Sprinting Guide
The Sprints

Understanding proper sprinting mechanics will help contribute to speed development. Mechanics has to do with the effects of energy and forces on the body. For sprinters, muscle power, neurological innervation, and length of limbs are the most important factors to consider. These factors influence the two main components that affect speed: stride length and stride frequency.

Stride length is governed by the power the sprinter puts into the stride, or the ground contact time. Stride length also has an effect on the angle of the force to the ground. When athletes overstride, or place the landing foot too far forward of their center of mass, they create braking forces that slow them down. While trying to lengthen their stride, by overstriding athletes may actually cause their stride to shorten. The best way to improve stride is not by changing technique but rather by improving the ability to produce power (i.e., speed and strength). Natural increases in stride length occur when greater power is applied to the ground due to improvements in stride frequency.

Stride frequency is limited by the physiological makeup of each athlete. It is governed by the firing ability of the nerves stimulating the muscles, the fiber type the muscles are made up of, and the length of the limbs. The more fast-twitch fibers one has, the greater stride frequency one can attain. Shorter limbs rotate with greater frequency. Longer limbs have a lower stride frequency. Short sprinters therefore typically run with a very powerful stride and on average run the short races (60 to 100 meters) faster. Tall sprinters generally run faster in the longer sprint races in which both speed and endurance are needed.

Technique

An athlete's mechanical potential is measured by the ability to place each body segment in certain required positions to reduce ground time, improve stride frequency and stride length, and reduce the air time of each stride. All of this, in turn, will contribute to faster speeds. Coaches must develop a technical model for each of their athletes that displays their stride pattern. Coaches must then work on modifying each athlete's movement patterns to help the athletes improve their sprinting technique (thus improving their technical model).
Stride Phase

Analysis of an athlete’s technical model will reveal aspects of the stride that show good technique or that need improvement. Here are some good striding techniques to look for:

1. A foot that is moving backward under the body upon landing (sometimes referred to as active foot plant or negative foot speed) (figure “a” below).
2. High heel recovery as the drive foot leaves the ground (figure “a” below).
3. A support foot landing that touches down as close as possible to a point under the center of mass (figure “b” below).
4. The ankle of the forward swinging leg should cross the support leg above the knee (figure “C” below).
5. A very tall posture with a slight forward lean from the ground, not from the waist (lean will be directly proportional to acceleration; the greater the acceleration the greater the lean, so once top speed is achieved forward lean should not be very noticeable).
6. Arms that swing backward as if reaching for the hip pocket (figure “c” below).
7. Arms bent at the elbows (bent less than 90 degrees on the upswing but greater than 90 degrees on the downswing) (figure “d” below).
8. Relaxed hands (some coaches advocate extended fingers to create a longer lever of the moving forearm. This longer lever creates a larger moment of inertia of the moving forearm that helps to put more force into the ground as the athlete drives off. Be sure not to create tension, however.)
9. Arms that swing forward to a chin high position into the midline of the torso but do not cross the midline (figure “d” below).
10. Relaxed shoulders, neck, jaw, and face.
11. A dorsally flexed ankle joint (toe up) just prior to the foot landing (figure “e” below).
12. Head is erect and eyes are focused on the finish line (figure “f” below).
13. Sprinter runs in a straight line throughout the race with very small amount of lateral movement.
Acceleration Phase

The technical model during the acceleration phase of the sprint, including the start, should have the following characteristics:

1. Acceleration is achieved by driving or pushing with the drive leg. This requires a good forward lean—from the ground up, not the waist. Remember that the amount of lean an athlete exhibits will be directly proportional to acceleration. Also remember that acceleration does not mean speed but the rate of increasing speed. If a line is drawn from the foot of the drive leg through the center of mass, that line also should extend through the shoulder joint and head (figure "a" below). That line should be at approximately a 45-degree angle from the ground.

2. The free leg will drive low and fast to place the foot down under the body and may even fall behind the center of mass depending on how quickly the athlete accelerates. Without proper acceleration the athletes will stumble since they are leaning so far forward.

3. The heel recovery of the drive leg will be very low coming out of the blocks in order to get the foot down fast in order to drive again and overcome inertia.

4. With each succeeding drive step, the athletes' speed grows until they reach their top speed. As speed increases acceleration decreases, so you should observe a continuous lessening of body lean (figure "b" below). Upon reaching top speed, posture should be very erect.

5. Along with the stride-by-stride decrease in acceleration, you should observe the athletes' heels rise higher as they get into their normal sprint stride.

6. The arm action during the acceleration phase is similar to the sprint striding phase. However, in the early phases of the start the hands will be driven very high and forward relative to the athlete's torso. The arms play a very important role in maintaining balance, rhythm, and relaxation, so you should have the athlete consciously work them vigorously.

7. As the athlete moves from the acceleration phase into the normal stride, you will want to focus upon the technical model for the sprint striding phase discussed above.
Finish Phase

The proper technique for a sprint finish requires concentration and timing. A mistimed lunge at the finish line is likely to cause the athlete to lose a close race. Here are examples of proper finishing technique:

1. The athlete maintains good sprint posture and a normal stride action through the finish line.

2. The athlete maintains the same sprint stride as in the middle of the race (it is common for sprinters to break down and start overstriding at the finish of a race when fatigue causes them to lose the ability to maintain good stride frequency; if athletes overstride, they will create braking forces that will cause them to slow down).

3. Good ankle dorsal flexion is maintained.

4. The landing foot is moved backward under the center of mass.

5. The athletes keep their strides quick, not long. Speed endurance allows the athletes to be able to maintain the best stride frequency they have. Whenever a sprinter has low speed endurance, stride frequency is diminished as fatigue sets in regardless of limb length.

6. The athlete continues to vigorously drive the arms.

7. As the athlete reaches the finish line, he or she lunges forward in order to lean at the tape. This is an effective technique, but it must be done just as the athlete takes his or her last stride through the finish line. There are two types of leaning models:

   • The athlete steps onto the finish line with the head lowered and both arms thrust backward to create a forward falling action (figure below).

   • The athlete drives the forward moving arm through the line and drives the opposite arm back and around to rotate the trunk. This technique turns the shoulder forward fast, helping the athlete to accelerate forward.
The Starting Blocks

The sprinter must achieve a starting position that will optimize the pattern of acceleration. To accomplish this, the sprinter must overcome inertia by applying maximum force against the blocks in the shortest time possible.

Block placement

The three block placement positions are determined by the location of the blocks relative to the starting line. Please note that the measurements in each of the following are taken from the front edges of the foot pedals, or blocks.

1. The bunch start (front block 16 in. from the line, with 11 in. between blocks) results in fast block clearance with low velocity, because the athlete spends very little time producing force.
2. The medium start (front block 21 in. from the line, with 16 in. between blocks) allows the athlete to spend more time applying force to the blocks, which results in a higher velocity. This is the generally recommended starting position.
3. The elongated start (front block 21 in. from the line, with 26 in. between blocks) obviously allows the greatest application of force, but it also requires tremendous strength and is not advantageous for most athletes.

A simple method to determine block placement is to have your athletes use the length of their feet as a guideline. The front block is placed one and one-half to two foot-lengths ahead of the back block. This puts every athlete in a set position close to the medium start position.

A more sophisticated method of determining block placement is to initially measure the distance to the ground from the trochanter, the bony protruberence on the outer hip (figure on the left) and use that measurement in the following two formulae to determine the appropriate distances (figure on the right) for the placement of the leading edge of the front block pedal from the starting line (“a”) and the distance between leading edges of the block pedals (“b”)

\[ a = 0.55 \times L \]  
\[ b = 0.42 \times L \]

The following chart provides standardized results for several leg lengths.

<table>
<thead>
<tr>
<th>Leg Length (L)</th>
<th>Line to Leading Edge (a)</th>
<th>Leading Edge to Edge (b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>26“</td>
<td>14¼”</td>
<td>11“</td>
</tr>
<tr>
<td>27“</td>
<td>14¾”</td>
<td>11¾”</td>
</tr>
<tr>
<td>28“</td>
<td>15¼”</td>
<td>11¾”</td>
</tr>
<tr>
<td>29“</td>
<td>16”</td>
<td>12¼”</td>
</tr>
<tr>
<td>30“</td>
<td>16½”</td>
<td>12½”</td>
</tr>
<tr>
<td>31“</td>
<td>17”</td>
<td>13”</td>
</tr>
<tr>
<td>32“</td>
<td>17½”</td>
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<td>33“</td>
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<td>38“</td>
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<tr>
<td>39“</td>
<td>21½”</td>
<td>16½”</td>
</tr>
<tr>
<td>40“</td>
<td>22”</td>
<td>16¾”</td>
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</tbody>
</table>
Athletes may feel uncomfortable at first because of the amount of weight that is placed forward on the hands. As the strength of the arms and shoulders increases, though, they will become more comfortable with this position.

**Set position**

Ideally, the block settings should result in your athletes having a 90° angle at the front knee and a 110° to 120° angle in the back of the knee. This gives a set position with the hips just slightly higher than the shoulders (figure “a” below). They should feel pressure against the rear block in the set position. When backing into the blocks in the "on your marks" position, athletes should firmly place one foot against the back block so that pressure will automatically occur when they rise into the set position (figure “b” below). The hands are placed just slightly wider than shoulder width apart, with the fingers and thumbs in a "high bridge" position. The shoulders are above and slightly ahead of the hands. The arms are straight, although not locked (figure “c” below).

The position of the blocks is different when starting on the turn (figure below). The position of the hands relative to the starting line must also be altered, the left arm dropped back slightly from the line to maintain the shoulders square with the block placement. This allows the starting sprinter to run on a tangent to the turn to counteract the force of the turn.
Block clearance

The stimulus for movement is reaction to the sound of the gun. Such a reaction is a voluntary response that is under an athlete's control, so it can be improved. For improvement, your athletes must learn the appropriate coordinated joint action. This establishes the correct movement pattern, which is perfected through repetition in practices.

Most of the block clearance time should be spent applying force against the blocks. The rest of the time is used in reacting to the gun and taking the hands off the ground.

For good starts, a sprinter must:

1. Cue on moving the hands and arms as quickly as possible in reaction to the gun.
2. Push back against the blocks.
3. Drive out; the direction of applied force should be out and up, not up and out; that is, the athlete should move the hips quickly from the starting position to a running position.
4. Run out of the blocks; do not jump out.

At the gun the sprinter starts without unnecessary delay. A quick response to the gun is of major importance for a fast start. In good sprinters the reaction time is about 0.12 - 0.18 seconds.

The power exerted on the blocks when starting will transmit to the runner's body the highest possible initial velocity. This is brought about by an explosive pushing of both legs against the blocks. When measuring the push-off force by each of the two legs, higher absolute values are often obtained for the rear leg than for the front leg, although the front leg is exerting force on the blocks longer and has therefore a greater influence on the initial velocity.

The main technical skills in the leg action are follows: after coming off rear starting block, the push-off leg starts to drive forward, i.e. the thigh is rapidly drawn forward and upward. At first the leading leg remains in an approximately horizontal position. Only when the foot passes the stretching leg (figure “d” below), that is, when the visible lifting of the thigh begins, will the leading leg begin to come forward somewhat. The front leg completes its extension as the rear leg completes its swinging action. In this stretching phase, which typifies the crouch start, the thigh of the swinging leg forms in most sprinters almost a right angle between the thigh and the trunk and between the thigh and the lower leg (figure “e” below). The power produced by the extension of the front leg must act optimally on the runner's center of gravity. This implies that the extended leg and the trunk must form a nearly straight line. The "starting angle" of a good sprinter is about 42° to 45° in relation to the track surface.

Proper arm action: arms have an important function in helping to produce the starting acceleration. Special attention must therefore be paid to the correct action of the arms. The movement of the swinging leg requires that the respective arm swings forward and upward. The arm tends to bend increasingly at the elbow until it reaches an angle of about 90° in the final phase of the movement. In this process the fist swings towards the forehead. The elbow has a slight outward spread. The opposite arm performs a corresponding counter-movement backwards.
Curve Running

All 200m and 400m runners must master proper turn-running technique to optimize overall performance. The athlete should run as close to the inside lane as possible, unless running in Lane 1 where he or she should run toward the middle of the lane to avoid the possibility of stepping on the curb. The athlete must not allow any drift to the outside when coming off the bend into the straightaway. Some adjustments must be made in the positioning of the upper body and arms. The athlete should carry the left arm lower, with the left shoulder slightly forward, and drive the right arm across to the midline of the body.

Richwoods Track Layout