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Safe at the Shoulder

The key to preventing shoulder injuries is understanding the anatomy of the shoulder complex and how the body's other muscles affect the throwing motion

By Daniel Cipriani

Why is the shoulder so often injured in baseball participation? Why is it so difficult to fully rehabilitate the shoulder? And why is it so hard to train the shoulder and prevent it from injury? The answer to all three questions is actually quite simple: because baseball athletes ask their shoulders to do more for them than any other joint.

Baseball players demand that their shoulders be very mobile and loose, move at high rates of speed, and perform difficult, repetitive tasks. Yet, athletes also demand that their shoulders remain very stable. It is true that the shoulder contains the most mobile system of joints in the human body; it is capable of moving through the greatest ranges of motion during daily activity as well as during sporting movements. At the same time, the shoulder is a relatively stable joint; it was designed to withstand tremendous forces from muscles, gravity, and even the ground. Still, for a joint to be highly moveable and dynamic while remaining stable is no easy task. Coaches and athletic trainers who work with baseball players face one of the most difficult jobs in all sports: to train the shoulder for incredible tasks, while also preventing it from becoming injured.

Functional Anatomy

In order to prevent injuries to the shoulder, it is necessary to fully understand its components. Most of us think of the shoulder simply as that part of the body that sits on top of the armpit. But the shoulder is actually much more, consisting of at least four major joints, over 20 different muscles, and three very important bones. The shoulder "com-

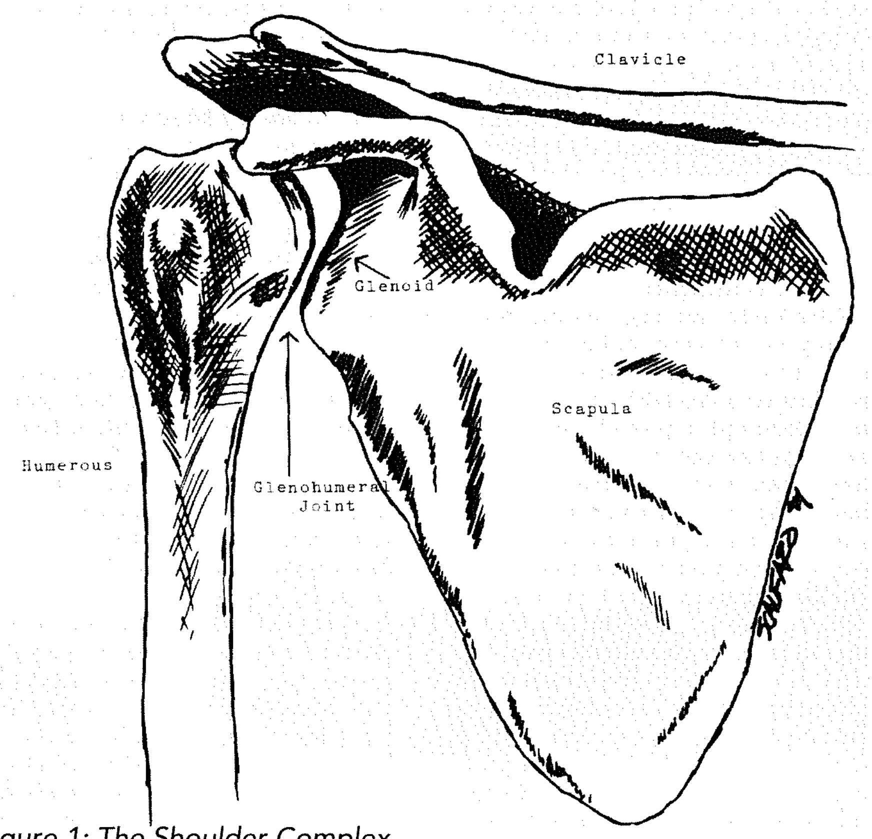

Figure 1: The Shoulder Complex

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plex" is made up by the collar bone (clavicle), the upper arm bone (humerus), and the shoulder blade (scapula). Together, these three bones are hooked together by ligaments and muscles to give us a very mobile single unit (see Figure One).

The humerus is attached to the scapula at what is traditionally thought of as the shoulder joint, the ball and socket of the shoulder. This union of the large shoulder blade and heavy upper arm bone are then attached to the rest of the body by way of the collar bone, a long bone that is attached at one end to the scapula, and at the other end to the sternum (breast bone). The fact that the entire upper arm and shoulder blade are hooked onto the rest of the body by way of only the collar bone should be a cause for concern in itself. After all, the arm and shoulder are not exactly the lightest parts of our anatomy, and yet they hang onto the rest of the body with very little support.

Probably the more amazing portion of the shoulder complex is the shoulder joint itself, the attachment between the shoulder blade and the humerus. The humerus rests against the flat glenoid of the scapula creating the glenohumeral joint, or shoulder joint. This is the part of the complex on which athletes usually place too much stress. Described as a ball and socket joint, it is actually more like an egg resting on the face of a penny. The ball-shaped head of the humerus is huge compared to the flat surface of the scapula to which it is attached.

Obviously, an egg resting on a penny is not very stable. So, as a part of the design, a rim of cartilage (the labrum) was added to the penny in an attempt to provide better stability for the egg. What we actually have then is an egg balanced on a bottle cap. This provides additional stability, but if you move the bottle cap around just a little too much, suddenly the shoulder is scrambled.

Fortunately, however, four very important muscles are attached to the humerus with the single most important job of keeping the egg attached to the bottle cap. These four muscles work all day long pulling the humerus up tight against the glenoid to keep this mobile joint stable. Commonly referred to as the rotator cuff, these muscles never get a chance to rest during the day—they work even when the arm is just hanging at our sides—which is another reason that the rotator cuff is so often injured in athletic participation.

Finally, the shoulder blade (scapula) should at least be mentioned. This monstrosity of a bone, which sits on our upper back, is actually one of the main protectors of the perilous shoulder joint. Seventeen different muscles attach to the scapula for the purpose of moving the scapula, holding it in place, sliding it, raising it, tipping it, or tilting it. One of the more important responsibilities of the shoulder blade is to move in such a way as to keep the rotator cuff in a more comfortable position to work. Often, when our arms are raised over our heads, such as when throwing a ball, the rotator cuff can become too cramped in its living space—it gets squeezed between the humerus and the shoulder blade. As long as the muscles of the shoulder blade help to move the shoulder blade out of the way, however, the rotator cuff can work efficiently without getting pinched off. In other words, as long as the scapula moves smoothly, the shoulder joint can be better protected.

Injury Mechanics

So, if the shoulder complex has so much protection, why then is it so often injured in baseball? Looking closely at the simple act of throwing a ball is the best way to shed some light on this question. In most cases, the purpose of the throw is to propel the ball at a high speed with accuracy. During the throw, an athlete will accelerate his or her arm to speeds greater than 90 miles an hour, generating this speed from the legs, pelvis, and trunk; watch a pitcher during the cocking phase and windup to see the excessive amount of trunk and leg involvement.

As the throwing motion is accelerated, the legs and pelvis serve to propel the upper body and arm in the direction of the target. The muscles of the legs and pelvis are huge and very powerful, which is what allows athletes to accelerate their arms at such high speeds. The

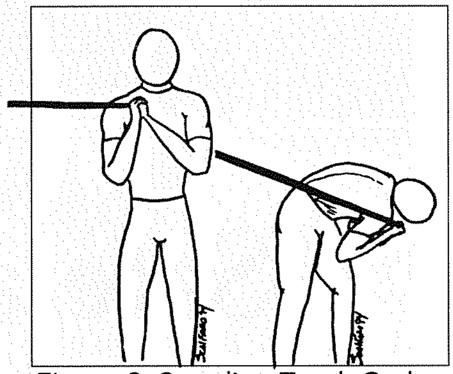
Figure 2: Standing Trunk Curl

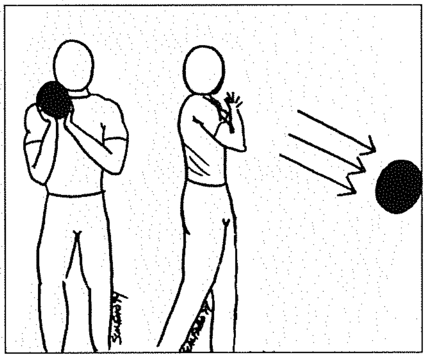
Figure 3: Medicine Ball Trunk Throw

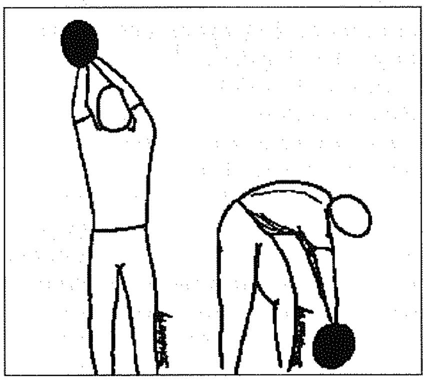
Figure 4: Medicine Ball Diagonal Deadlift

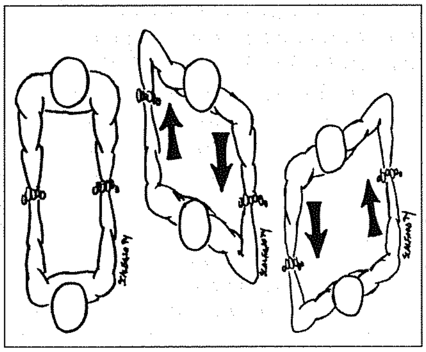
Figure 5: Partner Two-Handed Push-Pull

Illustrations by Terry Scalfaro

only problem is that something has to then slow this process down—or our pitchers would spin themselves into the ground.

Typically, it is the rotator cuff that is called on to slow this process down. But, when you examine the physiology, this really doesn't sound like a fair deal. An athlete uses the largest muscles in his or her body to accelerate the arm, and then asks four of the smaller muscles of the body to stop this motion.

According to Vern Gambetta, Director of Conditioning for the Chicago White Sox, using the rotator cuff to stop all this motion is like trying to slow down a dump truck rolling down a steep grade by using just the brakes. Slamming on the brakes to stop a huge mass will only damage the brakes; instead, the driver will downshift, using the transmission to assist with the slowing of the truck while applying the brakes just gently. The shoulder needs to be treated in the same fashion. Athletes need to call on their transmissions (legs, pelvis, and trunk) to assist their brakes (rotator cuff) during high speed activities.

Injury Prevention

Based on the above analogy of the runaway truck, it would appear that one of the best ways to prevent injury to the shoulder is to actually strengthen the muscles of the leg, pelvis, and trunk. Essentially, one can train the shoulders for throwing by training the pelvis and trunk to slow down the forces that they in fact created.

By observing an athlete in motion, particularly a baseball pitcher, it becomes even more obvious that the majority of the high speed forces behind the throwing motion do indeed come from the legs and trunk, and that the arm is just along for the ride. Athletes are taught to lunge with their lead leg in the direction they wish to throw, using the powerful muscles of the hip and back to accelerate their body forward. The stomach muscles (abdominals) are then used to accelerate rotation of the trunk, and the hip rotators (muscles in the gluteal region) are called upon to assist the abdominals in completing the forceful rotations of the body. With all these large, powerful muscles working together, the end result is a high-speed, rotary acceleration of the upper body. The shoulder muscles are then called upon to guide the arm and hand, in order to direct the throw or pitch to the appropriate target. The speed and power of the throw come from the hip and trunk, the accuracy comes from the shoulder and arm.

The only problem with this scenario is found in the training regimen of many athletes. Believing that their power comes from the shoulder, these athletes will spend many hours strengthening and training the shoulder, arm, and chest. While this is certainly important as a part of training, the hip, back, and abdominals are often neglected. Not only does this create a serious muscle strength imbalance, but the muscles responsible for most of the work are ignored and left unprepared for participation. If these muscles are not prepared to handle their own stresses, then the shoulder may be called on to pick up the slack—and the shoulder then becomes more susceptible to injury.

For the athlete who does focus some attention on his or her legs, hips, and trunk, the traditional exercises employed most often cover only a part of the muscles' functions. Squats, sit-ups, and deadlifts, while very effective for strengthening, fail to address the rotary components of each muscle. For example, sit-ups and squats teach the abdominals and gluteals to work well in one straight plane, namely flexing the trunk or extending the hips. However, the abdominals and gluteals also spend a great deal of time rotating the trunk with force. Thus, exercises need to be added to challenge these muscles with rotational forces.

The following is a list of potential exercises (which should be performed three to four times per week) to add to an already comprehensive conditioning program.

• Carioca drills (three sets of 25-yard sprints in each direction): The athlete runs laterally (sideways), crossing one leg in front of the other leg, alternating which leg crosses in front. This type of running requires rapid hip and trunk rotations repetitively.

• Standing Trunk Curls (standing sit-ups with a twist): Elastic tubing is attached to a fixed surface at shoulder height. The athlete stands with his or her back to the attached band, taking the free end and holding it over the right shoulder; the left leg should be straddled forward. The athlete then curls the trunk, while twisting to the left (tries to bring the right shoulder into contact with the left thigh). The elastic tubing provides the resistance for two sets to fatigue (Figure Two).

• Medicine Ball Trunk Throws: Using an eight- to 12-pound medicine ball (MB), the athlete throws the ball to a partner or pitch-back unit, generating the force from the legs and trunk. The hands should hold the MB close to the dominant shoulder, and should not extend during the throw (the hands stay against the shoulder during the throw). Be sure to stagger the legs with the lead leg forward. Begin with slow, short distance throws (eight to 10 feet) and progress to longer tosses with greater speeds, generally for two sets to fatigue (Figure Three).

• Medicine Ball Diagonal Deadlifts: Using an eight- to 12-pound MB, the exercise begins with the ball laying on the floor outside the athlete's left foot (for a right-hand dominant player). With both hands, the athlete grabs the ball and rapidly lifts it over the head, passing the ball over the right shoulder. When returning the ball to the floor, the movement is again rapid, with the athlete focusing on slowing the ball down prior to setting it back on

the ground. Perform one to two sets to fatigue (Figure Four).

• Partner Two-handed Push-Pulls: Standing facing each other, with feet at shoulder width apart or narrower, two athletes grasp each others' hands. One athlete then attempts to turn the partner by pushing one arm forward and pulling the other arm back. The partner being turned allows the motion to occur, but tries to slow down the motion. Athletes should take turns pushing-pulling, completing one set to fatigue each (Figure Five).

While these exercises are generally employed during preseason conditioning, the gains acquired during this time need to be maintained. Many injuries may occur later in the season if the athlete slowly loses the strength and fitness developed during the preseason. Simply continuing these exercises for one to two sets, two times per week during the season is normally sufficient to maintain the gains.

It is also important to note that all training should be initiated with some form of warming up exercises, to prepare the muscles and joints for stress. Warm-ups can be exercise-specific (light, short-distance throwing) or more general (light jogging, cycling, high-rep/low-weight free weight exercises). Cooling down can be as simple as just walking comfortably for three to five minutes.

In addition to the exercises outlined above, coaches and athletic trainers can employ a few extra measures to help prevent shoulder injuries. First of all, it is crucial to allow athletes the opportunity and time to accommodate to new exercises, increased repetitions, increased weights, or increased speeds of an exercise at their own pace. The body is fully capable of adapting to the stresses we place on it, but only if it is given sufficient time and opportunity. Injuries often occur when an athlete is progressed too fast, too far, too soon, too much, or too often, before the body has had a chance to adapt to any new training practices.

Secondly, taking measures to try and spot an athlete with a potential injury can be worthwhile. It is, however, probably the most difficult task as a part of injury prevention. It requires a trained eye at evaluating not only the shoulder complex, but the trunk and legs as well. When budgets allow, coaches should take advantage of athletic screenings provided by athletic trainers and physical therapists to evaluate the flexibility and biomechanics of not only the shoulder, but also the feet, knees, hips, pelvis, and trunk. While screenings are not absolute in identifying potential injury sites, they can assist in locating weak links, or at least establish baseline levels for each athlete.

Overall, try not to fall into the rehabilitation specialist's trap of tunnel vision. See the athlete as a whole functioning person, not a body part. Keep the whole body tuned and the transmission geared, and hopefully your brakes will never fail you. ▼