning the bones of a dislocated joint.

ROM (RANGE OF MOTION)—all joints are designed to move through a range of motion—an arc of normal movement limited by bone and ligaments which function like highway guard rails. Movement beyond these boundaries requires some mechanical deformity of the bone or ligament (stretch, tear, or fracture).

SCAPULA—the shoulder blade (see Fig. 2-1).

SPINE OF SCAPULA—a bony ridge on the back side of the scapula; it connects the acromion to the body of the scapula (see Fig. 2-1).

SUBLUXATION—partial dislocation of a joint (see Fig. 2-12C, 2).

WHAT'S NORMAL?

THREE NOT SO SIMPLE BONES

The shoulder skeleton is three bones (see Fig. 2-1):

1. scapula—the shoulder blade (the major bone)
2. humerus—the upper arm bone
3. clavicle—the collar bone

The odd-shaped scapula, the undisputed King of the Shoulder Bones, is a complex bone with unique features. It only indirectly attaches to the rib cage by way of the clavicle at the tiny AC joint (see Fig. 2-1a). Most of the scapula levitates on the back of the rib cage, held in place by more than a dozen powerful muscles. The joint socket is located at the side of the scapula (see Fig. 2-4); this arrangement provides a movable, adjustable, dynamic base for the arm.

An improbable strength

The arm hangs onto the trunk at the GH joint (the shoulder joint). The shoulder skeleton looks as if the arm should fall off onto the floor. When the arm is naturally hanging down by the side, there is no solid bony support for the humerus—a dramatic contrast to other joints such as the knee, hip and ankle which are as solid as stacked bricks. This foundationally-challenged marriage of humerus and joint socket is even more illogical because the shapes of the joint bones do not match. They are not hand in glove like some joints. The surface of the socket (the glenoid) is flattened and the end of the humerus is round.

If there is not a bony shelf on which the humerus can rest when the torso is vertical and if the bones don't fit, how can the arm support such great loads? And why do the arms not pull off of the body when a man deadlifts 500 pounds? The short answer is ligaments plus tendons plus muscles—not bone on bone support.

> The **Glenohumeral joint (GH joint):** the shoulder joint. The upper end of the humerus (the ball) meets the glenoid (the joint socket). The glenoid is part of the scapula. **GH** is not a standard medical abbreviation.

A fearless range of motion

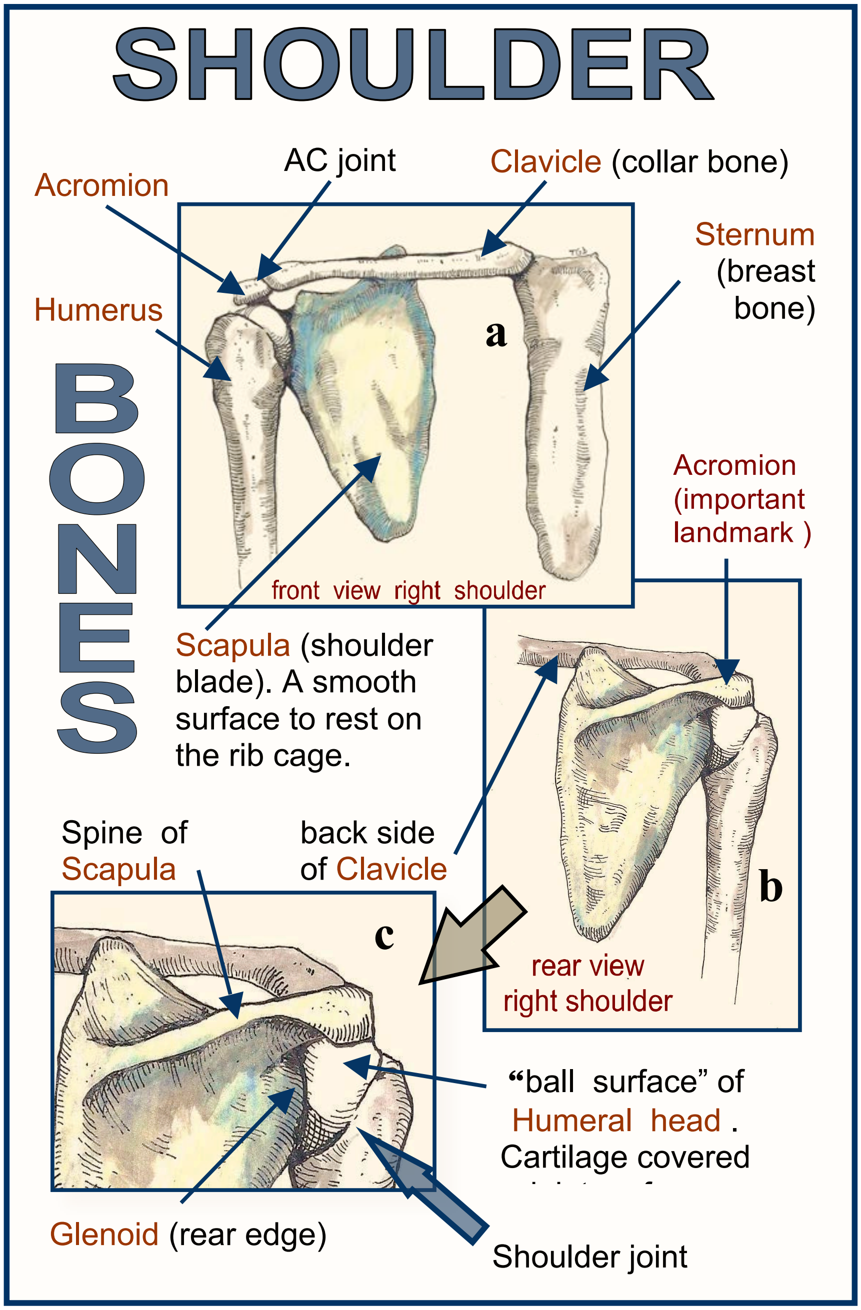
The arm is able to swing around widely in all directions for the very same reason it appears so loosely joined to the torso. The major structures of attachment—ligament, muscle and tendons—are flexible instead of rigid bone. Unlike the hip, the other ball and socket joint, the shoulder joint does not have a deep socket with bony curbs to limit movement and add support. Figure 2-2 illustrates the curb concept: the walls of a true socket act like curbs that limit the range of motion of the articulating bone. This is not a problem for the shoulder.

Large thoracic muscles hug the shoulder blade (scapula) against the back of the rib cage. They move it in coordination with the arm:

- a swinging pendulum motion
- a front to back sliding motion

This relationship of the scapula to the thorax increases the arm's mobility. For example, when you reach across your chest with your right arm to scratch the back side of your left shoulder, the humerus rotates on the

Fig. 2-1



SHOULDER
BONES
Acromion
AC joint
Clavicle (collar bone)
Sternum (breast bone)
Humerus
a
front view right shoulder
Scapula (shoulder blade). A smooth surface to rest on the rib cage.
Acromion (important landmark)
b
rear view right shoulder
Spine of Scapula
back side of Clavicle
c
"ball surface" of Humeral head . Cartilage covered
Glenoid (rear edge)
Shoulder joint

glenoid and the scapula slides forward. The value of this is obvious if you try to do this without moving your scapula. These muscles that manipulate and control the scapula are important in the prevention of injury. If weakened or fatigued, they may not be able to properly position the scapula (see Controlling abnormal motion, page 37).

THE JOINTS

Although, in common usage the term shoulder joint refers to the GH joint, the shoulder bones actually meet at four joints:

1. humerus to scapula (shoulder blade): this is the main joint—the GH joint; (see Figs. 2-3 and 2-4)
2. clavicle to scapula (collar bone to shoulder blade): the AC joint (acromioclavicular joint; see Figs. 2-1 and 2-13)
3. clavicle to breast bone: sternoclavicular joint
4. scapula on the rib cage: scapulothoracic joint (see Fig. 2-1a)

Both the AC and the sternoclavicular joints (collar bone to breast bone, see Fig. 2-1a) are minor joints at each end of the clavicle. The AC joint is frequently injured in contact sports such as football; it is the joint of the shoulder separation (see Shoulder Separation, page 53; Fig. 2-13).

Parts of the Shoulder Joint (the GH or Glenohumeral joint):

1. Head of humerus (the ball)
2. Glenoid (the socket)
3. Joint capsule plus ligaments
4. Glenoid labrum
5. Biceps tendon

The scapula-rib cage unit is not a joint in the usual sense, but it behaves like a joint. Because the glenoid is part of the scapula and the scapula is so mobile, the GH is like a joint on wheels.

The GH is technically a ball and socket joint, but it differs considerably from its cousin the hip joint. Because the glenoid is relatively flat and shallow, and the humeral head is larger than the glenoid surface, it is more like a basketball on a dinner plate than a ball in a socket (see Figs. 2-3 and 2-4). And just like a ball on a plate, the humeral head can roll off the glenoid—shoulder dislocation (see page 50, Fig. 2-12).

The original gasket?

An important structure within the GH joint is the labrum—a flexible ring of cartilage-like material that attaches circumferentially to the edge of

what a difference a curb makes !

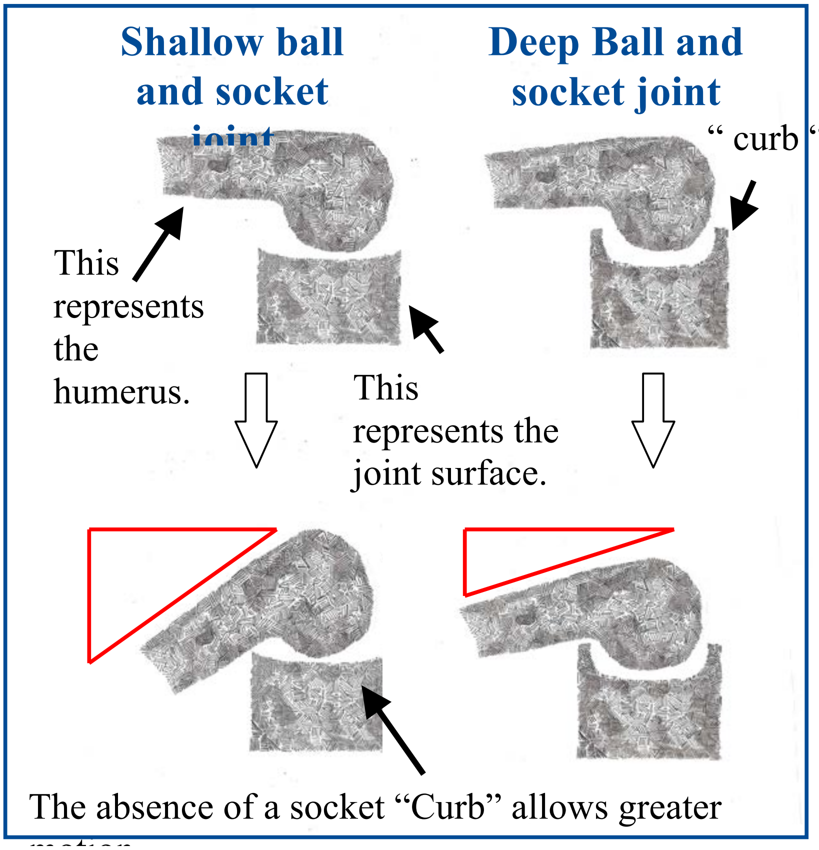


Fig. 2-2 (the ratio of the glenoid size to the humerus size is exaggerated in this depiction, the humerus is much larger)

RANGE OF MOTION

All joints are designed to move through a range of gd motion—an arc of normal movement limited by bone and ligaments which function like highway guard rails. Movement beyond these boundaries requires some mechanical deformity of the bone or ligament (stretch, tear or fracture).

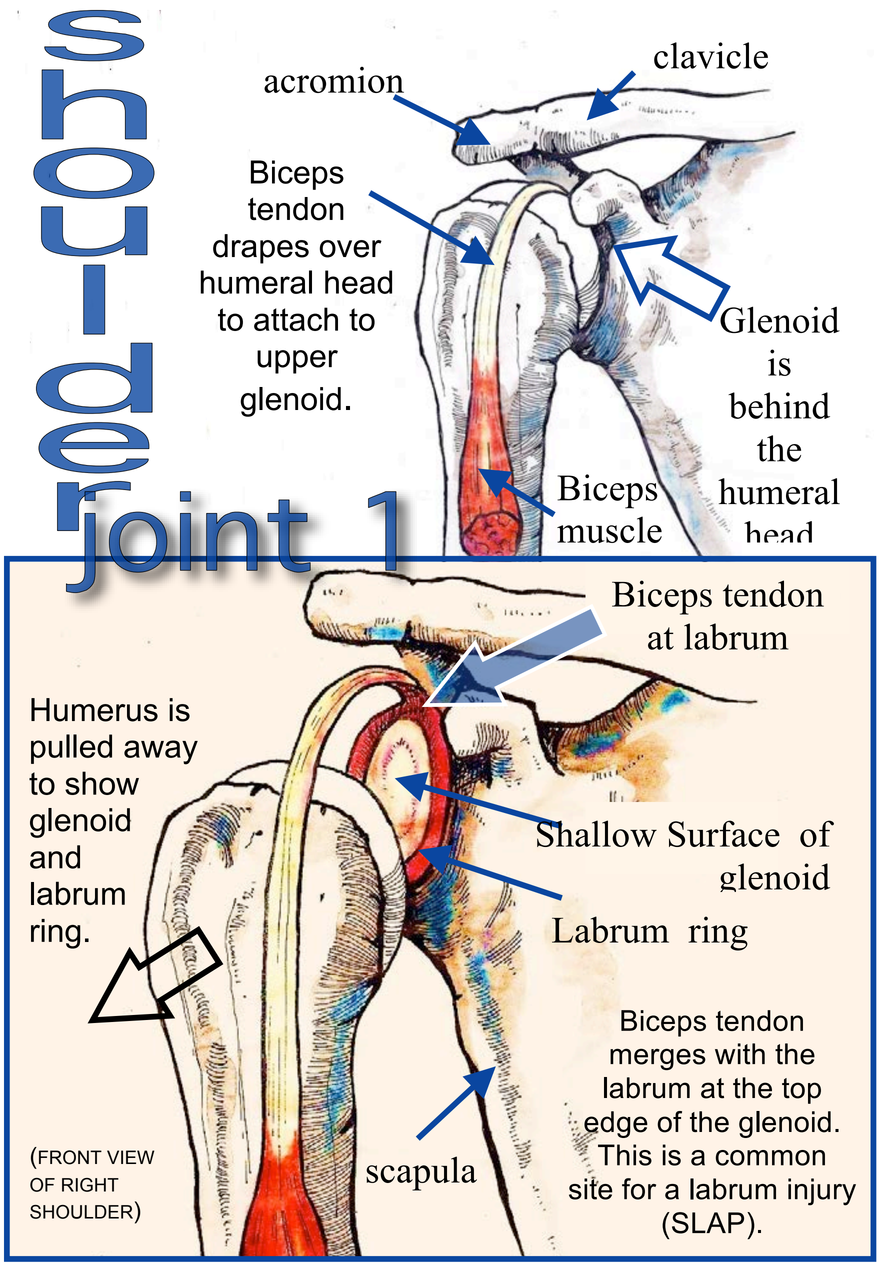


Fig. 2-3

Redrawn from Toldt, K. Atlas of Human Anatomy for Students and Physicians. New York: Rebman Co.,1903.

the glenoid (see Figs. 2-4 and 2-11). It hugs the spherical head of the humerus and acts like a gasket. This provides a deeper cavity and a larger surface area for the humeral head. It plays an important role in motion control within the joint because attached to it are two critical structures:

1. the capsular ligaments (glenohumeral ligaments, see Figs. 2-5 and 2-6); these are important in dislocation injury (see Shoulder Dislocation, page 50, Fig. 2-12);
2. the biceps tendon which is important in labrum injury (see Labrum Injury, page 47).

Figures 2-3 and 2-4 show the biceps tendon attached to the labrum at the top of the glenoid; the GH ligaments are shown in Figure 2-5. This trio of labrum, capsular ligaments and biceps tendon is important for normal function. They are targets of injury among throwing athletes. The sites of two notorious areas of injury are shown in Figure 2-11C (see Labrum injury, page 47).

What's with this biceps tendon?

At first impression, the relationship of the biceps tendon to the labrum seems to be just nerdy anatomy: (1) the tendon fastens to the top of the bony glenoid where it blends into the labrum; (2) then it passes down through the joint; and (3) along the front side of the humerus; (4) eventually, to attach to the biceps muscle (see Fig. 2-3). But, despite appearances, this route of the tendon through the labrum and through the joint is neither just a shortcut to the muscle, nor just more tedious anatomy. Actually, it is a clever way to help protect the joint. It is literally a shoulder restraint, just like a car's seat belt/shoulder strap—a vertical band in front of and above the joint. But, as with other high profile joint guardians, it can be the victim of injury (see Labrum Injury: SLAP, page 48).

THE JOINT CAPSULE: NOT YOUR ORDINARY BAG

The joint capsule is a flexible envelope that completely encloses the bones of the joint—like a bag. Contained within the front wall of the capsule are three ligaments that are critical to the athlete's shoulder (see Fig. 2-5).

These GH ligaments perform as seatbelts to prevent an abnormal forward movement of the humeral head: subluxation and dislocation. Figure 2-5 is an exaggerated depiction of the capsule and its ligaments. The important

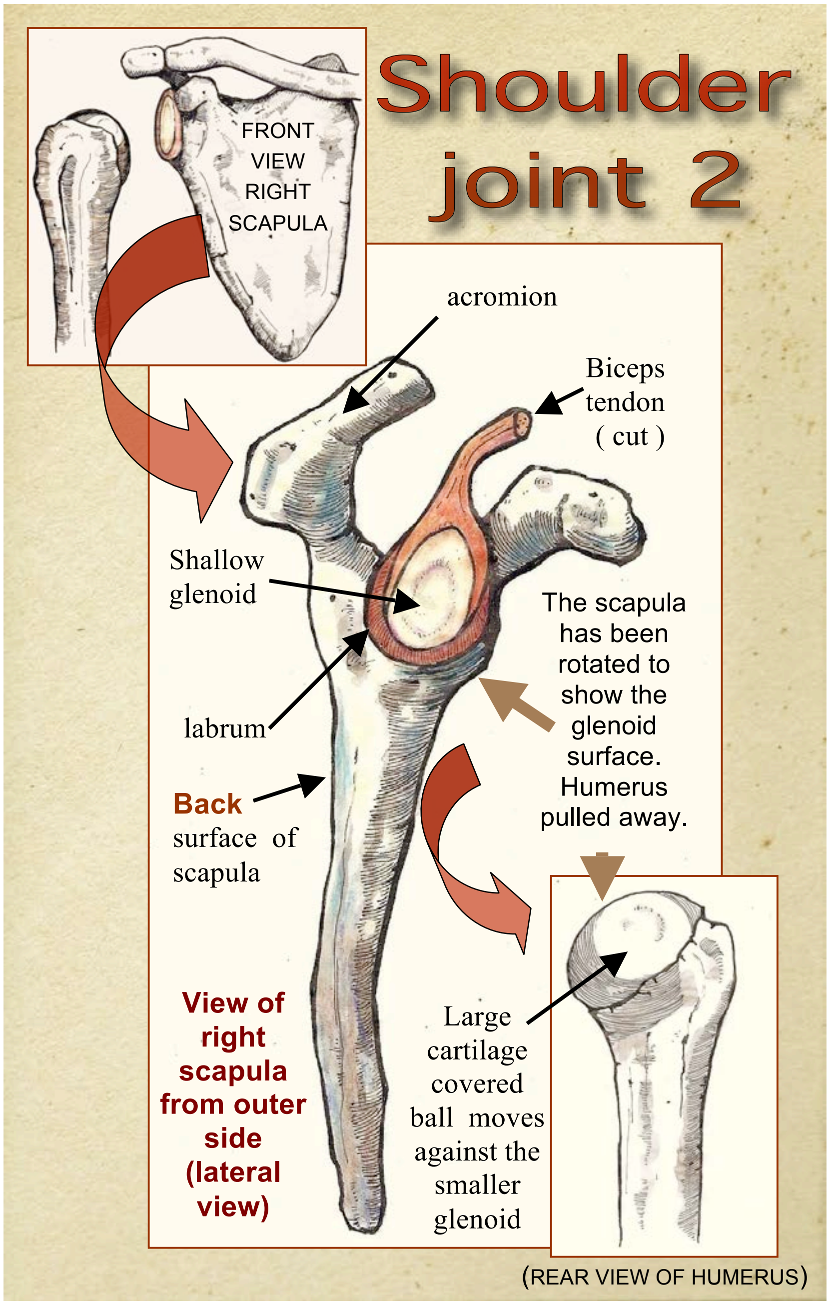

Shoulder joint 2
FRONT VIEW RIGHT SCAPULA
acromion
Biceps tendon (cut)
Shallow glenoid
labrum
The scapula has been rotated to show the glenoid surface. Humerus pulled away.
Back surface of scapula
View of right scapula from outer side (lateral view)
Large cartilage covered ball moves against the smaller glenoid
(REAR VIEW OF HUMERUS)

Fig. 2-4

concept is the relationship of the ligaments to the ball portion of the humerus. These three ligaments reach from the glenoid bone across to the humerus. Figure 2-5A shows the glenoid side; the humerus is removed. Figure 2-5B shows that the ligaments reach around the humeral head like a flexible three-fingered claw. They bridge over the smooth cartilage of the humeral head and attach to the bone at the edge of the joint capsule. Because they only attach at each end, the humeral head can slide freely beneath the strap-like ligaments. This specific feature allows them to constantly adjust to every humeral head movement.

Figure 2-6 shows why the lower ligament (the inferior capsular ligament) is able to effectively restrain forward motion of the humeral head. This adjustment mechanism applies to the other two capsular ligaments also. It is the lower ligament which is so often injured by shoulder dislocation.

DISLOCATION – the humerus moves completely off the glenoid (see Fig. 2-12).
SUBLUXATION – partial or incomplete dislocation.

THE ROTATOR CUFF: THE REGULATOR

The term rotator cuff refers to a group of muscles that help regulate movement at the shoulder joint. These four muscles and their tendons attach to the scapula (shoulder blade) and reach over to the head of the humerus (see Fig. 2-7). All four tendons blend together and converge onto the upper part of the humeral head. This forms a cap (or cuff). Figure 2-7C shows the tendon cuff of the left shoulder from the rear view; this represents one half of the cuff.

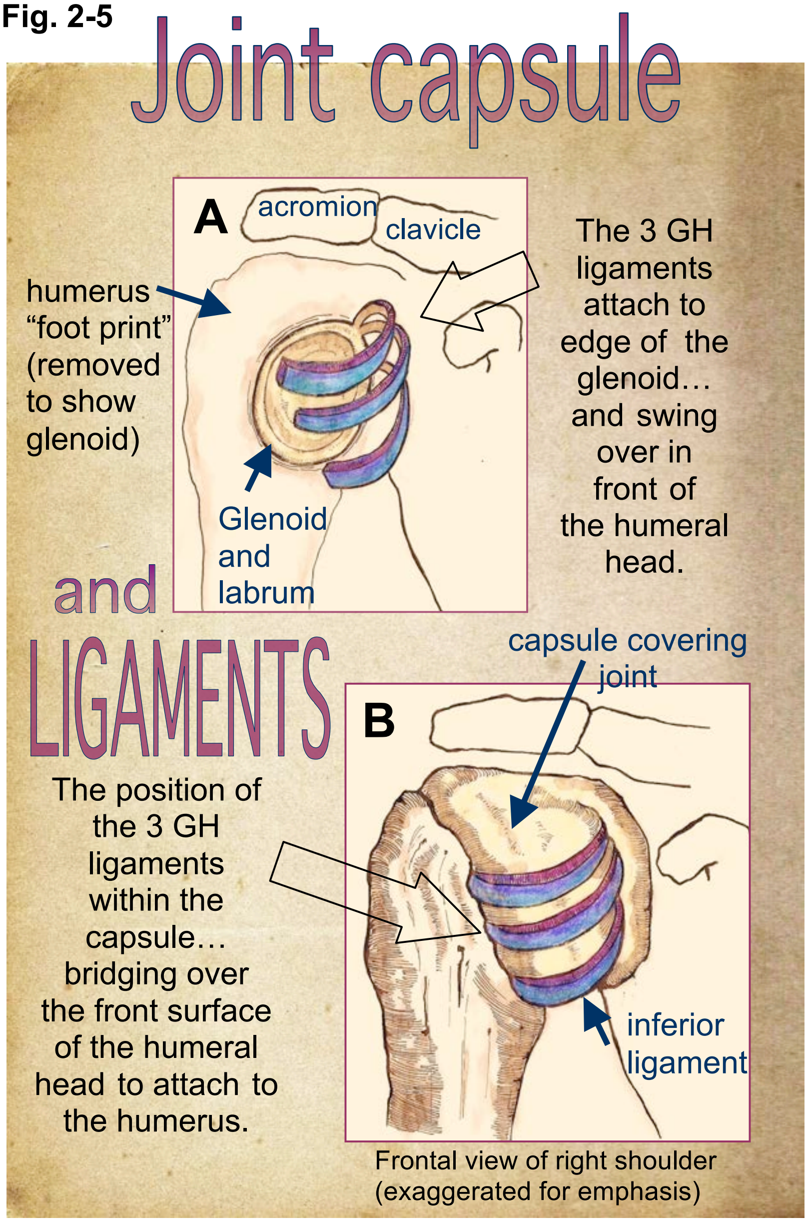
ROTATOR CUFF MUSCLES:
1. Supra·spinatus
2. Infra·spinatus
3. Teres minor
4. Sub·scapularis
Each connects to a tendon.

Because the muscles originate from both the front side and the back side of the scapula, the pulling angle of each tendon and muscle differs slightly. This adds to the precise control of the humeral head—similar to 3 people positioned as a triangle, all flying the same kite.

The rotator cuff muscles do two important things:

1. help the humeral head stay properly positioned on the glenoid surface;

Fig. 2-5


Joint capsule
A
acromion
clavicle
humerus "foot print" (removed to show glenoid)
The 3 GH ligaments attach to edge of the glenoid… and swing over in front of the humeral head.
Glenoid and labrum
and
LIGAMENTS
capsule covering joint
B
The position of the 3 GH ligaments within the capsule… bridging over the front surface of the humeral head to attach to the humerus.
inferior ligament
Frontal view of right shoulder (exaggerated for emphasis)

2. help larger muscles surrounding the shoulder (deltoid, pecs and lats) initiate specific movements; for example, the supraspinatus helps the deltoid move the arm away from the body (abduction).

Motion is the name of the game at the shoulder. Its design facilitates extreme motion, but with limitations—even professional race car drivers wear seat belts. The humeral head is constantly tempted to move out of place.

Why does this happen?

Although slightly artificial, it is useful here to divide movement of the arm and shoulder into two categories:

- what we see, and
- what we do not see

We see the arm move constantly for routine activities. This is the motion of utility. Arcs of movement are driven by the large visible shoulder muscles, especially the deltoid. What we do not see is the motion within the joint. Again, although very artificial, assume for this concept that the only moving part is the humeral head. It spins and rocks to allow the arm movement we see. Imagine the surface of the glenoid as a target; normally, even though the humeral head wiggles around slightly, it stays in the bull's eye. The rotator cuff muscles are the keepers of the bull's eye.

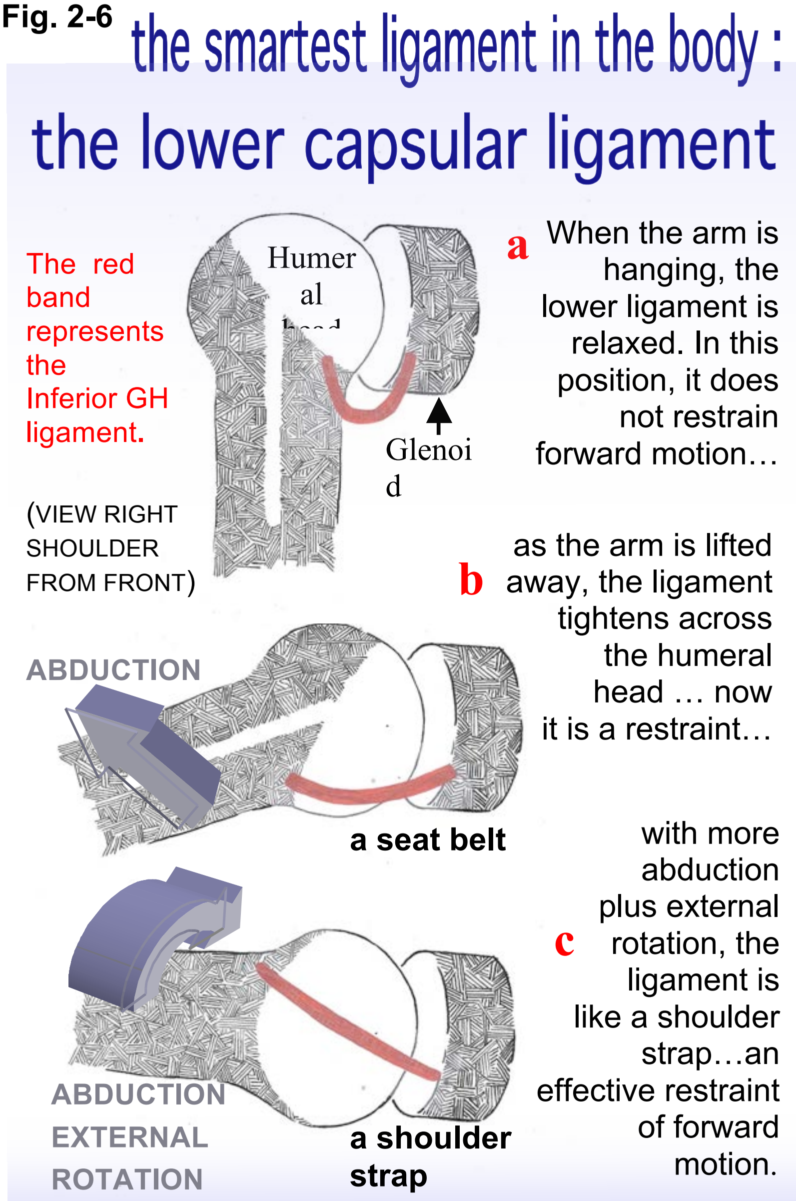
When the deltoid muscle lifts the arm away from the torso, it tends to pull the humeral head off the bull's eye. The principle is similar to a rotating baseball bat. If you choke up eight inches on the bat handle and rotate the fat end of the bat in a wide circle, the handle end also rotates in a smaller, tighter circle. The rotation at the large end of the bat is conveyed to the handle end. Rotation of the arm is conveyed to the humeral head. When this happens, the head tries to move away from the bull's eye and across the glenoid.

DELTOID MUSCLE: the major shoulder muscle which lifts the arm up and away from the body.

Controlling abnormal motion

Abnormal motion of the humeral head on the glenoid surface can be damaging to the joint; it is at the core of some significant shoulder injuries. It is this wayward motion which must be controlled and most of the task is

Fig. 2-6



Redrawn from Bowen, MK, Warrren, RF. "Ligamentous Control of Shoulder Stability Based on Selective Cutting and Static Translation Experiments." Clinics in Sports Medicine, 10(4)1991, Figs. 9,15,17, pp. 769-773. Copyright Elsevier, with permission.

assigned to the rotator cuff muscles. However, they do have help: the capsular ligaments and the large muscles of the shoulder such as the pecs (pectoralis major), the lats (latissamus dorsi), the serratus anterior, the trapezius and the deltoid.

Up to this point, the issue of abnormal position control has addressed the humeral head as the active player and the glenoid as passive. This is actually a simplification because the scapula has to constantly adjust in order to properly orient the glenoid. This can become an injury risk factor when muscle fatigue impairs proper positioning.

INJURIES

DISORDERED MOTION

There are several disorders of joint motion that produce pain and impair athletic performance. Abnormal shoulder joint motion reflects an inability of the restraints to control movement of the humeral head because they are overloaded or damaged.

Motion control for the shoulder is an integrated process that requires a team approach. Although the team is large, the franchise players are very familiar: (1) the rotator cuff, (2) the labrum, (3) the capsular ligaments and (4) the biceps tendon.

> Optimal performance of the shoulder requires cooperation of multiple elements.
> This is a delicate balance.
> Impairment of any one element disturbs the balance.
> Imbalance can produce overload.
> Overload = injury.

Each of these has specific duties depending on the position of the arm. They rotate and pass off the primary responsibility of motion control as the arm moves. They are like a basketball team—everyone handles the ball; everyone is a star when they score. Unfortunately, they are like a basket-ball team without subs; when one is hurt, they are forced to play one man down. When one restraint element is impaired, the others compensate. Sometimes this results in compensation overload and additional injury.

Because this is a highly integrated system, injuries often occur in combinations. For example, labrum injuries are frequently seen with rotator cuff injuries in athletes who play a sport with repetitive overhead arm motion (baseball, volleyball, tennis and swimming). A useful concept is that sometimes the injury that ultimately causes an overhead sports athlete to seek medical attention is the result of failure of the mechanical system, not just one single element.

ROTATOR CUFF INJURY

Athletes across a variety of sports deal with rotator cuff problems, but these injuries are most common among those participating in racket sports, swimming, baseball, golf, weightlifting, gymnastics and volleyball. Because a common feature of these sports is repetitive overhead arm movement, it is reasonable to conclude that something about this motion is central to the issue. In fact, some overhead arm positions are particularly stressful to the shoulder joint. But also important is the frequency and duration of subjecting the shoulder to these maneuvers.

Tendons are just tendons

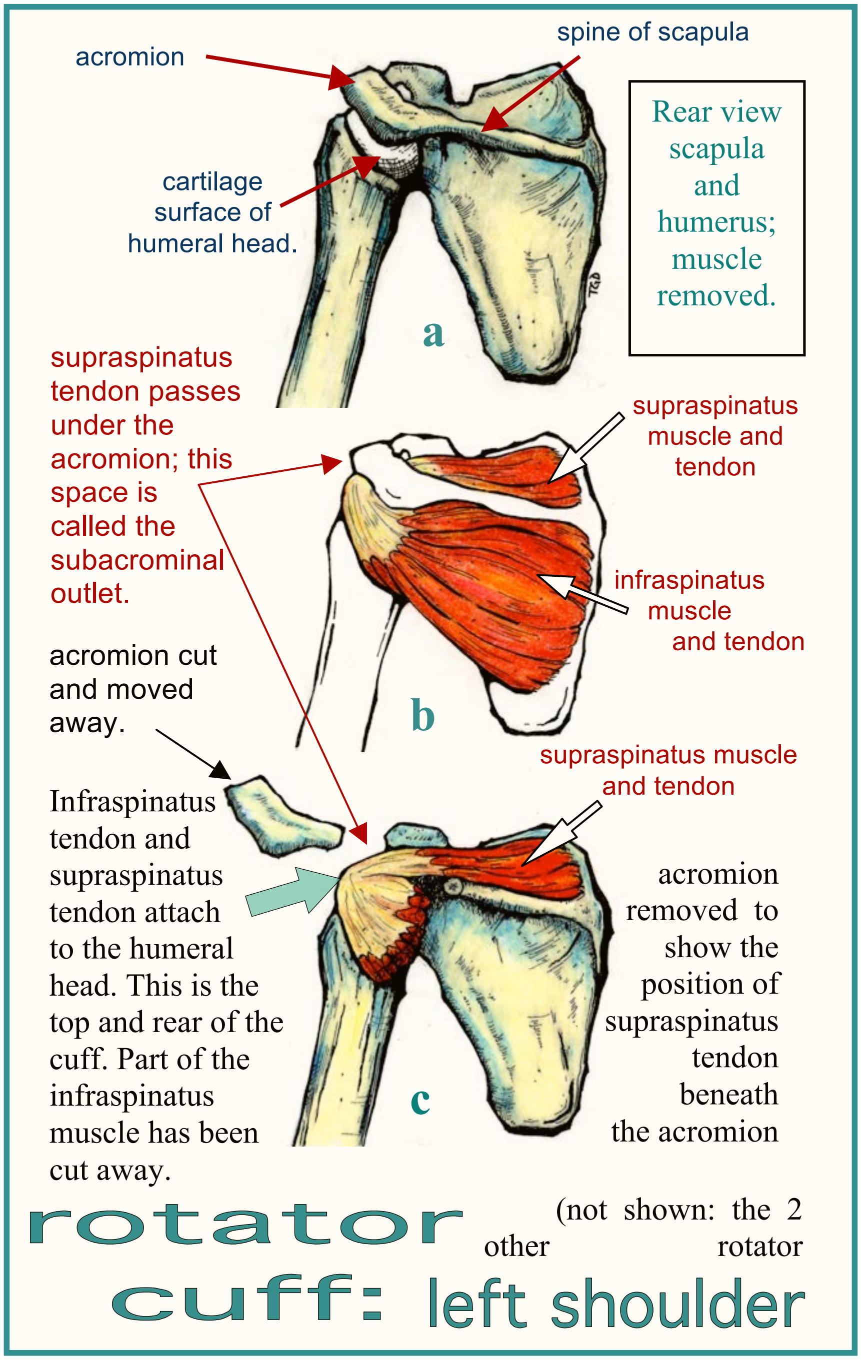
A rotator cuff injury is a tendon injury—damaged fibers and tendinosis. The degree of fiber injury can range from imperceptible microscopic fiber tears to complete tendon rupture. Most rotator cuff tendon injuries are considered overuse injuries, but like almost everything about the shoulder, they are slightly exotic.

Impingement and overload

If we could, we should all buy the extended warranty on our rotator cuffs. It was clearly not made to last. The incidence of RC tendon tears increases as an athlete ages; it is common in those greater than 50 years old. This age factor may be related to the normally fragile blood supply to the tendon; this probably worsens with age. The result can be a tendon which recovers poorly from an injury. In some cases this may be a factor even in younger athletes.

RC is not a standard medical abbreviation for **rotator cuff**. It is used here for convenience.

Fig. 2-7


acromion
spine of scapula
cartilage surface of humeral head.
Rear view scapula and humerus; muscle removed.
a
supraspinatus tendon passes under the acromion; this space is called the subacrominal outlet.
supraspinatus muscle and tendon
infraspinatus muscle and tendon
b
acromion cut and moved away.
supraspinatus muscle and tendon
Infraspinatus tendon and supraspinatus tendon attach to the humeral head. This is the top and rear of the cuff. Part of the infraspinatus muscle has been cut away.
acromion removed to show the position of supraspinatus tendon beneath the acromion
c
rotator
(not shown: the 2 other rotator
cuff: left shoulder

Generally a RC injury is caused by one or both of two scenarios:

1. impingement—tendon abrasion and compression (crush)
2. tendon overload—too much pull

Impingement: crush

Under certain circumstances, the tendon can be pinched and abraded—a condition called impingement. The damage results from the repeated crushing and scraping of the tendon against the bony acromion or by the edge of the glenoid. Obviously this is not a normal phenomenon; it signifies that something is in the wrong place at the wrong time—the humeral head, of course!

When the acromion compresses the tendon, it is because the humeral head has been pulled upward into and against the acromion (see Fig. 2-8). This typically happens as the arm is lifted away from the body (the abduction phase of abduction-external rotation, see text box below). The restraint mechanism that prevents this abnormal motion has failed. Because the lower RC muscles have not kept the humeral head in the proper position, the supraspinatus tendon is injured.

The other form of impingement is a consequence of a specific arm motion which is required for throwing, the tennis serve, and some other overhead sports (see Fig. 2-9). In pitching, this position is assumed during the cocking phase just before the arm moves forward to throw the ball. This motion is abduction and external rotation; to better visualize this see text box below.

> **WHAT IS ABDUCTION-EXTERNAL ROTATION ?**
> With the arm out stretched to the side, 90° to the thorax (abduction), palm facing down, external rotation is achieved by bending the elbow 90° and rotating the hand and forearm upward into the "swearing in" posture. The more extreme version occurs when the hand and forearm are rotated backward as far as possible. It is important because in the extreme, external rotation is a very stressful position (see Figs. 2-9 and 2-10).

When the arm is in this position, even if it is only for a fraction of a second, the RC tendon can rub and scrape against the upper rear edge of the glenoid bone and labrum. The target in Figure 2-10 represents the glenoid as seen from the side. When this is done repeatedly, the tendon can be damaged and weakened.

IMPINGEMENT

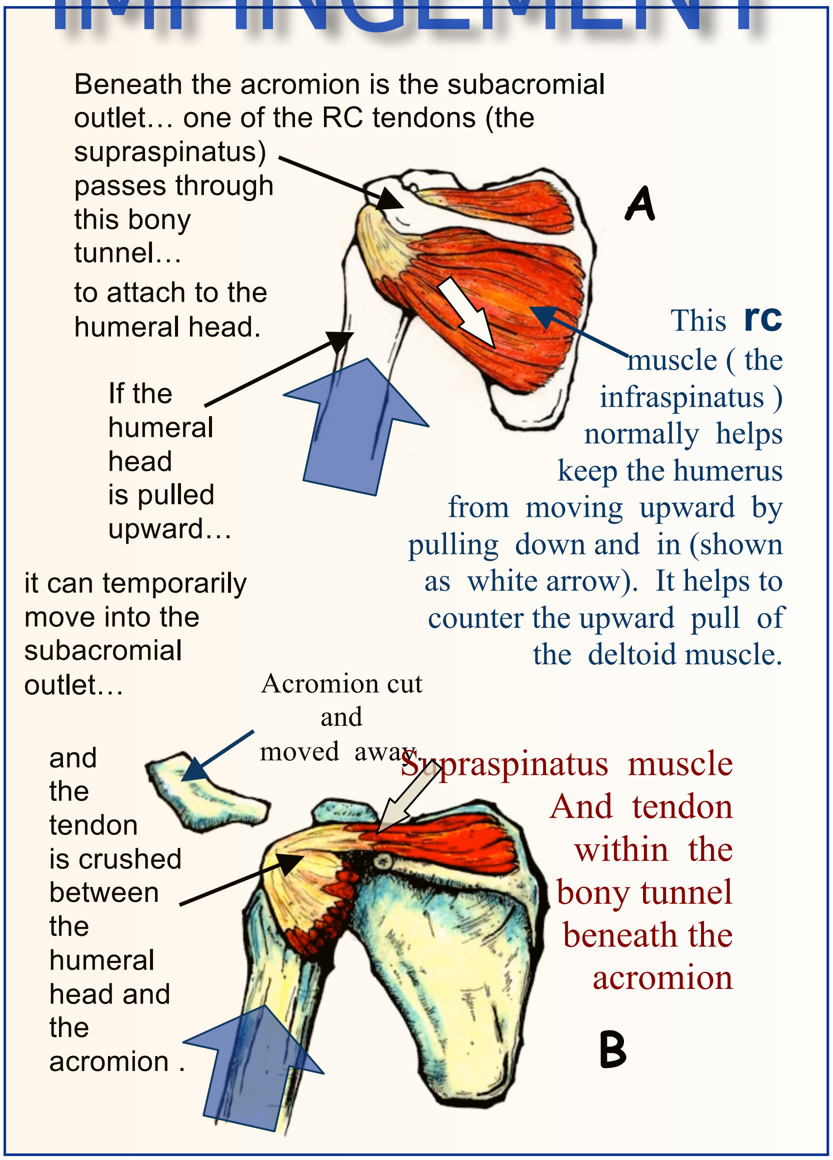


Fig. 2-8 **(rear view of left shoulder)**

Overload: too much pull

Overload produces the typical tendon injury. When an excessive force pulls on and stresses a tendon, the fibers can only stretch slightly before they snap and break (see Chap. 1: Ligament and Tendon Injury, page 5). A sudden overwhelming force such as a fall, or a dislocation, or significant traction applied to the shoulder can cause complete or partial tendon rupture. Most often an acute tendon disruption occurs in the supraspinatus tendon which is already weakened by tendinosis.

> A complete RC tendon tear is also called a full-thickness tear.

Another type of overload frequently damages the rotator cuff: repeated, recurrent overload or the overuse injury. The stress forces here are much weaker than the force required to tear the tendon in a single traumatic event. But, when frequently and repeatedly applied, these weaker forces can cause microscopic fiber damage. Problems arise when this damage does not repair properly; disordered healing, tendinosis and tendon weakness can result from insufficient recovery time. Typically these are not complete tendon tears.

What's with all these stresses?

The rotator cuff has two critical assignments:

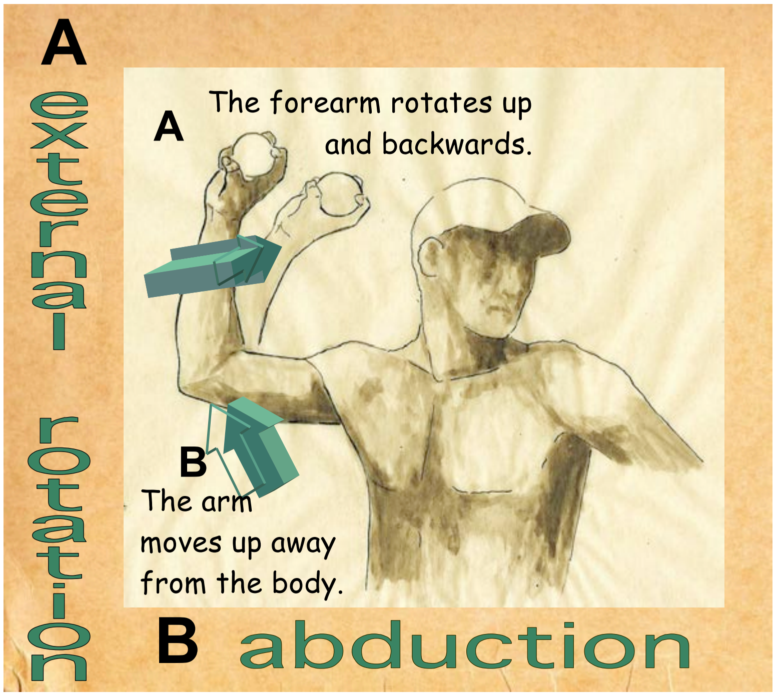
1. to help the large shoulder muscles lift and rotate the arm
2. to keep the humeral head properly positioned on the glenoid as the arm moves

It is this second job that is a high stress, risky business. Because the RC muscles are contracting concentrically and eccentrically (see Chap. 1: Concentric and eccentric, page 20) during almost all arm maneuvers, there are many opportunities to stress their tendons.

> **RANGE OF MOTION (ROM)**
> All joints are designed to move through a range of motion—an arc of normal movement limited by bone and ligaments which function like highway guard rails. Movement beyond these boundaries requires some mechanical deformity of the bone or ligament (stretch, tear or fracture).

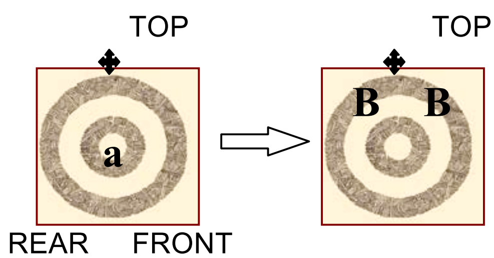
Powerful arm movements, such as throwing, tend to pull the humeral head off center (see Figs. 2-9 and 2-10). Control of this motion is a contest

Fig. 2-9



These targets represent the right glenoid
(view from side with humerus removed)

A The proper position for the humeral head is the bull's eye.



B Excessive overhead arm motion (the throwing motion) can move humeral head to positions **b** .
The subacromial outlet is marked by the symbol ✥

Fig. 2-10

between the rotator cuff muscles and the arm. Since the rotator cuff tendon is the "rope," the forces of this pulling competition are focused on the tendon. Therefore the arm position abduction and external rotation can not only cause impingement, it can overload the restraining tendons and contribute to an overuse injury (see Fig. 2-9 and text box: Abduction – External Rotation, page 42).

The potential for damage can be exaggerated by:

- muscle strength imbalance (weakness of RC muscles);
- muscle fatigue from prolonged repetitious training;
- any coexisting injury to some other shoulder structure that can change the joint dynamics, therefore putting even more stress on the tendons.

Extreme sport

The pitching motion requires the joint to function at the extreme limits of the normal ROM and the extreme limits of restraint competency. Rotator cuff muscle fatigue may reduce the ability to control the humeral head because a tired muscle is a weakened muscle.

How does it feel?

1. Sudden traumatic RC injury (a fall, direct impact or dislocation) is immediately painful; often this is accompanied by shoulder weakness.
2. In overuse and tendinosis, pain may appear gradually and worsen with repetitive shoulder activity, especially the throwing motion and overhead arm maneuvers.
3. As with all tendinosis, tendon damage can be present for quite some time before pain develops.
4. Typically pain is felt along the outer side of the upper arm and in the front and top of the shoulder.
5. It may be accompanied by stiffness, a grinding sensation with certain maneuvers, weakness, sensation of instability, and limited ability to perform in sport.
6. Pain may interfere with sleep depending on arm position.
7. Sport disability can range from minimal to substantial.
8. It can be difficult to know the exact condition of the tendon by the pattern of symptoms. Not only can a small tear feel the same as a large tear, it can feel similar to a labrum injury. The symptoms overlap.
9. The MRI scan is an accurate test to identify the extent of damage.

Treatment
Depending on the extent of injury, treatment options vary. Avoidance of painful activities and rest is recommended initially. For painful tendinosis with minimal or partial tendon tears, physical therapy to increase flexibility and strength is effective. If these therapies are not helpful within several months, surgery may be necessary.

Complete tears and large tears are repaired surgically as they will not heal; often the tendon pulls off and away from its connection with the humeral head. The torn edge of tendon retracts, leaving a gap because it is under constant tension from the elastic muscle (see Chap. 1: Healing and Repair, page 8). The ends may recoil like the cut ends of a stretched rubber band.

If a partial tear involves 50% of the tendon diameter, it is frequently treated as a complete tear. Techniques using the arthroscope are available; the tendon can be reattached to the bone using special stitches which are anchored into the bone. Sometimes, it is necessary to remove a portion of the acromion bone if it is impinging upon the tendon.