How To Improve Pitching Performance and Prevent Injury

Physical Therapy in Corpus Christi for Baseball

The average baseball pitch takes less than five seconds. To the outside observer, the actions occur so quickly, it's impossible to see much more than a flurry of activity. The leg comes up, the pitcher strides forward as the pitching arm cranks back, the trunk tilts forward, and the ball is released. Sounds simple, doesn't it? But the accuracy and speed of the pitch depend on many, many actions such as the foot position and orientation (turned out/turned in), shoulder and pelvis rotation, knee extension, and trunk motion and position.

All of these movements together form a concept of biomechanics referred to as kinematics. Athletes such as baseball pitchers are very interested in the kinematics of pitching. They want to increase the ball velocity and improve their performance without adding stress to the pitching arm or ending up with an injury. The authors of this article reviewed all publications between 1994 and 2008 looking for information on kinematics (biomechanics) and kinetics (movement) to aid pitchers in this way.

All of the information found from various studies was summarized under five basic groups: 1) kinematics and ball velocity, 2) kinematics, kinetics, and injury, 3) fatigue, 4) development of the pitcher, and 5) pitch types. Since there has been a lot of new information over the last 10 to 20 years about pitching biomechanics and movement, the intent of this article is to help pitchers, trainers, and coaches focus on improving performance without causing injury. Let's take a closer look at what they found.

1) Ball velocity. Pitching speed isn't just about the pitching arm. The entire body (arms, legs, trunk) is involved. The legs are really the foundational support for every pitch and should be the first place to start in improving ball velocity. For example, the force of the push-off of the throwing leg is directly linked with wrist velocity. Too short of a stride length can actually slow down the forward momentum of a ball. Studies show that pelvis and trunk rotation must be coordinated together to improve ball velocity. Greater pelvic rotation is needed to improve ball speed.

The lower body and trunk create the power that is channeled up the kinetic chain to the pitching arm. Each pitcher must work to find his or her own unique rhythm of movement, joint positions, and coordinated motion to produce an explosive pitch. They must do so without injuring themselves. That is a difficult task.

2) Kinematics, Kinetics, and Injury. Studies show that injuries are most likely to occur as a result of force on vulnerable soft tissues from repetitive pitches. And it's the moment of transition from one position to another, one movement to another that should be the focus of training and practice.

For example, when the pitching foot leads off, is it pointed straight, turned out, or turned in? Even the smallest degrees of motion can make a difference. The foot position causes rotation of the pelvis. Too much rotation, too soon can slow the ball and ruin a pitch. And believe it or not, the foot position transfers energy through the pelvis to the arm affecting force at the elbow and shoulder.

Some pitchers lead with the elbow, a well-known movement pattern that compensates for a weak ulnar collateral ligament along the inside of the elbow. The net result is to put more strain on the shoulder, resulting in elbow-derived shoulder injuries. All shoulder injuries should be examined for pathologic elbow kinematics as a contributing factor.

3) Fatigue. It's clear now to sports professionals that pitching every inning of every game is no longer a good idea. But that's how it was done in the early days of baseball and for many years after. Fatigue (no matter how strong the athlete is) can lead to injury. Researchers have studied this problem trying to determine a formula whereby a pitcher would be able to calculate exactly how many pitches would be safe.

Younger, less developed pitchers are especially at risk for pain and injury from over-pitching. High-pitch counts (more than 75 per game or more than 600 per season) are to be avoided. Pitching when the arm is fatigued is also a no-no. Children must be trained from early on to let the coach know when he or she is tired. They must be taught that a fatigue-related injury can be prevented. They may think one more pitch is going to win the game, but in the long-run, they are not helping the team out if they end up injured. This can be a difficult concept for any athlete, especially young ones.

The coaches must also take it upon themselves to monitor their pitchers. Loss of pitch speed and pitching inaccuracies are clear signals of fatigue. Counting pitches and staying under the evidence-based guidelines determined by research is an easy and effective way to prevent injuries. And pitchers don't just injure their elbows and shoulders. Pitchers are also at increased risk for groin injuries, abdominal muscle strain, and knee and back soreness.

4) Developing the pitcher. You may think some people are natural-born pitchers. But even children with natural pitching ability must develop strength and skill. Those skills are developed over time, starting from the very earliest pitches thrown. Even professionals continue to train after years of pitching thousands of balls. No one should think that they can't improve. One way to improve is to analyze the pitch from the first pitch of the game to the last. Researchers using slow speed videotaping have been able to document how pitching kinematics changes over time (usually because of fatigue).

Some other useful tools in helping the young pitcher develop include using lightweight (instead of standard-weight) baseballs when practicing pitches and re-evaluating pitch mechanics during growth phases. Growing bones and increasing height during puberty can alter the biomechanics of movement and pitching. Growth plates at the ends of growing bones are especially vulnerable to injury during growth spurts. This is another reason to limit pitches as described.

5) Types of Pitches. As the pitcher trains and develops, he or she will advance from one type of pitch to another. There are many pitch types to learn such as fastballs, cutters, curves, sliders, sinkers, changeups, and knuckleballs. But it's always advised that young pitchers learn the fundamentals of fastballs first, then changeups and third, curveballs. Each pitch type requires its own unique combination of movements to achieve speed and accuracy.

Researchers are working to understand the biomechanical requirements of each pitch type. Forces and torques on each joint are being measured and analyzed for each pitch type in an effort to reduce injuries. Young pitchers can benefit from the knowledge gained so far by following this order of pitch development.

In summary, there are many biomechanical factors in pitching that rely on one other to create ball velocity and accuracy. Flexibility, strength, body size, and joint motion all combine together to define a great pitcher. Each link of the kinetic chain from head-to-toe (or for pitchers, from toe-to-head) is important in the development of a young pitcher's skill. Proper timing and sequencing of movement and rotations must be developed with years of practice. Performance can be improved without increasing injuries by following guidelines determined by diligent sports researchers. Coaches, parents, and players must put aside personal desires and abide by these rules for the sake of the player and the team.

Reference: Dave Fortenbaugh, MS, et al. Baseball Pitching Biomechanics in Relation to Injury Risk and

Performance. In Sports Health. July/August 2009. Vol. 1. No. 4. Pp. 314-320.