chapter 1

Developing Proper Mechanics

When a pitcher develops good pitching mechanics for the delivery, he is apt to have good control and to throw in a loose, injury-free way. Good mechanics can also lead to greater arm strength; many pitchers have increased fastball velocity by working religiously on mechanics. Keep in mind that it takes a lot of time and many repetitions to break existing habits.

In this chapter we break down the full-windup delivery into its many phases and show you how to teach each phase in progression. We begin with the lower-body mechanics, progress into upper-body mechanics, and finish with a look at the entire delivery.

Lower-Body Mechanics

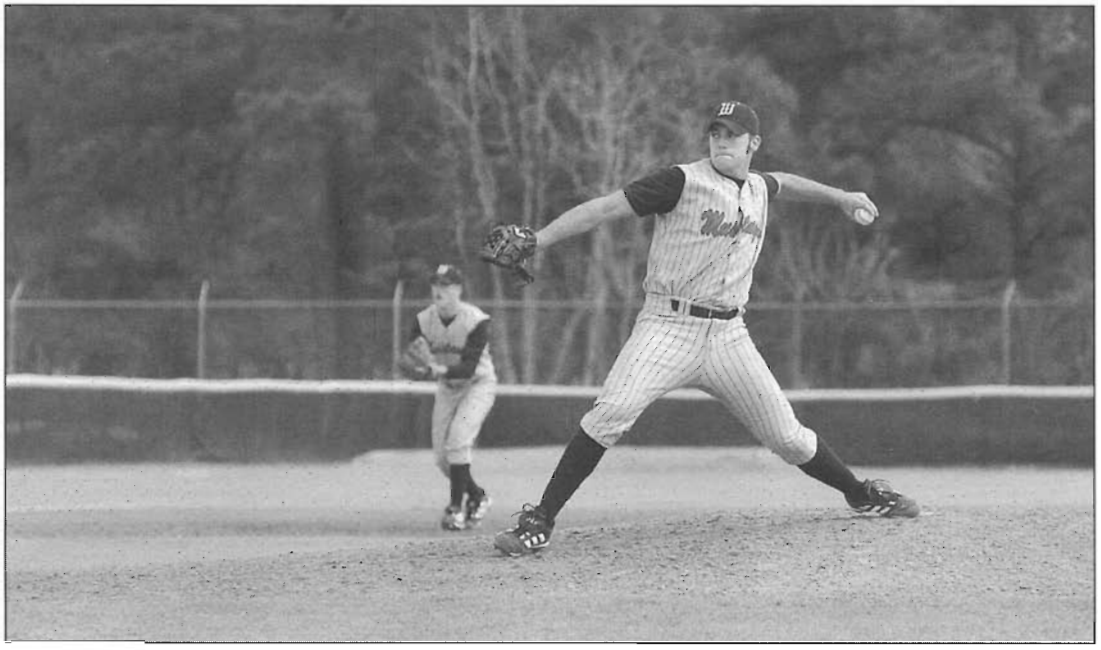
Lower-body mechanics are important for both control and power. The mechanics begin with the feet—the pivot foot and stride foot—and progress up through the legs to the hips. *Lower-body mechanics should be altered to match the pitcher's natural arm slot. The pitcher's natural arm slot should never be adjusted to match the lower-body mechanics.* To create a good overall pitching delivery, a pitcher must develop a solid mechanical base.

Foot Placement on the Pitching Rubber

Contrary to popular belief, there is no preferred foot placement on the rubber; it is a matter of individual preference. Conventional thinking has the right-handed pitcher on the right side and the left-handed pitcher on the left side of the rubber.

Instead of making a steadfast rule about which side is best for either right- or left-handers, let's think about how a pitcher can get the best results from his pitches. A pitcher with a low three-quarter or a side-arm pitch may prefer to use the opposite side of the rubber to take advantage of his natural movement.

A right-handed pitcher who starts on the right side of the rubber and throws slightly across his body may benefit from being on the left side of the rubber. From this angle he goes in a more direct line to the target, which



Developing proper technique not only ensures effective pitches, but it also strengthens the arm and helps prevent injuries.

enables him to use his hips more and doesn't cause him to lock himself out.

Experimentation and observation will provide the answers to where a pitcher should place his pivot foot on the rubber. Once a pitcher establishes a position, he must work from that position on a regular basis to create consistency.

Footwork
Initiating the Windup

A pitcher can use three different techniques in the beginning of the windup as he shifts weight from the back foot to the pivot foot: the rocker step, the step back, and the step to the side. All three techniques are effective when executed correctly, and each pitcher should choose the technique that works best for him.

In all three techniques, the pitcher should keep his head over his pivot foot to ensure that he does not transfer too much weight backward away from the target (figure 1.1). The rocker step and the step back start momentum and develop rhythm for the windup.

Figure 1.1 Head over pivot foot.

Rocker Step

The pitcher places the pivot foot on the appropriate side of the rubber, with the front section of cleats hanging over the front of the

rubber and the back section of cleats on top of the rubber. The stride foot should be behind the rubber at shoulder-width distance from the pivot foot (figure 1.2). When the pitcher takes the sign, his weight should be over the pivot foot. He should have very little weight on the stride foot, and he should be up on the toe of the foot.

Once the pitcher has the signal and begins the windup, he simply shifts his weight and rocks back. Keeping his head over his pivot foot, he shifts his weight from the pivot foot to the stride foot. The stride foot starts up on the toe and, with the weight shift, goes back on the heel (figure 1.3). As the stride foot goes onto the heel, the pivot foot begins to pivot. When the weight starts to shift back to the pivot foot, the stride foot goes back up on the toe before beginning to lift into the gathered position (figure 1.4).

The rocker step has two advantages. First, most pitching mounds in high school, and some in college, are not constructed correctly and drop off behind the rubber. A rocker step, rather than a step back, is helpful on an incorrect mound. Second, when a runner is on third base, there is less chance of a balk should the runner start toward home. The rules state that the pitcher must clear the rubber with his pivot foot when stepping off to deter the runner. This is somewhat confusing to the pitcher if both feet are starting on the rubber as in the step-back technique.

Figure 1.2 Proper position for taking the sign.

Figure 1.3 Weight shift on the windup.

Figure 1.4 Pivot foot action.

Step Back

Many pitchers like to use the step back when starting the windup because it gives them a better rhythm than the rocker step. The step back is fine as long as the pitcher keeps his head over his pivot foot when stepping back—this will keep him from stepping too far (figure 1.5). Also, the pitcher must try to step within the boundaries of the rubber and not off to the side—the momentum of a step to the side would cause him to go toward first or third base rather than second base before going toward the plate.

When using the step back, the pitcher starts with both feet on the rubber while getting his sign. With a runner on third base, the pitcher's weight should be on the stride foot when he gets the signal—this weight shift helps him get off the rubber if the runner breaks for home. After getting the signal, the pitcher starts the windup by stepping back with the stride foot or stepping off with the pivot foot.

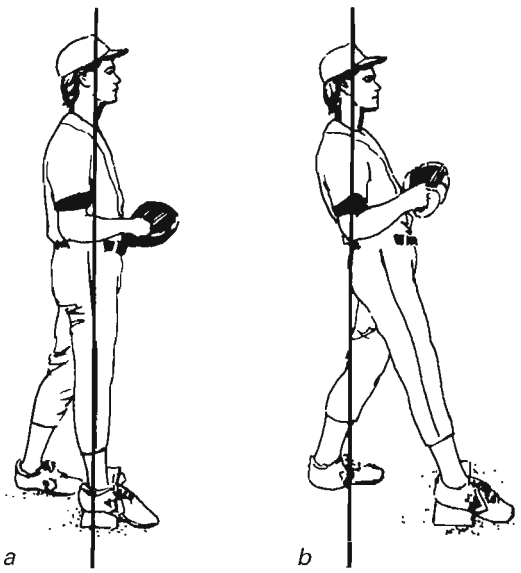


Figure 1.5 *(a)* Correct and *(b)* incorrect step back.

Step to the Side

When a pitcher's arm slot drops down to low three-quarter or side arm, it makes mechanical sense to step to the side instead of back toward second base (figure 1.6). The pitcher with the low arm slot will use more rotation and coil in his delivery, and stepping to the side seems to make the pivot leg lift and hip rotation movements a more fluid motion.

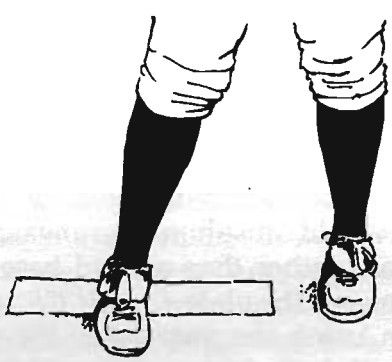


Figure 1.6 Stepping to the side.

Pivot

When the pitcher begins to step or rock back, the pivot foot lifts slightly (although the foot does not appear to lose contact with the rubber). The pitcher then rotates the foot externally and places it in front of the rubber with only the outside of the foot making contact with the rubber (figure 1.7).

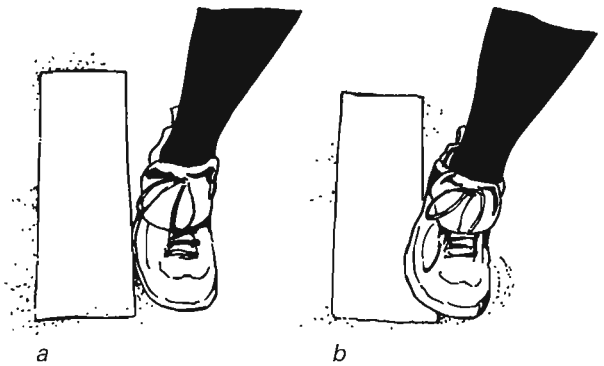


Figure 1.7 During the pivot, only the outside of the foot touches the rubber, as shown in *a*.

Young pitchers commonly make the mistake of pitching with the foot half on and half off the rubber, thinking that this will give them a greater push. Later in this chapter we will see that a push or drive isn't nearly as important as balance. With the pivot foot half on and half off, it is impossible to gather momentum; a pitcher cannot balance with his pivot foot in this position. Without this pause for balance to gather momentum, the pitcher will rush, causing control problems and possible injury.

The pivot foot should always be placed in front of the rubber with the toe slightly lower than the heel. The level of the heel is important for many reasons:

- If the heel of the pivot foot is lower than the toe, the pitcher tends to lean back during the delivery (toward first base for a right-handed pitcher). This may cause loss of control or injury.
- It is difficult to balance for the gathering phase when the heel is lower than the toe.
- The primary movement in any leg activity requiring a push is plantar flexion, in which the ball of the foot pushes down and the heel comes up. So when starting off the plate, the pitcher gets greater push by starting with the ball of the foot slightly lower than the heel.

- Placing the toe lower than the heel may help the pitcher lean in a bit (toward third base for a right-handed pitcher). This may help keep shoulders and hips closed until the proper sequence.

Gathered Position

The gathered position is that point when all momentum from the windup comes together for a change of direction before the pitcher goes toward the plate. The stride leg lifts and rotates back to load the hips, which are preparing for the stride to the target (figure 1.8). In this phase the body is getting lined up, loaded up, and ready to explode to the plate.

The technique, timing, and tempo of getting to the gathered position will vary from pitcher to pitcher, but each pitcher must have a consistent gathered position. When the gathered position is consistent from pitch to pitch, the release point will become consistent, which correlates to better control.

Figure 1.8 The gathered position.

Back Leg in the Gathered Position

As the stride leg is lifted and rotated, the back leg must remain tall and only slightly bent. A slightly bent back leg will provide good balance; and by staying tall, the pitcher will keep the advantage of pitching on a downhill plane. Many pitchers will want to bend the back leg too much and collapse the back. When collapsing occurs, the pitcher's release point will be much lower and the baseball will travel at a much lower angle. A pitch with a higher release point is much harder to hit than a pitch with a lower release point.

Stride Leg in the Gathered Position

Each pitcher has his own delivery, so there is no prescribed movement of the stride leg in the gathered position. The stride leg movement varies according to the arm slot of the pitcher. The gathered position and the movements leading to the gathered position should be adjusted to work with the pitcher's existing arm slot. Changing arm slots to match lower-body mechanics is a major contributor to arm injuries.

It is important to understand that the pitcher *lifts* his leg into the gathered position. Many refer to this action as a *leg kick,* which is not accurate at all. The pitcher's arm slot determines the height of the leg lift. When the arm slot is high, the pitcher should lift the leg high with little hip rotation. The lower the arm slot, the lower the leg lift and the more hip rotation involved.

The pitcher with the high arm slot should work up and down in his delivery. The stride leg will go up and slightly back before going to the target (figure 1.9). The pitcher with a high three-quarter arm slot will require less height in his lift, but he needs more hip rotation. The low three-quarter or side arm slot will not need as much height in the leg lift but will require even more hip rotation in the gathered position (figure 1.10).

Getting the pitcher into the proper gathered position according to his arm slot is crucial for development of control and velocity. For ultimate power, control, and arm health, the pitcher should combine the proper height of the leg lift with the proper amount of hip rotation. In the quest for more velocity, a pitcher will often go to extremes with the leg lift and either go too high or get too much rotation for his particular arm slot.

Figure 1.9 Vertical (high) leg lift (overhand pitcher).

Figure 1.10 Horizontal leg lift (low three-quarters).

Common Leg Lift Problems

Lifting the stride leg into the gathered position is one of the first and most important movements a pitcher makes. When the beginning of a movement is off, the rest of the movement will follow, and the result is a poor delivery. The majority of leg lift problems can be corrected with repetition of the correct movements.

Leg Swing

A leg swing occurs when the pitcher swings his leg up and back to the gathered position. A small leg swing may be beneficial to a pitcher's rhythm, and as long as he maintains balance, he should not tamper with it. When a pitcher has too much leg swing, the foot will go too far back behind the rubber, causing him to lean toward the plate with his upper body (figure 1.11). When the upper body begins to lean forward, the pitcher will begin to rush forward ahead of his legs, which will result in high pitches. Too much leg swing sometimes causes the pitcher to get too much hip rotation, or coil, in his delivery, which will create problems depending on his arm slot.

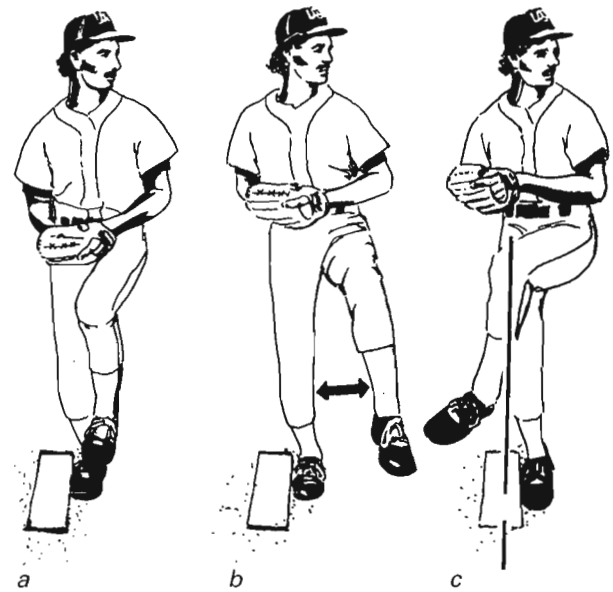


Figure 1.11 *(a)* Proper hip rotation in the gathered position; *(b)* too open; *(c)* too closed.

Kick Instead of Lift

The foot should be under the knee during the leg lift (figure 1.12a). When a pitcher kicks his foot out away from his center of gravity, as shown in figure 1.12b, his body will compensate in balance by tilting back in the opposite direction of the kick. A small kick with the foot may not be a problem; however, when a pitcher has an exaggerated kick, his torso will tilt backward and not stay in a line with

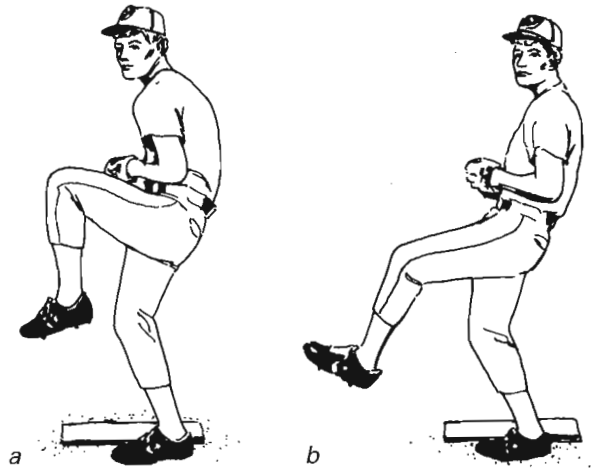


Figure 1.12 *(a)* The foot must be below the knee in the gathered position. *(b)* Incorrect foot position.

the target. *The body will follow the head as it goes off line. The head should remain over the pivot foot before going to the plate.*

Flexed Stride Foot

The stride foot in the gathered position should be relaxed and hanging down at a slight angle. When a pitcher flexes his foot in this position, he will be in a heel-down position instead of a toe-down position (figure 1.13). The heel-down position will cause the pitcher to land on the heel during the stride and create problems later on in the delivery. The stride foot should be under the knee in a relaxed position before going to the plate.

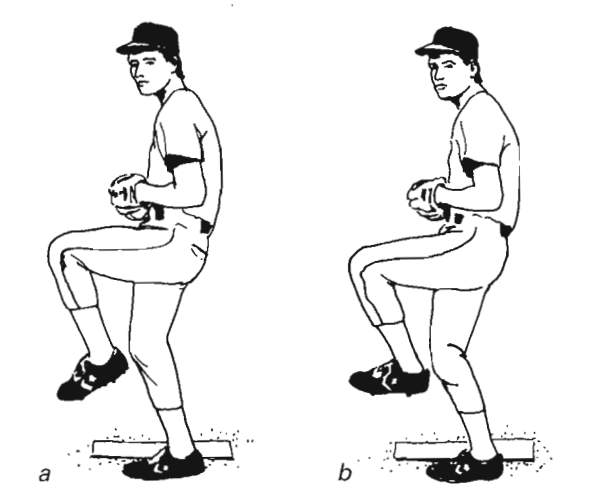


Figure 1.13 *(a)* Proper and *(b)* improper foot position for the gathered position.

Stride

The stride is the major contributor of poor control and will also limit or enhance a pitcher's velocity. The direction of a pitcher's stride is a big factor in determining location, and the degree to which a pitcher uses his hips will determine his velocity. Pitchers should work daily on the proper stride to have a solid, repeatable delivery, which includes both power and control.

Direction of the Stride

The pitcher should step or stride directly toward the target. The target in this case is the catcher's mitt, which will move according to the pitch. A catcher may set up 6 inches inside, 6 inches outside, or anywhere in between. The plate is 17 inches wide plus 6 inches on either side, so the pitcher will be throwing to a spot somewhere in a 29-inch area. (Should the target move in archery, the archer would adjust his arm, as would the free-throw shooter if the basket moved between shots.)

Upon locating his target, the pitcher makes the appropriate leg lift and strides on a straight line to the target (figure 1.14). Pitchers should make every effort to land on or near the line to the target. Many pitchers will insist on

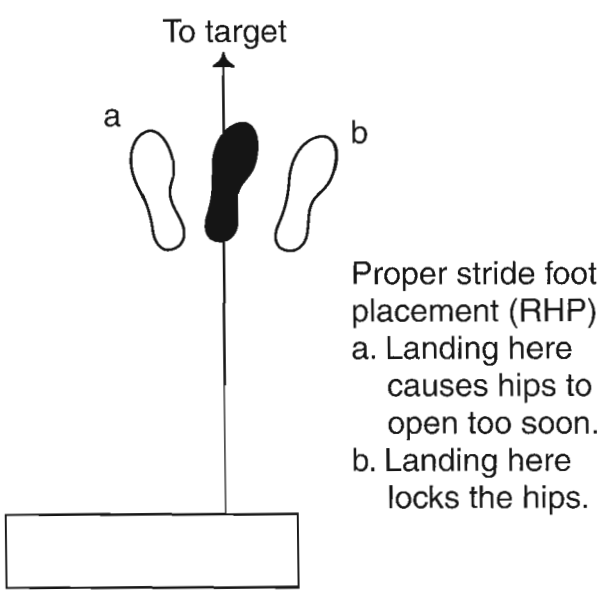


Figure 1.14 Stepping directly toward the target is the most efficient stride.

stepping in the same spot for every pitch; however, it is much easier to make a two- or three-inch adjustment with the stride than to change release points with the throwing hand. Simply said, the pitcher will line up with the target, step toward the target, and throw to the target.

Using the Hips to Create Power in the Stride

Once the leg is loaded up and back, the stride leg will travel down to an area slightly in front of the rubber. When the stride foot is an inch or two above the ground, the foot will then follow the slope of the mound until it reaches the landing spot in line with the target. Simply put, the pitcher's stride leg will go up, down, and skim the ground (figures 1.15, 1.16, and 1.17).

As the stride begins, the pitcher must keep the hips closed until the stride foot hits the ground. This action is similar to the stride of a good hitter. In both cases the hips do not open until after the foot lands for optimum power. When the hips start to open before the foot lands, the pitcher loses power; this is similar to the hitter who opens up too soon and swings the bat using only his upper body. The right-handed pitcher will face third base as he delivers the pitch, and the hips will pop as the foot lands. The hips then cause the upper body to rotate as the pitch is made. Leading with closed hips is the key to throwing for velocity; at the same time it produces less stress on the throwing arm.

The foot should remain under the knee until the pitcher begins to go to the plate. At this time the foot should go first, followed by the knee, and finally the front hip. When the foot and knee go together, the hips open too soon and the pitcher loses power. The stride foot should also stay on line to the target and not stray left or right of the line. When the stride foot of the right-handed pitcher lands

Figure 1.16 Stride leg goes down.

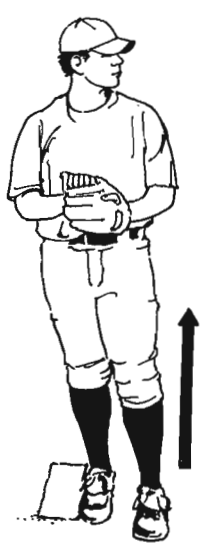


Figure 1.15 Stride leg goes up.

Figure 1.17 Stride leg skims the ground.

too far left of the line, the hips will open too soon. When a right-handed pitcher's foot lands too far right of the line, the pitcher's hips will not open, and the pitcher will lose the power from the hips and must make the adjustment with his upper body to hit his target. This is not only physically tough to do but also puts added stress on the throwing arm.

Landing

The stride foot should land on the line to the target with a slightly closed foot (figure 1.18). Should the foot be too open upon landing, the hips will open too soon and the upper body will begin rotation too soon, causing a loss of power and stress on the throwing arm.

When the stride foot lands too closed (for a right-handed pitcher toward third base), the pitcher will lock his hips, lose power, and add stress to the arm. (Think again of the hitter and his stride foot. When he opens up his foot, he loses power; if his foot is closed off, he completely locks his hips.)

The pitcher should land on the inside of the stride foot. As he transfers the weight to the stride leg, the foot will spin slightly to position pointing to the target. This action will occur naturally and should not be forced. Landing on the inside of the foot will help to keep the knee inside the foot and help the hips to stay closed until the proper time to unlock.

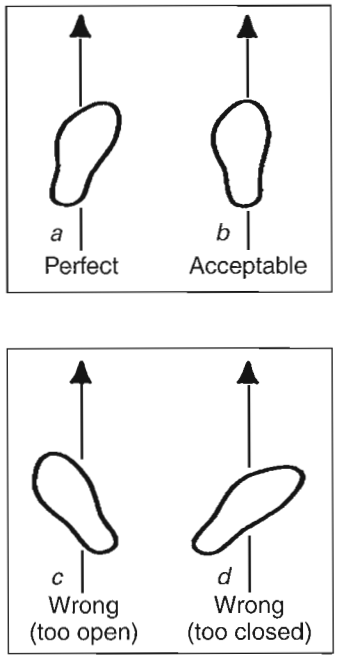


Figure 1.18 The foot should *(a)* land slightly closed, or *(b)* point straight to the plate. In *(c)* the hips open too soon, and in *(d)* the hips are locked out and cannot open.

Stride Leg Bent but Firm

The stride leg should be bent but firm upon landing. The stride is used to stop the body's forward momentum and transfer it to the throwing arm. The stride leg cannot do this if it collapses on landing. Instead the leg should straighten slightly *after release*. The momentum created in the windup will be sustained if the stride leg angle is approximately 90 to 105 degrees. (When the stride leg angle is less than 90 degrees, there is a tendency to collapse the stride leg, which will kill momentum for the throwing arm.)

Stride Length

The length of the stride varies from pitcher to pitcher and should be the result of proper use of the hips, proper stride direction, and a proper landing. A pitcher does not benefit from trying to jump at the target or increase the length of the stride. Many young pitchers associate a longer, more powerful stride with more velocity and create many problems with overstriding. *Stride length is a result, not an action.*

When a pitcher focuses on using his hips correctly, staying closed, floating his hips toward the target, and keeping the knee of his stride leg inside, he will establish the length of the stride. When the pitcher deliberately tries to reach out with his stride foot, the back leg will collapse so that he can drive at the target, the hips will open up, and the stride foot will often land on the heel instead of on the inside ball of the foot (figure 1.19). As a result of this drive to the plate, the throwing arm will not get set up high in the back, which will create high pitches and extra strain on the throwing arm. The pitcher will then throw behind his front leg instead of over the front leg. In essence, the back side is fighting the front side instead of the two sides working together.

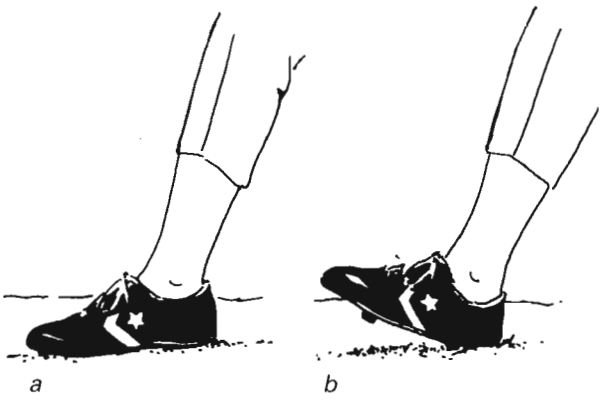


Figure 1.19 *(a)* Proper and *(b)* improper landing.

A stride that is too long shows some observable signs. The stride foot landing on the heel is an obvious indication. The pitcher who overstrides will sometimes lock his leg before the upper body is over the stride leg, causing the pitcher to stop forward momentum and start to spin out to the side. The lower body pushing back against the upper body will create a lack of velocity and control as well as place extra strain on the arm.

At the conclusion of a solid delivery, the pitcher will finish his pitch with his nose out over his toes, and the arm will be free to follow through and decelerate on its own (figure 1.20). When a pitcher overstrides or locks his front leg before the pitch, the throwing arm will recoil and not take its natural path of deceleration. A sudden change of direction or recoil of the pitching arm will lead to arm injuries.

Figure 1.20 Nose in front of the toes.

Measuring Stride Length and Direction

When a pitcher is having a good day in the bullpen and he is using his legs for optimal control and velocity, he should measure his stride length as a reference on those days when he is not performing up to his standards. For a quick reference, the pitcher can measure his stride by walking heel to toe back to his position in front of the rubber. In a practice setting, the coach may want to use a tape measure to record the optimal stride length.

During preseason or winter work, if the pitcher is throwing on a wooden or fiberglass indoor mound, he can mark the mound with tape or marker much as a pole vaulter or long jumper does in track for quick reference.

Stride length and stride direction are the keys to control of the baseball. Stride length affects the pitcher's release point and will determine whether the pitch is up or down (vertical). Stride direction will affect the pitcher's ability to control the baseball side to side (horizontal). A pitcher must work hard to have a consistent stride to the plate for optimum performance.

Back Leg

When the pitcher has started forward in the delivery, he rides the inside of his pivot-leg knee. His center of gravity should be over the inside of that knee. This will keep his hips closed and his momentum back until right before the landing, when the foot turns, the hips open, and the forward momentum is transferred. All of these actions, of course, generate power to whip the arm (figure 1.21).

After the ball is released, the back foot begins to rise. The back foot rotates internally, and the knee should remain close to the body. The back foot must not drag—it must leave the rubber immediately. Any time the back foot drags, it kills a lot of the forward momentum that has been built up, diminishing velocity.

After the pivot foot rolls, the proper action is for the foot to go up in back as far as is natural. The pivot-leg knee should stay in as

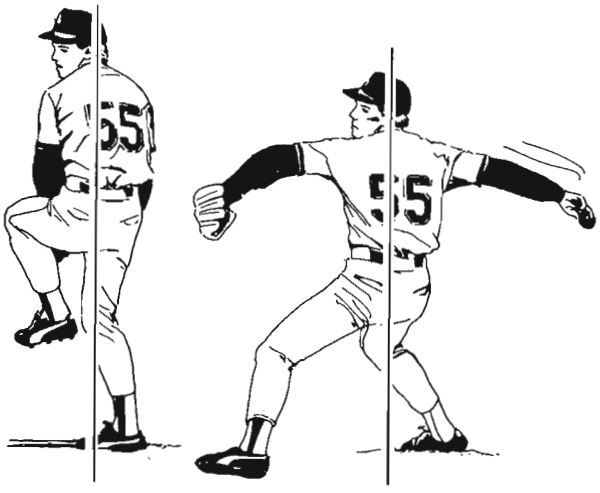


Figure 1.21 Riding the inside of the back leg.

close as possible to the stride leg. This action promotes good control because it keeps the body in the strike zone (figure 1.22). A common mistake pitchers make is to lift the back knee up and out toward third base (for a right-handed pitcher) as if getting on a horse.

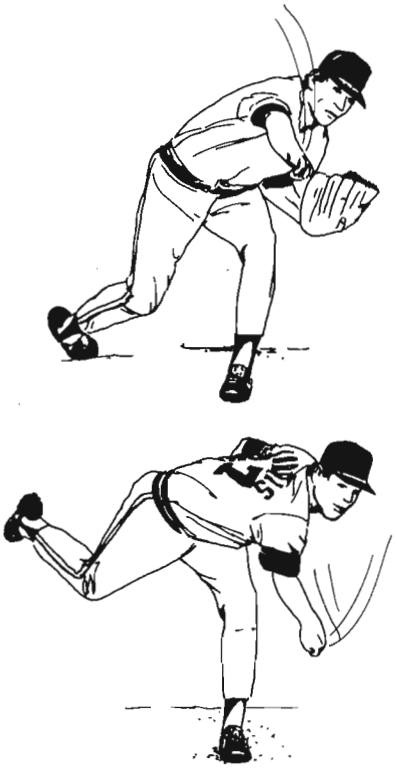


Figure 1.22 When the back foot rolls, the knee stays in.

Importance of a Free Back Leg

For every action, there is an equal and opposite reaction. When a pitcher is balanced on his stride leg during the actual throwing of the ball, the hand whips toward the plate and down in front of the body. To compensate for this whip, the back leg should be free to come up in back as high as is needed. It is not uncommon for a hard-throwing pitcher's back foot to be higher than the pitcher's head during the follow-through (figure 1.23).

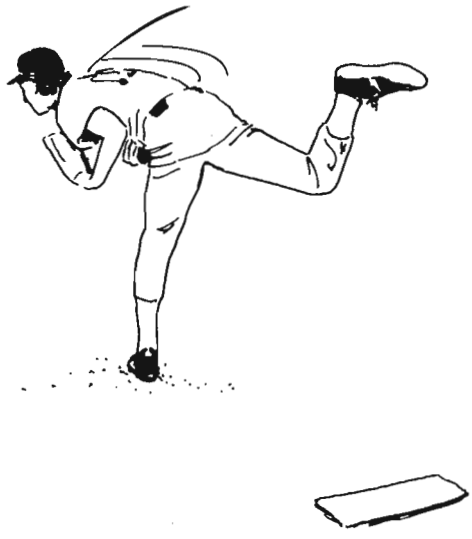


Figure 1.23 The back foot may be higher than the head during follow-through.

Fielder's Stance

After the foot is rolled, with the knee staying in close to the body, the foot should fall naturally to a spot approximately 18 to 24 inches from the stride foot. From this position, it should be easy for the pitcher to field his position (figure 1.24).

Upper-Body Mechanics

Upper-body mechanics begin simultaneously with lower-body mechanics. The hands actually initiate upper-body movement when starting the windup. This preliminary action

Figure 1.24 Pitcher's fielding stance.

during the delivery will be discussed only briefly; the most important aspects of upper-body mechanics start when the pitcher gets to the gathered position. At this point, the shoulders and head play a big role in the delivery. The arms, working opposite each other, turn all the power generated from the legs into the final act of generating speed when the ball is pitched. Upper-body mechanics don't end after the ball is released, however. The follow-through, or finish, of the pitch is important to performance and injury-free pitching.

Handwork for Taking the Signal

A pitcher can use two distinct styles when taking the signal from the catcher. Pitchers may prefer one or the other, but neither style is superior.

Ball in Glove

Before taking the signal, the pitcher places the ball in the glove in such a way that, when he is ready to take the ball out of the glove to make the pitch, he can easily grip it properly. His pitching arm then dangles down by his side or stays with the ball in the glove. The advantage of having the ball in the glove is that the pitcher can change grips and the opposing team won't be able to figure out what the pitch will be.

Ball in Hand

When using the ball-in-hand style, the pitcher should place his hand at his side or behind his back. The advantage of this style is that if the pitcher needs to make a throw to another base, he already has the ball in his hand. The disadvantage of this style is that a pitcher must be sure not to take his grip on the ball before he starts his windup. When the ball is not in the glove, opponents may be able to see the grip and foresee what the pitch will be.

Handwork Initiating the Windup

Simultaneously with the footwork of the windup, the hands start a preliminary movement to gain momentum. Pitchers all have their own ways of getting into a gathered position; the type of preliminary action a pitcher takes in the windup is not important in terms of mechanics. Many pitchers prefer to go over the head with the hands, others like to start with the hands in the gathered position, and still others like to start with the hands lower than the gathered position and bring them up to the breaking point (figure 1.25).

Comfort and rhythm often determine hand placement in the preliminary phase of the windup. *As long as the pitcher keeps his head over his pivot foot and gets to the gathered position with good balance, his windup style is acceptable.*

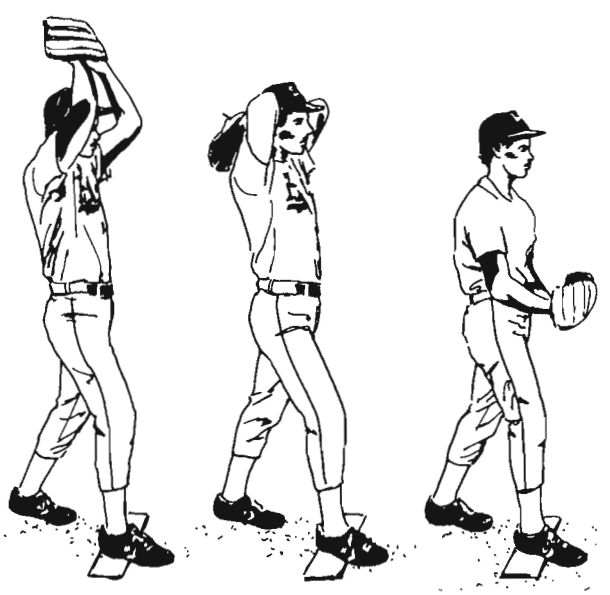


Figure 1.25 Different handworks for initiating the windup.

Hands in the Gathered Position

When the pitcher is in the gathered position, his hands should be at rest next to his body at his center of gravity. (To find the center of gravity, hang the arms straight down at the sides and fold them at the elbows across the body. Where the hands meet is the approximate center of gravity.) See figure 1.8 on page 5.

There are several reasons to place the hands in the gathered position. Resting the hands on the body at the center of gravity creates a constant breaking point—that is, the ensuing actions of the glove side and ball side will always be constant. It is impossible to break the hands in the same place every time when they are away from the body. When hands break away from the body, it is usually caused by late-inning tiredness. When the hands break at different locations with each pitch, the pitcher's timing will be thrown off. A one-inch difference in the break point may mean six inches' difference in the pitch, a loss of a few miles per hour, or a greater chance of injury.

When the pitcher holds the hands away from the body, the throwing arm has a tendency to go *behind* the pitcher, creating too much arm swing. When the pitcher holds the hands next to the body, the arm cannot go behind him but only straight back, giving the pitcher extension but not wasted motion (figure 1.26). The hands should break at the precise moment when the stride leg and the body start forward. Any deviation from this will create improper timing.

When the stride leg starts forward before the hands break, rushing occurs. The leg and body are out in front of the throwing arm, so the tendency is to try to rush and catch up to the leg. The delivery is not synchronized, and the pitcher is more apt to throw a high pitch and open the door to injury.

The desired position before the throw is the T-position, with the front shoulder closed and the fingers on top of the ball. To get to this position, the pitcher must rotate the thumb of each hand down when the hands break. This ensures that the pitching arm takes the desired swing with the fingers on top of the baseball. At the same time, rotating the glove hand thumbs-down keeps the front-side shoulder closed until the proper time (figure 1.27).

Lead-Arm Action

Think of the lead-arm action as a one–two punch. In the first step, the lead arm reaches toward the plate. At the same time, the stride leg starts forward (figure 1.28). At the conclusion of this segment, the lead arm is straight or almost straight toward the plate. The throwing

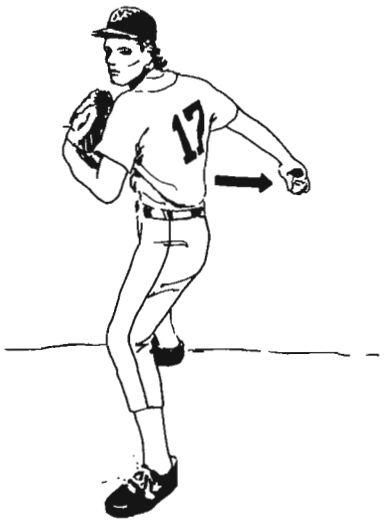


Figure 1.26 The ball hand should go back toward second base, not toward first or third base.

Figure 1.27 The glove hand and the ball hand should rotate thumbs down.

Figure 1.28 The stride leg starts forward as the lead arm reaches toward the plate.

Figure 1.29 The T-position.

arm is also set up and ready to start acceleration. This is called the T-position (figure 1.29).

In the second step, the lead arm comes back in to the hip in a tuck position. (Imagine reaching out with the lead arm and grabbing the top of a fence and then pulling yourself over the fence during the tuck.) The athlete should try pulling the glove as low to the side as possible for a better follow-through (figure 1.30). Simultaneously with the tuck, the throwing arm accelerates toward the plate.

When the shoulders are lined up and the lead elbow is pointing at the target, the next sequence of moves will be determined by the pitcher's arm slot. The lead-arm elbow of a pitcher who has an overhand arm slot will come down by his side. The lower the arm slot, the farther away from the body the lead elbow should travel. The elbows of the lead arm and the throwing arm should mirror each other in the delivery for optimum performance.

Many pitchers have what is called a "dead" front side—they don't use their front side to

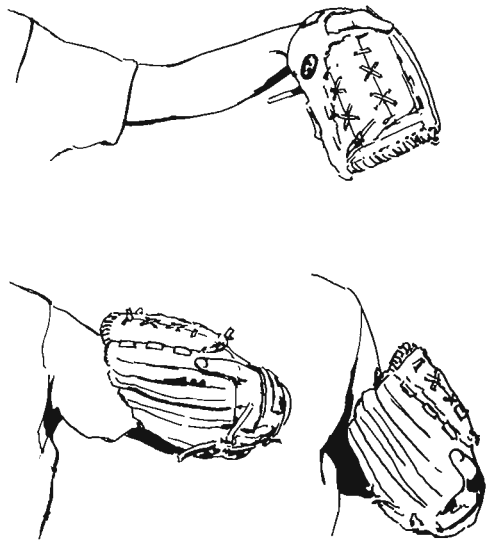


Figure 1.30 Pulling the glove low and to the side.

create power. To see how the lead arm can create power, think about the martial arts punch. One arm is tucked and one is straight toward the target. The key to this punch is that the opposite side is pulling in while the punching side is extending toward the target. Similarly, in pitching the lead arm is pulling in while the throwing arm is starting acceleration.

The glove should never travel behind the pitcher's body but should stay in front and slightly to the side. The lead elbow will travel back behind the pitcher and can be seen sticking up in the follow-through, but the glove should remain in a position to catch a ball hit back up the middle. (With the aluminum bat and the strength of today's hitters, a pitcher must be able to protect himself.)

Flying open occurs when the lead arm "flies" away from the pitcher toward first base (for a right-handed pitcher) or third base (for a left-handed pitcher). When the lead arm goes astray, the lead shoulder follows (figure 1.31).

Flying open causes several problems for the pitcher. When the lead shoulder creates horizontal momentum and the throwing shoulder attempts vertical momentum (high three-quarter to overhand delivery), the result is strain on the throwing shoulder. Flying open also causes control problems. For a pitcher to have good, consistent control, all

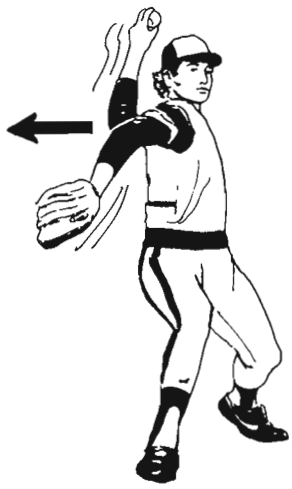


Figure 1.31 Flying open creates horizontal momentum.

Figure 1.32 In the T-position, the fingers should be on top of the ball.

body parts must work together in proper sequence.

Throwing-Arm Action

When the hands break from the gathered position, the throwing hand's first movement is down and back. The palm of the hand faces down while the arm extends back toward second base. Many pitchers take the throwing hand down and back toward first base (for right-handed pitchers), and this is acceptable if the throwing arm can still catch up to the body in the delivery. The problem arises when the arm swing is too big and the body starts to the plate before the arm is in the correct position. The throwing hand should try to go down and back and up toward second base for the most efficient delivery.

The throwing arm should be back and up toward second base, but full extension is not necessary. (Extension out front during release is important.) The fingers should be on top of the ball, and the wrist should be loose but should not flop (see figure 1.32).

The overhand pitcher should take his throwing hand back toward second base; however, the lower the arm slot, the more rotation occurs, and the throwing hand may travel toward first base (right-handed pitcher) or third base (left-handed pitcher). As the stride foot lands, the pitcher's throwing hand should be set up in the back and ready to go to the target.

A common mistake some young pitchers make is to turn the ball over (palm up) before they get to the top of the backswing. Turning the hand over too soon leads to flinging the ball with a stiff arm. The correct method of turning the hand over at the top results in a more efficient throw as well as less strain on the rotator muscles.

As the stride foot lands, the arm starts forward in the throwing phase with the elbow automatically leading. The elbow should be at least as high as the shoulder when it comes by the pitcher's head. (A low elbow is not mechanically efficient and will cause elbow injury.) The hand follows the elbow forward, on an inside-out path that starts at the point where the hand goes from on top to behind the ball. When the hand is behind the body, it should be inside the elbow and moving outward. As the hand gets closer to the release point, it moves farther away from the head toward full extension. By the time the arm is fully extended, the ball has been released and the hand is out in front of the body. The hand now pronates and starts to come back inside the elbow during the follow-through. The ball is released at a point even with the bill of the cap when the arm is still bent but on the way to full extension. After the ball is released, the arm pronates as a reaction to the rigorous throwing action. This pronation is one of the arm's protective mechanisms (figure 1.33).

Figure 1.33 The arm pronates after release.

The path the arm takes during the delivery—whether it be side-arm, three-quarter, or overhand—should be the same in relationship to the head and elbow. The differences in these pitching styles are due to the degree of flexion in the torso. A side-arm pitcher bends a great deal at the waist, but the elbow is still as high as the shoulder (figure 1.34). The three-quarter delivery also requires some flexion of the torso. Only the overhand pitcher should keep his torso straight during delivery.

Hooking occurs when the pitcher's wrist is flexed (cocked) when the arm is extended down and behind the pitcher. The palm should be facing first base (right-handed pitcher) and not facing up. Hooking is another habit that pitchers need to break early—it is almost impossible to correct after a pitcher gets to high school or college (figure 1.35).

Figure 1.34 The torso should flex during delivery.

Hooking causes too much action in the wrist and creates control problems. Because the wrist goes from full flexion to hyperextension in the backswing, it prevents the development of consistency. Pitchers who hook will also have a tough time being drafted into professional baseball.

Figure 1.35 Hooking the wrist creates control problems.

T-Position

The T-position, like the gathered position, is a checkpoint in the delivery. The arms should be extended and level with the plane of the mound so that the upper body resembles the letter T.

The T-position is the last position the body takes before the throwing arm starts forward. As the stride leg approaches landing, the throwing arm sets up and prepares to start forward with acceleration (figure 1.36). Simultaneously, the lead arm prepares to come back into the center of gravity. As the stride leg lands, the lead arm comes back toward the center of gravity, and the throwing arm starts forward.

Timing is the key to a good delivery. If this sequence is off for some reason, the pitch will not be mechanically efficient, which will result in less accuracy, less velocity, and a greater chance of injury.

Figure 1.36 The T-position is the last position before the forward throwing motion begins.

Shoulder Action

The shoulders should remain horizontal to the mound throughout the delivery until the throwing arm has been set up and is coming forward (figure 1.37). (The exception might be the straight overhand pitcher who drops his back shoulder back to some degree to allow for the overhand release.) When the throwing arm is coming through with the pitch, the shoulders will tilt depending on how much pull the lead arm is contributing.

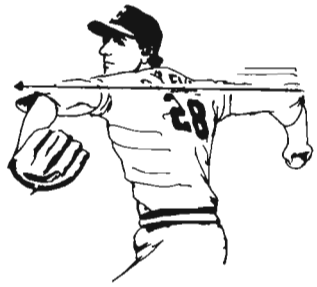


Figure 1.37 The shoulders should remain horizontal during delivery.

A common problem among pitchers is aiming the front shoulder up in the air. The front shoulder should be pointed toward the target. To throw a great distance, the pitcher must drop the back shoulder and elevate the front shoulder, but when throwing from a mound, he must aim the lead shoulder toward the plate. When the back shoulder is down and the lead shoulder is up, the pitcher will usually have a control problem (figure 1.38).

Figure 1.38 Shoulders that aren't level cause control problems.

The shoulders should rotate, or coil, depending on the arm slot of the pitcher. The overhand pitcher's shoulders should remain in a line from home plate to second base throughout the gather phase of the delivery. The high three-quarter pitcher will have a little bit of rotation, or coil, and the low three-quarter or side-armer will rotate even more before going to the plate.

Follow-Through

A pitcher's follow-through is important for injury-free pitching. Theoretically, the follow-through does not affect the pitch because the ball has left the hand. A good follow-through can gently slow down the tremendous arm speed built up during the throw and reinforce good pitching mechanics.

A sound delivery features a nice follow-through, just as an inefficient delivery prohibits a good follow-through. For this reason coaches have gotten by with saying that to get a pitcher to follow through is to make him throw the ball lower.

The path the follow-through takes is unique to each pitcher. The follow-through should continue the path the pitcher's arm took to release the ball. An overhand pitcher finishes with his elbow just to the outside of his stride-leg knee. A three-quarter-arm pitcher gets more horizontal momentum and therefore finishes farther away and up from the

knee. A side-arm pitcher finishes closer to the waist on his opposite side. A follow-through should not be forced; the arm should just go along its intended path (figure 1.39).

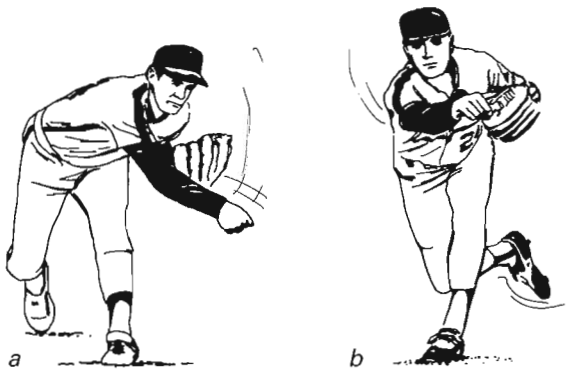


Figure 1.39 The arm should follow its natural path during the follow-through: *(a)* overhand; *(b)* side-arm.

Recoiling the Throwing Arm

A common error of many pitchers is to recoil the throwing arm after ball release. Instead of letting the arm take its natural course after release, the pitcher snaps the hand back up, causing tremendous pressure on the shoulder and elbow. The pitcher's back also straightens up instead of bending during follow-through to allow the whole body to gradually slow the arm, preventing injury.

Recoiling, whether with the arm, back, or both, is dangerous, and pitchers should prevent it or eliminate it for injury-free pitching. For help in correcting recoiling, see the chair drill, page 64.

Combining Upper- and Lower-Body Mechanics

Perfect pitching mechanics require not only perfect upper- and lower-body mechanics but also a perfect synchronization of the two. When his two body halves aren't working together, the pitcher loses control and velocity and increases the odds of being injured.

In the ideal delivery, the pitcher has balance before and after he releases the ball. Balance before the pitch refers to the gathered position in which the pitcher momentarily balances on one leg before he pitches the ball. Balance after the pitch refers to when the pitcher is again balanced on one leg in the finished position (figure 1.40). A good balance point after release leads to a good fielding position to protect the pitcher from the ball hit up the middle.

An extremely hard thrower sometimes has such arm speed that it forces him to fall off during the follow-through. As long as the pitcher reaches to the plate and falls toward the plate, this is acceptable. When the pitcher falls off to the side, there is a problem earlier in the delivery. Too much rotation in the gathered position can cause the pitcher to fall off as well as fly open with the front side, which causes the head to travel away from the target, taking the body along. Occasionally, something simple such as landing on the outside of his stride foot will cause an extreme fall off the mound.

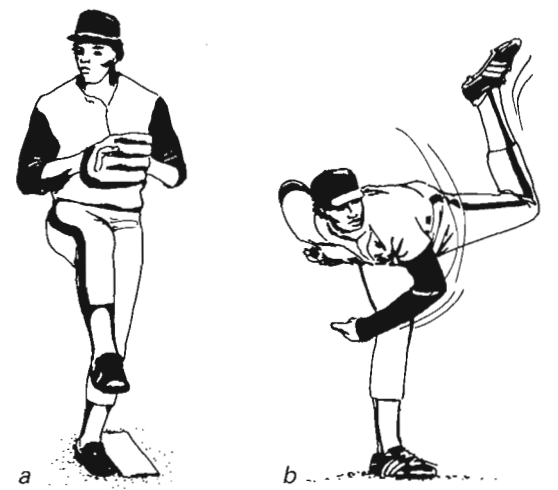


Figure 1.40 Balance *(a)* before and *(b)* after the pitch.

Sequence, Timing, and Rhythm

A pitcher can work hard to perfect his delivery and have each segment in good working order, but unless he has the proper sequence and timing as well as some rhythm in his delivery he will not realize his potential. As the pitcher lifts the leg to the gathered position, he should also lift the hands. The hands

will rise slightly as the knee comes up; and as the knee starts down to begin the stride, the hands will also go down and prepare to separate (figure 1.41, a and b). As the stride foot begins to go toward the target, the hands separate (figure 1.41c). The hands separate exactly at the time the stride leg begins to move toward the target. When the hands break too early, the upper body will arrive in the throwing position before the legs. When the hands separate too late, the legs will be in the throwing position before the arms. *When the stride foot lands, the shoulders must be aligned with the target and the throwing hand must be at its apex in the back.*

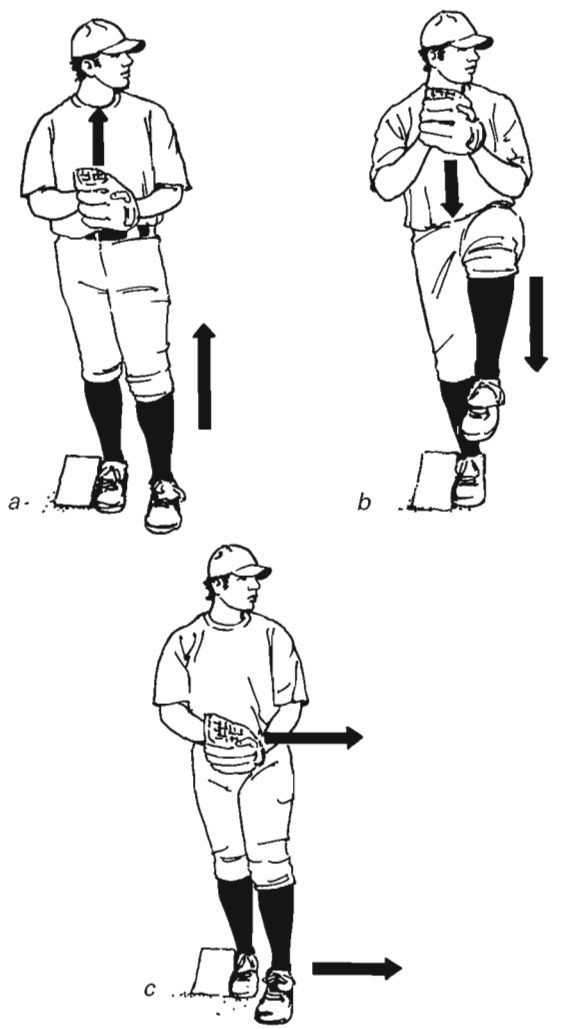


Figure 1.41 A rhythm is created when the hands bounce with the stride leg knee: hands bouncing *(a)* up and *(b)* down, and *(c)* breaking as knee goes forward.

When the hands bounce up with the stride-leg knee, it creates a rhythm to get all the parts working together for proper timing. The size of the bounce is an individual preference but should not travel higher than the chin and should only go up and down and not travel away from the body. Too much movement in the bounce may work to create a loss of rhythm and an inconsistent break of the hands.

Alignment During Delivery

Imagine a line drawn from second base through the rubber to home plate. In the ideal pitching delivery, all of the pitcher's movements, weight shifts, and momentum should stay on or close to this imaginary line. Any movement, weight shift, or momentum that takes the pitcher toward first or third base is not only wasted but also forces the pitcher to constantly try to correct this misalignment—creating extra movement, weight shifts, and momentum. The end result is too much side-to-side action and not enough action to the plate. The ultimate result is less control and more injury.

Let's examine the different components of the delivery and the alignment of their movements.

Pivot Step

The nonpivot foot starts the pitching delivery; to maximize efficiency in the windup, the pitcher should step according to his own arm slot. The overhand pitcher steps more in a line toward second base; the lower the arm slot, the more the step should move toward first base (right-handed pitcher) or third base (left-handed pitcher). The initial step starts the pitcher with the proper amount of rotation in his delivery. Regardless of where the pitcher steps, the head must remain over the pivot foot.

Leg Lift

Often a pitcher will kick his foot toward third base (right-handed pitcher) when he gets into the gathered position. When the foot goes away from the body, the upper torso counters this weight shift by leaning back.

The foot should stay under the stride-leg knee, and the head should stay over the pivot foot in the gathered position.

Hands

The hands should remain close to the center of gravity in the gathered position. When they get away from the body, the first reaction is for the throwing hand to go back in the opposite direction when the hands break. A right-handed pitcher's hands, when held away from his body toward third base, will cause the throwing hand to go back toward first base before getting extended in the T-position. This extra movement toward first base can cause too large an arm swing, and ultimately it can cause the pitcher to drag his arm through delivery. A big arm swing makes the body start toward the plate before the arm sets up.

Stride Leg

When a pitcher steps to either side of the line to the plate, he is cheating himself mechanically. A pitcher who throws across the body (a right-handed pitcher steps to the third-base side of the line) blocks out his hips and cannot create nearly as much power as he would if he used his hips. When a pitcher opens up the hips too much (a right-handed pitcher steps to the first-base side of the line), he also cheats himself of power.

Front Shoulder

The front shoulder also should follow the line between second base and the plate. When the front shoulder opens up (for a right-handed pitcher, the shoulder goes toward first base), the throwing shoulder tends to drag through the delivery (which can cause injury); and the rest of the body tends to go with the front shoulder, causing the pitcher to fall off the mound toward first base.

Lead Arm

The lead arm should extend toward the plate when the pitcher is in the T-position. When the throwing arm starts forward, the lead arm should come in to the center of gravity. If it were to fly open (toward first base for a right-handed pitcher), it would take the front shoulder with it.

Head

The head may be the most important component of the pitching delivery. Wherever the head goes, the body follows. When the head goes toward the first-base side of the plate, the body will follow. When a pitcher falls off toward first base, it is often because his head pulled him in that direction. The head should always go directly at the target.

90-Degree Rule

Five instances in a pitcher's delivery require an angle of approximately 90 degrees between two body parts. A coach should be able to measure these angles with the naked eye, and by doing so he can determine whether a pitcher is mechanically sound.

- *Gathered position.* In the gathered position, the angle of the stride-leg knee should be no greater than 90 degrees (figure 1.42). With the foot under the knee, the leg lift will be at 90 degrees when the stride leg is at the waist; but should the pitcher lift his leg higher, the angle will go to less than 90 degrees.
- *Landing of the stride leg.* When the stride leg lands to stop the forward momentum, the

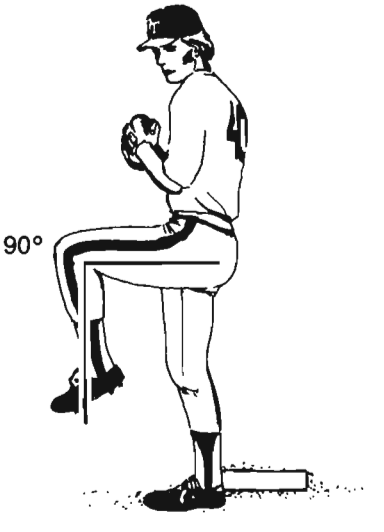


Figure 1.42 The stride-leg knee should be at 90 degrees at the waist and decrease in degrees as the leg rises.

angle of the knee should be at least 90 degrees (figure 1.43). At anything less than 90 degrees, the stride leg will collapse. (An angle of up to 105 degrees is acceptable.)

- *Throwing-arm elbow.* When the elbow starts forward in the acceleration phase, it should be at least as high as the shoulder. This requires a 90-degree angle with the torso and the upper arm (figure 1.44). (This angle can be greater than 90 degrees but never less than 90 degrees.)
- *Lead-arm elbow.* As the throwing arm goes toward the plate, the lead-arm elbow should be approximately as high as the lead shoulder (figure 1.45). (This angle can be less than 90 degrees but never greater.)
- *Throwing-arm acceleration phase (external rotation).* When the elbow is lined up with the torso and is leading the hand into the release area, the goal is a 90-degree angle of the elbow (figure 1.46). Generally speaking, the more velocity a pitcher has, the more external rotation in the arm. Many pitchers who have shoulder injuries lose the flexibility in the shoulder joint and cannot get back to 90 degrees, and they lose velocity as a result. *Do not force the elbow ahead of the hand. This happens naturally when the torso starts forward.*

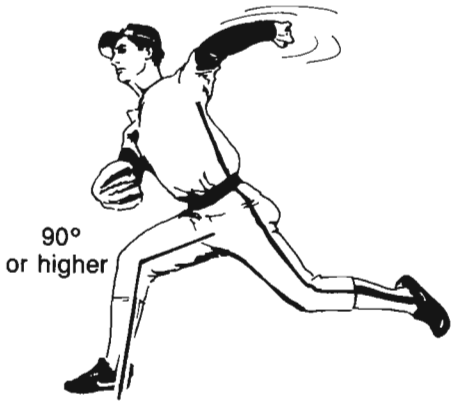


Figure 1.43 On landing, the stride leg should be at least 90 degrees.

Figure 1.44 When the elbow starts forward, the angle between the body and the arm should never be less than 90 degrees.

Figure 1.45 The lead arm should never be more than 90 degrees.

Figure 1.46 During external rotation the elbow is at 90 degrees.

Matching Arm Slot to Delivery

Once the pitcher establishes a natural arm slot, he should tailor the delivery to that particular arm slot. A coach can determine a pitcher's natural arm slot by watching him play long toss.

The lower the arm slot, the more rotation, or coil, in the delivery. The lower the arm slot, the more bend in the pitcher's torso. The higher the arm slot, the lower the finish and the lower the arm slot the higher the finish.

The front-side elbow must take the opposite path of the throwing arm during delivery. The path of the front-side elbow will determine how high the back leg will travel and how close it will land to the stride leg during the follow-through.

Overhand Arm Slot

The overhand pitcher will use an up–down delivery to take advantage of his arm slot. The overhand delivery will feature a higher leg lift than lower arm slots use and will have little if any hip rotation when getting to the gathered position. Even though the knee will come up higher, the foot must remain under the knee in the gathered position and when going to the plate in the stride.

Every effort must be made to keep the body lined up between home plate and second base because the overhand delivery is an up–down delivery and uses very little side-to-side rotation. The lead arm and shoulders may have a little tilt but must be pointed at the target during delivery. The front-side elbow must stay close to the body throughout the delivery.

During the follow-through, the throwing arm must finish outside of but close to the stride-leg knee. The back leg in the overhand delivery should be high in the back before finishing in the fielding position.

High Three-Quarter Arm Slot

The high three-quarter pitcher will use a little more side-to-side rotation in his delivery than the overhand pitcher to take advantage of his arm slot. The high three-quarter delivery leg lift will not be as high as the overhand's leg lift but should include a little more rotation of the hips. In the gathered position the knee of the lift leg should rotate back to the back side of the rubber to load the hips before going to the plate.

The shoulders will rotate slightly on the high three-quarter delivery, which will cause the throwing arm to go toward the first-base side of second base for the right-handed pitcher and the shortstop side of second base for the left-handed pitcher. The front side will also rotate slightly in the gathered position but will point to the target when the stride foot lands.

During the follow-through the throwing arm will finish outside the stride-leg knee at a greater distance away from the knee than the overhand delivery uses. *The farther the throwing hand is away from the head during delivery, the farther outside the stride-leg knee the throwing arm will finish.* The back leg will not finish as high in the back, and the back foot will land farther away from the stride leg in the fielding position.

Low Three-Quarter Arm Slot

The low three-quarter pitcher will use more rotation, or coil, in his delivery to take advantage of his arm slot. The lift-leg knee will not be as high as the lift for the high three-quarter arm slot but will rotate more toward second base. The lift-leg knee will rotate to the back of the pitching rubber or even slightly behind. The shoulders will also rotate more in the low three-quarter delivery, causing the throwing arm to swing more toward the second baseman for the right-handed pitcher and toward the shortstop for the left-handed pitcher.

The torso will bend slightly at the waist during the delivery of the low three-quarter arm slot to keep the throwing-arm elbow at shoulder height. The lead-arm elbow will point to the plate when the stride foot lands, but it will travel away from the body opposite of the throwing arm.

The path of the throwing arm in the follow-through will be outside the knee at a proportionate distance. The pitcher's back leg will land farther away from the stride leg in the fielding position.

Side-Arm Slot

The side-arm pitcher will use more rotation in his delivery than other arm slots require, to take advantage of his arm slot. The leg-lift knee will coil back behind the pitching rubber. The shoulders and throwing arm will also rotate more than in any other delivery. The throwing hand of the right-handed side-

armer may rotate as far as the second baseman before lining up again as the stride foot hits the ground.

To keep his elbow at shoulder height, the side-arm pitcher will bend his torso at the waist even more than the low three-quarter pitcher. The side-arm slot lead elbow will take the opposite path as the throwing arm and appear to be flying open.

The throwing arm in the follow-through will reach to the plate and then follow the lead elbow across the knee. The back leg will not get high in the back and will land farther yet from the stride foot in the fielding position.