PROPER PITCHING MECHANICS

While each pitcher is a different person and can display some individuality in his mechanics, everyone has similar anatomy (the same muscles, bones and ligaments in the same locations) and is throwing following the same laws of physics (force = mass x acceleration, etc.). Thus, research has shown common traits among healthy, successful pitchers. What follows is a description of proper mechanics, based upon three-dimensional high-speed automated analysis of thousands of pitchers by the American Sports Medicine Institute and other biomechanics labs. The photographs are a high school pitcher who displayed proper biomechanics during testing.

1. "Torque" is rotational force. Whereas a force pushes or pulls a body segment, a torque produces or resists angular motion. A simple example is that when you bend your elbow to bring your hand toward your shoulder, your biceps (and other muscles) are applying an elbow flexion torque. When pitching from the windup, the pitcher rotates his back foot parallel and in front of the rubber, whereas when pitching from the stretch, the pitcher's back foot starts parallel and in front of the rubber. The front leg is then lifted and the pitcher strides towards the plate. In the windup, the leg lift occurs first; from the stretch, the front leg is not lifted as high and the leg lift and the stride occur more at the same time (as a strategy to control the running game).
2. From its maximum height, the front knee drops and then starts to stride toward the plate as the throwing hand takes the ball out of the glove.

3. As the front leg strides forward, the two arms swing down, apart and then up. The throwing hand should be on top of the ball during this motion. This is difficult for some youth pitchers due to small hands and limited strength, but all grown (post-puberty) pitchers should be able to keep their hand on top of the ball.
4. At the instant the front foot makes contact with the mound, the throwing arm should be rotated up as shown. Specifically, the throwing elbow should be lifted high enough to create an armpit angle ("abduction angle") of about 90 degrees. In other words, if you drew an imaginary line through the two shoulders, the throwing elbow should be on this line.

5. Another critical aspect of the arm is the "external rotation." That is, the forearm should be at about a 45-degree angle above horizontal at the instant of front foot contact. If the forearm is already vertical or past vertical, then the arm is too "early." Conversely if the forearm is not up enough -- that is, the hand is not much higher than the elbow -- the arm is too "late." For some pitchers, the arm is so late that at the time of foot contact, the hand is below the height of the elbow. The colloquial expression for this is "Inverted W." Pitchers with a late arm or early arm have poor timing between their upper body and lower body, increasing the risk of arm injury and reducing their ability to generate velocity.
6. At the instant of foot contact, the stride length should be slightly less than body height. It is also important that the front foot should step slightly across the back foot, with the front foot rotated slightly inward. By foot contact, the pelvis (hips) has started to rotate to face home plate, while the upper trunk (shoulder) has not started to rotate. This allows the pitcher to stretch the core muscles in his trunk for extra energy. If you look closely, you can see the muscles stretched in these front view and side view pictures of foot contact. A pitcher who rotates his lower trunk and upper trunk at the same time is not using his trunk enough.

7. Next is the "arm cocking" phase. During this dynamic phase, the front knee is straightened a little, in order to stop the lead hip moving forward and allow the pelvis to rotate (that is, allow the belly button to face the plate). The upper trunk then rotates to face the plate, while the arm rotates back into a fully cocked position (maximum shoulder "external rotation"). The elbow should still be bent about 90 degrees; in other words, the forearm and upper arm should be in a "L" shape. Maximum torques are produced at the elbow and shoulder near the time of maximum external rotation. These torques slow down the arm cocking and initiate the arm's forward rotation (shoulder "internal rotation").
8. Next is the "arm acceleration" phase. During this brief explosive phase, the arm straightens at the elbow then "internally rotates" at the shoulder. The arm acceleration phase ends at the instant of ball release.

9. There are many different "arm slots" at ball release. Some pitchers are more overhand, while others are more "3/4 arm" or sidearm. Regardless of the arm slot, the shoulder abduction angle should be about 90 degrees. In other words, different pitchers can have different tilts to their shoulder-to-shoulder line, but the throwing elbow should be approximately on the shoulder-to-shoulder line at the instant of ball release. Having the elbow far below or far above the shoulder line is dangerous for the tendons and ligaments in the shoulder joint.
10. A good follow-through is important for a pitcher's health. The arms, trunk and legs need a good follow-through to dissipate the energy in the throwing arm. For a 3/4 style pitcher, the throwing hand should come across the lead thigh. The hand will come across more toward the lead hip for a sidearm pitcher and more toward the lead knee for an overhand pitcher. The trunk should become close to horizontal, with the back of the throwing shoulder visible to the batter. The pitcher should be in a prepared position to defend himself against a line drive hit at him.

CONCLUSION

Each pitcher should strive toward the positions and timing of proper pitching mechanics to maximize his performance without placing undue stress on his elbow and shoulder. Proper mechanics are described here in general. While professional teams have used biomechanical analysis for years, advances in technology now give amateur players opportunities to measure their mechanics. However biomechanical technologies are just tools for coaches and players to determine what to work on. Proper mechanics are achieved by players and skilled instructors working together.

REFERENCES

Pitch Variety

A youth pitcher should concentrate on mastering two pitches, the fast ball and change-up. As players get older, they may elect to learn the breaking ball once they master the fastball and change-up.

**Fast Ball – Four Seam Grip:** The most commonly used grip for accuracy is the four seam fast ball. The four-seam fast ball is held with the index and middle finger positioned across the large seams. A finger’s width should be the distance between the index and middle fingers with the thumb positioned underneath the ball on a seam. The pitcher should be sure there is a small space between the web of the hand and the ball. The third and fourth fingers are curled back.

***This grip should be taught to all youth players to encourage proper grip and mechanics***

**Fast Ball – Two Seam Grip:** The two-seam fast ball is held with the index and middle fingers across the seams where the horseshoe-like seams almost meet. The thumb is placed on a seam at the bottom of the ball, while the third and fourth fingers are curled back. Using this grip provides a little extra movement on the fast ball. Again, the pitcher should be sure there is a small space between the web and the hand and the ball.

**Three-Finger Change Up:** The purpose of a change up is to give the appearance of a fastball, but the speed of the ball is much slower, the hitter’s timing is disrupted. The three-finger change up can be gripped in any way the pitcher feels comfortable. Most pitchers grip the first and third fingers running the length of the seams with the middle finger in between the seams. The thumb is positioned underneath on a seam. Some pitchers grip the three-finger change up similar to a four seam fastball with slight modifications. The post important aspect of the change up is that the ball, unlike all the fast ball grips, is tucked back against the pad of the hand. When throwing any change up, the key is to keep the same pitching mechanics and arm speed. The grip of the ball will slow the speed of the pitch.

**Pitching Drills**

The following drills are designed to break down the pitching motion into progressions that can be isolated. They can be done from shorter throwing distances.

**Slow Motion Drill:** Standing on the rubber, or a simulated rubber, or simply line in the dirt or grass and without a ball, the pitcher begins the pitching progression as slow as she or she possibly can. This concentration drill allows the coach and pitcher to look very closely at each progression of the motion and make corrections. The pitcher fakes a pitch and completes the
progression of motion and make corrections. The pitcher fakes a pitch and completes the progression with the follow through.

**Pivot Foot Drill:** The pivot foot drill beings with the pitcher’s pivot foot or power foot placed against the rubber with the instep facing the target or the plate. The weight is on the stride foot. At this point the body should be in control and above the plane of the rubber. The pitcher transfers the weight to the pivot foot which then creates the directional side (meaning glove side pointing to the plate) and goes right through to the knee lift and finishes the progression. This drill reinforces the control over the rubber as well as the creation of the directional side.

**Knee Lift Drill:** Starting in the knee lift position, the pitcher simply holds a proper, comfortable knee lift for three to five seconds, and then completes the progression moving to the stride and launch positions. This drill reinforces the balance needed and controlled direction towards the plate.

**Launch Drill:** With the feet separated more than shoulder-width apart, and in a good launch position (both elbows at shoulder height, ball facing away and throwing arm in a “L Shape”), the pitcher should simply lift the stride foot slightly, transfer weight from the pivot foot back to the stride foot, continue with the progression by driving the glove side elbow down and back past the hip, and throw the ball with a good follow through. If need, the coach can reinforce any position of the launch by simply hold or reinforcing the position. For instance, a pitcher may drag his elbow through the delivery, and the coach may correct it by hold the elbow at the correct height at the start of the launch.