This past winter, with all the snow, the number of snowballs thrown far exceeded the number of baseballs and softballs thrown. This is all about to change. With that change will be the onset of a large increase in arm injuries and complaints as greater than 70 million 'ball-playing' individuals emerge from their winter slumber. A large majority of these complaints will be related to musculotendinous overuse injuries, primarily of the shoulder and elbow.

As is the case with most overuse injuries, many of these arm injuries are avoidable with well structured and adhered to pre-season training and conditioning programs as well as appropriate in-season behavior. Strength training and cardiovascular fitness training have been suggested by some authors to reduce overuse injuries by upwards of 50% while lessening the severity and loss of playing time of those that do occur. However, by the time coaches and medical care providers are aware of the problem, the injury has occurred. Recognizing these injuries and beginning treatment is the topic of this article along with an attempt to explain both similarities and differences between baseball and softball players.

BIOMECHANICS

Despite the visual differences between baseball and softball pitchers, there are many similarities. Both baseball and softball players create velocity with the strength of their lower body and back. Transfer of this energy to the ball across the shoulder joint is primarily a function of the pectoralis major muscle. This coupled with scapular stabilization (emphasis on the Serratus anterior muscle) allows a pitch to be successful.

The primary differences between the two is that the baseball pitch occurs with significant shoulder abduction and internal rotation as the main contributor to power while the softball pitch occurs with the arm in the plane of the body and adduction of the arm across the body is the power generator.[1] Further, deceleration forces for the softball pitcher are greatly reduced versus the baseball pitcher due to the striking of the lateral thigh after ball release. It is during the deceleration phase of the pitch that eccentric muscle firing is elevated exposing the superior labrum, biceps complex, and posterior capsule to possible injury.[2]

"The stressful, injury producing portion of a typical pitch occurs in approximately 0.2 seconds..."

The shoulder is one of the last joints to be stressed as the power from the lower extremities, trunk, and back is transferred to the ball to allow accuracy. The velocity and the forces generated are enormous. Internal rotation for a baseball player reaches speeds of 7000 degrees per second and forward flexion velocity reaches 5000 degrees per second for a softball pitcher. The problem is not the speed of rotation,

however, it is the rapid acceleration and deceleration of the shoulder and arm that causes failure of the soft tissue enveloped around the shoulder and elbow.[1]

The stressful, injury producing portion of a typical pitch occurs in approximately 0.2 seconds and is extremely sensitive to slight changes in body or body-segment position.

"Arm injuries occur 82% of the time in softball players and 90% in baseball players."

The abduction – external rotation position of the cocked baseball shoulder places a physiologic compression on the posterior labrum and posterior rotator cuff. This position, referred to as hyperangulation by Dr. Jobe, leads to the common problem of internal impingement.

Conversely, the windmill motion for softball pitchers places much less stress on the posterior shoulder but instead causes anterior stress across the anterior capsule, rotator cuff interval, and biceps – labral complex. Tension on the biceps caused by a relatively increased joint distraction force and the increased stress on the subscapularis and pectoralis muscles leads to the common anterior shoulder complaints for softball pitchers.

Although the elbow is further down the chain of energy transfer for a pitch (after the shoulder) its vulnerability is increased by poor mechanics and specifically poor shoulder motion. Attempting to utilize the smaller elbow joint ligaments and muscles to correct abnormalities around the shoulder is fraught with problems.

The relative extension of the elbow throughout the softball pitch lessens the stress on it compared to baseball pitchers. The rapid deceleration for baseball pitchers causes some excessive tension on the anterior elbow capsule and the distal biceps. This stress, absent in the softball pitcher, may be the reason that relatively few elbow problems are seen in softball throwers.[3]

INCIDENCE

In this situation, like other overuse injuries, the major complaint is that of sore or aching discomfort following a period of exercise of throwing. This aching, tooth-like pain is a sign of inflammation and swelling and often has been present for several days, weeks or even months before a thrower seeks help. Rotator cuff tendonitis is the most common complaint for both baseball and softball players contributing at least 30% and 27% of the overall injury incidence in these athletes respectively.[4]

The incidence of elbow problems in these individuals is quite different. Baseball studies have demonstrated that upwards of 15% of the reported injuries are due to elbow complaints while softball studies often do not even record or mention elbow problems as an issue. This may be due to the relatively limited number of softball studies that have been completed. It may however also be due to the different relative position of the elbow for the softball pitcher where near full extension is maintained throughout the motion.

Arm injuries occur 82% of the time in softball players and 90% in baseball players. Time loss (more severe) injuries are not uncommon in baseball and softball players. Ankle sprains

and leg contusions are the most common injuries but usually do not result in time away from the sport.

Diagnosis

The diagnosis of arm injuries in throwers begins with a thorough history. The classic description of an insidious onset of sore, aching muscles and joints signals an overuse injury. Though this is often a result of the shear number of throws made by the athlete, other overuse problems such as compensatory muscle firing to adapt the throwing motion to protect injured tissue can occur. These injuries rarely cause significant problems while throwing nor are they described as sharp, stabbing pains. Sharp pains during play often indicate mechanical problems from torn structures such as the shoulders' labrum, posterior capsule, or the ulnar collateral ligament of the elbow.

"...Many of the common injuries are overuse problems and appropriately treated with rest."

The physical examination of an injured thrower should begin with observation of the external anatomy and simple joint motion. It is possible that such problems as nerve entrapment (supraspinatus or infraspinatus muscle wasting), serratus anterior muscle weakness (scapular winging), and peri-scapular weakness (drooping shoulder) can be identified with this type simple observation. Next, evaluate the range-of-motion and assess the gross muscle strength.

It must be remembered that the throwers' shoulder will have a shift of the arc of motion with a relative increase in external rotation usually. This is not problematic as long as the overall arc is preserved (combined internal and external rotation) compared to the opposite shoulder. Careful examination of the posterior shoulder, however, is necessary as even with a preserved arc of motion many throwers will suffer from a tight posterior capsule limiting normal shoulder coupled internal rotation and adduction. This problem (often referred to as GIRD) is noted as decreased internal rotation and cross-arm adduction usually with a stretching discomfort noted while testing.

Provocative tests are perhaps the most elucidative of the examination techniques for throwers. These tests usually are done to evaluate ligamentous and support structures about the shoulder and elbow. When performing them it is important to remember the difference between normal and pathologic laxity. As mentioned above, many throwers have increased range-of-motion and their laxity is not the problem. Only when their injury and pain can be related directly to the laxity should they be assumed to be associated.

The most common shoulder provocative tests look for anterior capsular laxity, labral pathology, and posterior capsular tightness. The anterior apprehension sign for anteriorly unstable shoulders is not common in shoulders unless a history of dislocations exists.

However, the continuation of the apprehension test (done in our clinic lying supine) is the performance of the Jobe relocation test. This is designed to accentuate or eliminate the capsular laxity by relocating the humeral head into the glenoid cavity prior

to placing an external rotational load on it while the shoulder is abducted. Internal impingement, SLAP tears, and anterior capsular problems can all be demonstrated with this maneuver and its results.

Elbow provocative tests are less easy to perform and less well defined. It is common to find a loss of overall elbow extension in experienced throwers. This is felt to be an adaptive process which protects the anterior elbow from deceleration forces or is the result of repeated injuries occurring during this phase.

Ligamentous examination of the ulnar collateral ligament by placing valgus stress on the elbow must be done without allowing compensatory shoulder external rotation. We place the shoulder in maximal external rotation before stressing the elbow to help lessen this variable. Muscular stressing of the elbow with careful palpation will lead to the accurate diagnosis of several muscular strain injuries common to throwers such as pronator syndrome and flexor muscle tendonitis.

> ***"The differences in the softball pitchers windmill motion and the overhead baseball pitch are visually striking."***

While most injuries, especially overuse injuries, can be diagnosed through a thorough history and examination, radiologic exams including x-rays and MRIs can be helpful. Extended periods of pain need to have x-rays performed. Sharp or stabbing pains, especially those occurring while throwing, often are better defined using a MRI either with or without intra-articular contrast.

TREATMENT

As with most sports, in season injuries are difficult to treat due to the time stress issues. Unfortunately, many of the common injuries, as noted above, are overuse problems and appropriately treated with rest. This rest obviously needs to be an 'active rest' period where an athlete's cardiovascular fitness and core strength is not lost. We will attempt to reduce a throwers pain, improve their motion, and then return them in to play via an accelerated interval throwing program.

Depending on the injury, baseball players often need to be held off the field during the active rest period. Since all throwing motion for them is the same, it isn't sufficient to stop them from pitching only. Commonly we note that prior to seeing us these injured athletes stop pitching and move to catcher or third base. While this may reduce the number of throws, it certainly is not a rest period. Batting is often possible without problems given the position of both the shoulder and elbow and the virtually separate stresses involved.

Softball pitchers represent a different situation. Though not always the case, during the early 'active rest' period, a softball pitcher may not need to be taken off the field entirely. Anterior shoulder problems including bicipital tendonitis and rotator cuff interval problems may be a result of the windmill motion and not stressed or aggravated by the overhead motion. Additionally, the early rehabilitation for softball shoulder and elbow injuries can include batting due to the different stresses.

One issue that rehabilitative experts have pointed out about the differences between the

two sports is that the basic overhand motion – except for softball pitchers- is similar. Yet the injury rates for baseball players are greater. This fact is utilized in many rehab processes and interval throwing programs often begin for baseball and softball players with 'oversized' balls and then progress to the use of regulation baseballs and softballs.

We commonly will begin the interval throwing workouts using footballs and volleyballs before progressing to softballs and then baseballs as appropriate. Though few studies exist to support this notion, it appears that the smaller baseball often is 'muscled' towards its target creating poor mechanics and abnormally elevated forces.

Conclusion

Softball and baseball injury patterns, beginning with overuse problems, are very similar. The history from these throwers is usually similar as are the treatment regimens. The differences in the softball pitchers windmill motion and the overhead baseball pitch are visually striking. Associated with this difference is the prevalence of different injuries in the two.

Understanding the biomechanics and stresses placed on the upper arm during the throwing motion will allow a more accurate diagnosis and treatment plan. While unfortunate, the treatment plan may need to include a period of active rest where no throwing and hence play is allowed. This rest is then followed by an accelerated rehab period with a disciplined and directed interval throwing program.

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