Practical Biomechanics
For the
100m Hurdles

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I. Technical considerations in the sprint hurdles

A. General flow of the sprint hurdle race

The sprint hurdle event must be thought of as a sprinting event. In that sense acceleration as well as maintenance of high velocity throughout the race are key ingredients to success. Analysis of top-flight hurdlers has shown that:

1. Acceleration does not stop at the first hurdle but rather continues through the 4th and 5th hurdles. This should not be surprising in that 100m sprinters accelerate approximately for the same distance before reaching top velocity.
2. Stabilization of maximum velocity is extremely strong through hurdles 6, 7, 8, and 9. Speed endurance, or more specifically, Rhythm Endurance is well developed by successful hurdlers.

These findings well illustrate that high levels of specific conditioning will be required of the sprint hurdler who wishes to achieve top level performances.

B. Start to the first hurdle

An 8-stride pattern to the first hurdle is advocated. This becomes even more important to the more advanced hurdler. The rhythm used in running eight strides to the first hurdle is much closer to the rhythm used between the remainder of the hurdles and thus helps the athlete "get" into their rhythm sooner in the race.

1. Attack the first 4-5 strides with the characteristic inclination of the body found in the normal accelerating run from blocks.
2. Perform the last three strides before the hurdle with a slightly more upright body position in order to approach the hurdle in a more effective posture for hurdle clearance.
3. The first five strides should be driving and powerful with strides 6-8 emphasizing an increase in cadence much as in the rhythm of the inter-hurdle run.

C. Takeoff foot

The term Takeoff Foot will refer to the trail leg foot. It will be this foot from which the hurdler will propel herself into the hurdle. As we will see latter all of the strides initiated by the takeoff foot are longer than those initiated by the lead foot.

D. Cut step

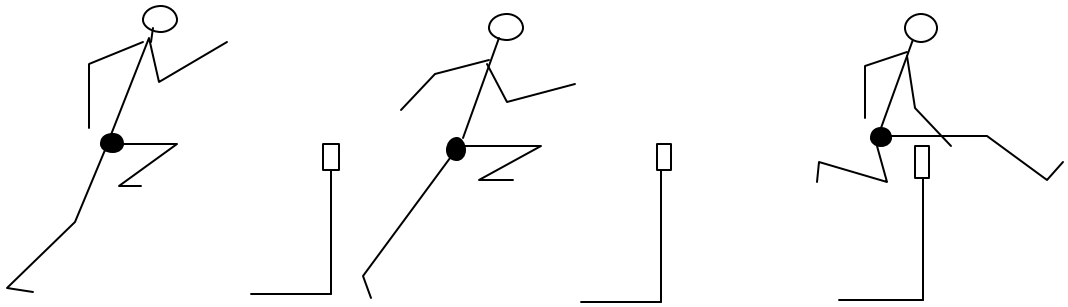
The term Cut Step will refer to the step before the hurdle. The stride before the hurdle is slightly shorter than the previous stride and involves a lighter, active landing action of the takeoff foot to keep the projection of the center of mass over the hurdle low and well directed. By active landing we will mean an active, quick placing of the trail leg into the takeoff position somewhat faster than in the previous running stride. This active landing action will "cut" or shorten the last stride thus preventing planting or braking action and therefore minimize loss of velocity going into the hurdle. This placement should be on the forefoot and occurs approximately 2.0 meters from the hurdle. Anthropometrical considerations must be made in determining correct takeoff distance from the hurdle.

E. Lead leg action

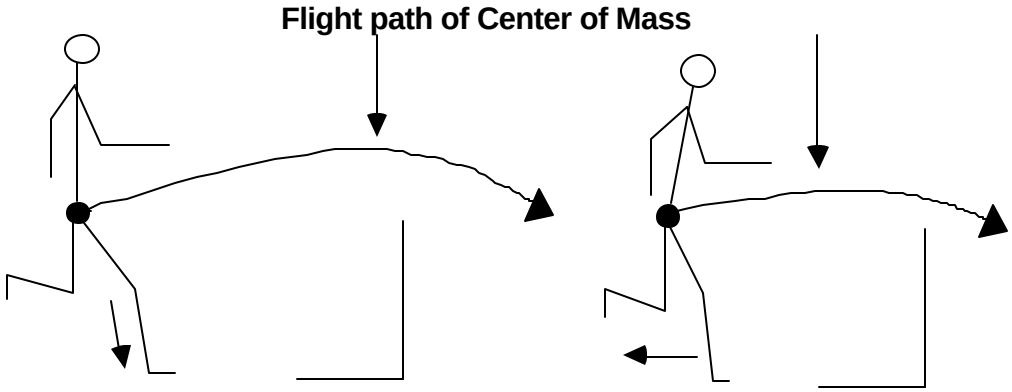
The lead leg initiates and controls to a great extent the hurdle clearance. Efficient clearance begins in the strides before the hurdle. Once the lead leg finishes its last ground contact phase before the hurdle, it immediately is recovered, heel to butt, as the knee is driven up to a point over the hurdle rail. This requires flexion at the hip and the knee. The lower lead leg remains tucked under the thigh until the thigh

has reached parallel to the ground or above. When the thigh reaches its apex, momentum is then transferred to the lower leg by relaxing the hamstring and allowing the knee joint to open. The knee does not lock. (Another reason for flexing the hip and then extending the lower leg as a two step sequence is that the rectus femoris and hamstring muscles are multiple jointed muscles which cross over the hip and knee, and a characteristic of such muscles is that they do not permit complete movement in both joints simultaneously.)

1. It must not be considered a mistake to not fully straighten the lead leg at the knee joint.
2. The lead leg and its opposing arm must move in a parallel manner. If the arm is directed inwards toward the leg, then the leg will also move inwards, crossing toward the arm, and the forward motion of the body will be disturbed.
3. The velocity of both arms must coincide with that of the lead leg.



Sprinting through the Hurdle



Too much planting action

Active foot plant and good sprint action into the hurdle.

F. Trail Leg Action

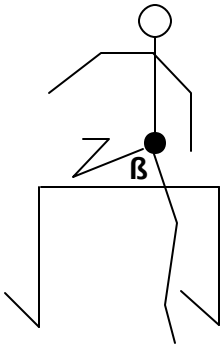
The trail leg must work in concert with the lead leg and lead arm actions. The trail leg should be active throughout its range of movement. As the trail foot leaves the ground, the leg is drawn vigorously forward and upward, tucking the heel tightly to the butt and thereby shortening the trail leg lever as much as possible. This enables the leg to pass over the hurdle with greater speed and reduces the degree of compensating rotation in the rest of the body. The foot of the trail leg should never rise higher than the knee. The trail leg is kept tightly folded until the knee has reached the front of the body and is ready to accelerate downward to the track once again. The athlete should not attempt to make a long stride with

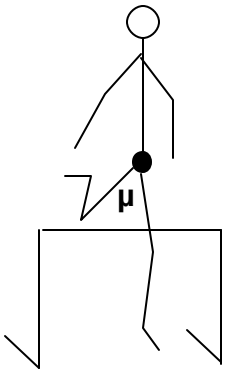
the trail leg coming off the hurdle. Early in the race this "getaway stride" may need to be longer to aid acceleration but most certainly will need to be shorter as the race progresses beyond hurdle 5 or 6 and the athlete reaches maximum race speed.

G. Sequencing of actions

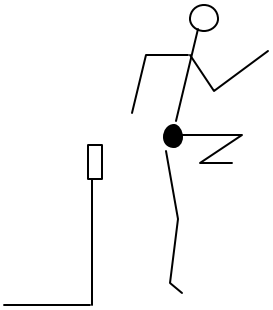
Problems for the coach and athlete aspiring to elite levels arise largely from established motor and neural patterns within the athlete. Especially with athletes who have been hurdling for many years, a definite rhythmic pattern is ingrained which may ultimately be the greatest hindrance to breakthrough performances. The athlete must be able to:

1. Adapt to performing hurdling action sequences at varied speeds. Anticipate the hurdle coming up more quickly.
2. Break ingrained mental and physical rhythms from past races that were not of a high performance standard.
3. Understand the interplay of the lead leg, trail leg, and arm actions in hurdle clearance and running between. Because balance is a key ingredient in hurdling, these levers must work at highly corresponding velocities that are well coordinated.

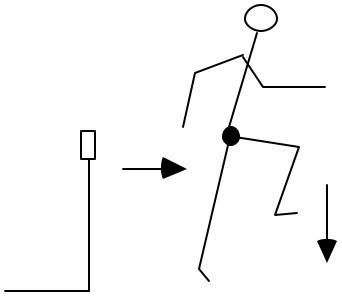




The angle of the trail leg with th e hurdle rail will depend on the height of the hurdler.



Posture at Touchdown



The Getaway Stride

H. Running between the hurdles

All hurdlers take essentially the same number of strides in a race. Therefore it is quite reasonable to assume that the hurdler with the greatest stride frequency should have the greatest success providing technique and power were equal to that of their opponents. The distance between the hurdles is

overcome in three strides. The strides are not all of the same length and vary somewhat according to the anthropometrical characteristics of the athlete. The length of strides between the hurdles appears to approximate the following.

	Touchdown Distance	1st stride	2nd stride	3rd stride	Takeoff Distance
Early race 100h	95cm	150cm	205cm	195cm	205cm
Later race 100h	105cm	150cm	200cm	190cm	205cm

The statement has been made that hurdling should deviate as little as possible from sprinting. However, in comparing the technique of the flat sprint with that of interhurdle running, essential differences in the running movement of the two can be seen. In overcoming the interhurdle distance in three strides the amplitude of limb movements by the hurdler is often less than that employed in the flat sprint. This of course depends to some extent on anthropometrics and individual strength levels. All the pivoting phases in the interhurdle run must be slightly shorter than in the flat sprint. This is especially significant in the case of the takeoff foot where greater pivoting time indicates more planting action resulting in higher vertical velocity and therefore greater flight time over the hurdle. Heel recoveries are lower (particularly for the trail leg) and ground contact time is kept to a minimum (athlete appears to be running on hot coals). As you can see in the chart above, those strides initiated by the trail leg are greater than those initiated by the lead leg in every case. This accounts for a lower heel recovery of the trail leg compared to the lead leg.

I. Maximum Velocity Stride Length as it Relates to Stride Length Requirements in the sprint hurdles

The required stride length to effectively accelerate and maintain velocity in the sprint hurdles has been described above. In the measurement of stride length values of sprinters and hurdlers during maximum velocity sprinting, the coach knows the current physical capacity of each athlete. In order to best attain the high frequencies necessary for success, the hurdler's sprint stride length potential must be greater than the stride requirements for the hurdles. Within the biomechanical limits dictated by leg length, the coach must direct the training of the hurdler to overcome any stride length deficiencies. This means that force production is generated with proper hurdle running mechanics. This allows the hurdler to race between the hurdles at a lesser percentage of their maximum sprint stride. This in turn allows for higher frequencies and better rhythm maintenance.

II. FAULT-REASON-CORRECTION

This section will attempt to address some common problems found in the sprint hurdles and suggest possible reasons and corrections.

A. Too far from the first hurdle

POSSIBLE REASONS:

1. Sprint strides during initial acceleration from blocks are too short.
2. Blocks may be set too close together resulting in too short of an initial stride.
3. Arm action in acceleration to first hurdle may be too passive.

CORRECTIONS:

1. Athlete lacks contractive strength levels necessary to drive from the blocks with sufficient stride length to make the 13m distance in 8 steps.
2. Move blocks to medium spacing and check body angles in start position.
3. Lengthen arm action and increase the amplitude of arm movement.

B. Too high over the first hurdle

POSSIBLE REASONS:

1. Too close to the hurdle at takeoff
2. Takeoff foot planted on heel

3. Non-existent or non-active cut step
4. Lead leg not folded tightly until thigh reached parallel or above
5. Athlete afraid of hurdle

CORRECTIONS:

1. Keep athlete in sprint acceleration posture longer. This will keep strides shorter and help the athlete attain a higher velocity. Make sure the athlete is accelerating in a pattern of acceleration and not overstriding. If the athlete is planting their takeoff foot like a long jumper this will make the last stride before the hurdle too long and result in placement too close to the hurdle.
2. Practice a tall posture, making the cut step active and on the front of the takeoff foot.
3. As 2.
4. Rehearse proper lead leg mechanics and body posture going into hurdle. Also examine what the takeoff foot is doing. If it is planted on the heel than the lead leg will tend to open up too soon.
5. Use hurdles in practice that are constructed of soft, flexible materials or constructed to be forgiving. If the hurdle is not a threat to life and limb, the athlete will gain the necessary confidence to run through the hurdle with the velocity necessary to perform efficient technique.

C. Hitting Trail Knee on the Hurdle

POSSIBLE REASONS:

1. Rushing takeoff (Hot stepping the takeoff)

CORRECTIONS:

1. Focus on an active cut step and do not rush the force application of the trail leg.
2. Leave the trail leg back until you feel a push off of the toe. This will cause a stretch in the thigh muscles, which will snap the trail leg through with little or no effort.

D. Off balance coming off the hurdle

POSSIBLE REASONS:

1. Lead leg and opposite arm are driven inward and not parallel to the direction of travel.
2. Trail leg opening up too soon as it clears the hurdle

CORRECTIONS:

1. Work on keeping the lead leg mechanics as described above so as to enable the athlete to more easily keep their actions in line with the direction of the run. Use sprint arm action into the hurdle and not across the body. Also, the athlete may be too close to the hurdle.
2. Do a significant amount of work on trail leg mechanics to keep the leg folded until the thigh has reached a position where the knee is pointing in the direction of travel before opening up toward the ground. This problem often occurs when the athlete is trying to rush the trail leg to the ground.

E. Hitting hurdles late in the race

POSSIBLE REASONS:

1. Loss of rhythm
2. Too close to hurdles
3. Loss of concentration

CORRECTIONS:

1. Trail leg opening too soon thus causing getaway stride to be too long resulting in placement of the next takeoff too close to the hurdle. Also if the athlete fails to maintain a hips tall position this may cause them to sit and thereby not maintain good sprint mechanics.
2. Keep trail leg tight and shorten getaway stride.
3. Think of the hurdle race as 100m long and 48" wide. Learn to control attention to what's happening in your lane and to concentrating on your own rhythm.