Dynamic Chiropractic

SPORTS / EXERCISE / FITNESS

The Windmill Softball Pitch

There has been an explosion of interest in fast-pitch softball. This certainly has some of its roots due to the amazing performance of the American team in the last Olympics. Both the numbers of girls and women and the level of play have increased dramatically. Unfortunately, little is known regarding the biomechanics and types of injuries patterns seen in players, particularly pitchers. Recently, research interest has produced two studies which help begin the process of better understanding and preventing and rehabilitating common injuries.

A study by Lossli et al.[1] was a retrospective search for the types of injuries seen in collegiate softball pitchers as observed by their trainers. The incidence of time-loss injury was 45%; of these, 27% were due to overuse injury at the shoulder.

A more recent study performed by researchers at the Biomechanics Laboratory in Inglewood, California, used electromyographic (EMG) recording of shoulder muscle activity in fast-pitch softball pitchers.[2] Previously, this same group has measured the shoulder muscle activity in tennis, baseball, swimming, and golf. This current study used 10 collegiate-level pitchers. Fine-wire intramuscular electrodes were implanted into six shoulder muscles of each pitcher. The pitchers were videotaped and underwent motion analysis to define the different phases of the softball pitching activity. This also provides a frame of reference for statements regarding peak muscle activity.

The frame of reference is a side view of the body. If the pitching arm can be viewed as the hand on a clock with full circumduction moving from 12 o'clock through 3, 6, 9, and back to 12, the 12 o'clock position is full elevation, 90 degrees of shoulder flexion would be considered the 3 o'clock position, and the arm by the side as the 6 o'clock position. Two almost complete revolutions are performed prior to ball release. The phases based on this system are:

- Windup: arm behind the back; arm in internal rotation or neutral; weight on ipsilateral foot;
- Phase 2: 6 o'clock to 3 o'clock position; contralateral leg begins to lift;
- Phase 3: 3 o'clock position to 12 o'clock position; arm begins external rotation; trunk rotation to same side; contralateral leg extended prior to foot contact;
- Phase 4: 12 o'clock position to 9 o'clock position; arm "opens up" to ipsilateral side with full external rotation;
- Phase 5: 9 o'clock position to ball release; internal rotation of trunk and arm; arm adducted across body;
- Follow-through: ball release with arm contact of lateral thigh.

The reference point for the amount of contraction stated for each muscle was derived from measuring activity of an individual muscle with a maximum contraction using a standard manual muscle test (MMT) measured with EMG. In the published study, the contraction of each muscle is stated as a percentage of the MMT with a mean and standard deviation chart for comparison. The following discussion will be a summary of muscular activity based on the above phases. The windup demonstrated minimal muscle activity and a wide range of individual variation; therefore, the discussion will begin with phase 2.

Phase 2: Arm Traveling Forward from by the Side to 90 Degrees Elevation

The supraspinatus was quite active during this phase, helping to stabilize the humeral head, allowing the deltoid to further elevate the arm. Activity of the deltoid was about half that of the supraspinatus. Interestingly, the infraspinatus was the most active muscle during this phase, acting as a stabilizer. This was separate from the teres minor, which had far less activity. It is also interesting that other studies demonstrate that this type of infraspinatus activity is often more with the arm in internal rotation (the infraspinatus is an external rotator).

Phase 3: Arm Travels 90 Degrees to Full Elevation

Activity is primarily in the posterior deltoid, infraspinatus, and teres minor during phase 3. The "kicking in" of the teres minor confirms observations with other sports activities: that the teres minor becomes more active at higher elevation. Supraspinatus activity drops sharply during this phase.

Phase 4: The "Cocking" Position (Reverse Movement of Standard Overhand Pitching)

The primary activity is seen in the decelerator muscles: the internal rotator/adductors (pectoralis major and subscapularis). This coupled effort by the pecs and subscapularis act to protect the anterior capsule. Activity of the external rotators (infraspinatus, teres minor, posterior deltoid) drops to a moderate level. The serratus anterior begins to increase activity in this phase.

Phase 5: The "Bowling" Movement of Behind the Back to by the Side Ball Release

The primary muscles are the pectoralis major, subscapularis, and serratus anterior. The pectoralis and subscapularis act together to internally rotate and adduct the arm while the serratus anterior helps to stabilize the scapula.

The Follow-Through Phase: "Putting the Brakes on"

Contrasted to standard baseball pitching, the follow-through has far less muscle activity. This is due to the energy of the pitch being dissipated through contact of the arm at the lateral thigh just after the ball is released. The teres minor is the muscle with the highest activity during this phase.

Summary

Although visually dissimilar, there are some common findings between standard baseball and fast-pitch softball pitching. The pectoralis major is still the primary power generator at the shoulder. Stabilization is required in both pitches by the anterior muscles during the "cocking" phase. Also, the serratus anterior is requisite for proper scapulohumeral synchrony. The primary differences are that with a standard baseball pitch, (1) the humerus is abducted; (2) internal rotation is the main contributor to power; and (3) deceleration in follow-through requires a high level of eccentric muscle activity of the external rotators. With fast-pitch softball, (1) the humerus is in the plane of the body; (2)

adduction across the body is the primary power generator; and (3) deceleration occurs primarily from arm contact with the ipsilateral hip.

A review of muscle activity during softball pitching should aid attempts at prevention and rehabilitation of soft-tissue and biomechanical injury about the shoulder. Observation of pitching may reveal flaws or weaknesses in a specific phase that may be corrected through appropriate myofascial release or exercise. Although this study focused on the shoulder's contribution to pitching, the reader must be reminded that much of the stress on the shoulder is reduced by the contribution and synchrony of trunk and lower body participation. Attention to these areas must not be ignored.

References

1. Loosli AR, Requa RK, Garrick JG, et al. Injuries to pitchers in women's collegiate fast-pitch softball. Am J Sports Med 20:35-37, 1992
2. Maffet MW, Jobe FW, Pink MM, et al. Shoulder muscle firing patterns during the windmill softball pitch. Am J Sports Med 25:369-374, 1997.

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