Shoulder Rehabilitation, Part II

By Thomas Souza, DC, DACBSP

Last month we discussed a general overview approach to rehabilitation of shoulder problems based on condition. This month and the following month, the focus will be directed at four sporting activities: throwing, swimming, tennis, and golfing.

This month we will discuss throwing and swimming. When attempting to rehabilitate a shoulder problem in relation to a specific sport or sport activity, it is important to consider two aspects:

1. the general muscular requirements of the sport activity;
2. the underlying condition or injury (e.g., impingement vs. instability), and the known muscular adaptations or compensations that result.

Throwing

Throwing is a component of many sports, however the focus here is on the pitcher. Some extrapolations can be made with other related sports, but the demands of high-speed overhand pitching presents unique characteristics that do not easily transfer into other throwing activities.

Muscular Demands

Muscular demand is phase-dependent. Although there are variable descriptions of the phases of throwing, generally there are four: windup; cocking; acceleration, and follow-through.

The act of throwing is a "whipping" maneuver where acceleration generated in a proximal body part or joint is imparted to the following distal joint sequentially. In the professional pitcher, at least half of the force production is due to lower body contribution, decreasing the demands on the shoulder. This point is often lost by more amateur pitchers or throwers who try to throw "from the shoulder." Muscles that initially function eccentrically switch quite abruptly to concentric contraction, especially in the immediate transition from cocking and acceleration. There is minimum shoulder activity in the windup.

As the arm is brought into the cocking position, generally the anterior shoulder muscles (internal rotators/adductors) fire eccentrically, as the posterior muscles (external rotators/abductors) fire concentrically. The act of throwing is therefore plyometric, where a pre-stretch in the anterior musculature is
followed by a concentric firing. The posterior muscles fire concentrically during the cocking phase and eccentrically during the acceleration and follow-through phases.

In the professional, the deltoid positions the arm for early cocking, while in the late phase of cocking, the rotator cuff stabilizes the humeral head. In amateurs, this is less of a sequence and more a force-couple relationship where the deltoids and rotator cuff act together. In the acceleration phase, the external rotators (infraspinatus/teres minor/posterior deltoid) contract eccentrically to counter the massive acceleration generated by the internal rotators adductors (subscapularis/pectoralis/latissimus dorsi). The peak of activity for the supraspinatus is in late cocking. This peak is increased in the pitcher with instability and decreased in the pitcher with impingement. The eccentric activity of the pectoralis major and latissimus dorsi, and the concentric activity of the serratus anterior during cocking, are decreased with both impingement or instability. This may allow anterior translation and superior migration during late cocking, creating a vicious cycle. Biceps activity increases at the shoulder in both amateurs and those with instability.

Training and Rehabilitation

Based on the above electromyographic observations, following are some suggested strategies:

- Shoulder muscles must be trained both eccentrically and concentrically.
- Emphasis should be placed on the rotator cuff muscles; given that they act throughout most of the throwing phases, the emphasis should be on endurance.
- The biceps may act as an important secondary stabilizer at the shoulder and should be trained eccentrically.
- Concentric training of the serratus anterior is essential for providing stability for the moving scapular platform.
- Stretching of the posterior capsule and musculature may help prevent superior migration of the humeral head.
- If injured, a slow return to throwing may be accomplished with several training concepts; one example is called the Fungo routine, where speed and accuracy are initially de-emphasized.
- An emphasis on trunk rotational training is paramount for decreasing the demands on the shoulder.
Swimming

Swimming is an endurance activity and as such must be approached with this focus during rehabilitation. Although there are several common swimming strokes, the emphasis here is on free-style. The swimming stroke is divided into pull-through and recovery. These phases are divided as follows:

Pull-through

- hand entry
- mid pull-through
- end pull-through

Recovery

- elbow lift
- mid-recovery
- hand entry

Muscular Demands

In general, pull-through is large muscle dominant (adductor/internal rotator), with force being provided by the pectoralis major first (clavicular portion mainly), followed by the latissimus dorsi. Assistance is provided by the serratus anterior and the internal rotation functions of the subscapularis and teres major. Recovery is a small muscle-dependent movement with contributions from the rhomboids and middle trapezius to retract the scapula as the teres minor/infraspinatus and posterior deltoid externally rotate the shoulder. Abduction is performed by the supraspinatus and deltoid. The serratus anterior and upper trapezius serve to rotate the scapula upward for shoulder stabilization after mid-recovery in preparation for hand entry. Although generally the teres minor and infraspinatus function in concert with the free-style stroke, they serve different roles. The infraspinatus acts to depress the humeral head in mid-recovery, and the teres minor acts in concert with the pectoralis major during the pull-through phase.

There are two muscles that are required to fire continuously at a level of 20 percent above a comparative manual muscle test (MMT); the subscapularis and serratus anterior. It has been demonstrated that muscles that fire at this intensity are likely to fatigue leading to compensation or damage.
Specifically, there are some patterns of inhibition in patients who suffer from instability or impingement. Many of the patterns appear to be attempts at preventing too much internal rotation in an effort to avoid further impingement.

- Peak activity of the anterior and middle deltoids at the end of pull-through is decreased markedly when evaluated with EMG in swimmers with painful shoulders; this results in a dropped elbow and a hand entry farther lateral compared to non-painful swimmers.
- The subscapularis activity during mid-recovery is decreased in the painful shoulder.
- The infraspinatus muscle demonstrated a significant increase in activity at the end of pull-through; the increase in external rotation visually appears as a dropped elbow during recovery.
- Peak activity of the upper trapezius and rhomboids at hand exit was decreased in the painful shoulder.
- The propulsive activity of the serratus anterior was greatly diminished during the pull-through phase in the painful shoulder.

Training and Rehabilitation

Based on the above electromyographic observations, the following are some suggested strategies:

- Use high-speed endurance training for the subscapularis and serratus anterior.
- Focus on concentric types of training for the posterior shoulder muscles (infraspinatus, posterior deltoid, middle trapezius, and rhomboids).
- Stretch the posterior capsule if the patient suffers from impingement.
- Concentrate on rotator cuff training for stabilization prior to hand entry.
- Perform simulated proprioceptive neuromuscular facilitation (PNF) training out-of-water.

Obviously, this is quite a cursory overview, yet this should provide some stimulus for further interest in the details of biomechanics and training for each sport.

References


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