# 400-Meter Hurdle Theory

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## INTRODUCTION

The 400m hurdle race is arguably the most demanding of all events in the sprint-hurdle group. It requires a combination of speed-endurance and hurdling skill along with a unique awareness of stride pattern (between hurdles) which requires special concentration throughout the race.

## TECHNICAL CONSIDERATIONS

Hurdling, whether the highs or the intermediates, is a sprinting action. In fact, if we evaluate the velocities achieved in the two races, we find that the long hurdler is actually sprinting at a faster mean velocity than the high hurdler. (Kevin Young, in his WR 46.78 had an average velocity of 8.55 m/s; Colin Jackson, in his WR 12.91average 8.51 m/s.)

**Without question, the hurdler should strive to accelerate the last few strides into the hurdle.** The last stride prior to the hurdle should be shorter and quicker than the previous strides.

The hurdler should gain an erect "hips tall " position during the final strides of the approach. As in high hurdling, a quick lead knee action initiates the take-off to the hurdle. **Leading with the knee is the single most important fundamental of efficient hurdle technique.** A quick lead knee results in what is often called a *delayed trail leg,* that is, the trail leg gets full extension at takeoff.

The lower hurdle height requires less body lean into the hurdle than in the high hurdles. Although the trail leg may clear the hurdle in a lower plane than in the highs, it must continue driving forward and upward to allow the hurdler to return to good sprinting action.

The stride length for the hurdler who takes 13 strides between hurdles averages 2.45m versus an average stride length of 2.05m for the high hurdler. The hurdle clearance stride for the intermediate hurdler is approximately 3.50m, and is about the same for the high hurdler. Of course, since the hurdle is 6" shorter than in the highs, the hurdler does not need to raise his or her center of mass as high as the high hurdler to clear the hurdle.

Since the parabolic path of the hurdler's center of mass has not deviated from normal sprinting action as much as the high hurdler's, the inter- mediate hurdler does not need to be as aggressive in trying to *"snap"* the lead leg down, nor does he need to snap the trunk back, since he has not leaned into the hurdle as much as the high hurdler would.

It's sometimes suggested that the long hurdler "float" or "glide" over the hurdle relative to the more aggressive action of the high hurdler. However, these terms are

misnomers and more often than not connote slowing down over the hurdle. Complete recovery of the trail leg, continuing the knee drive forward and upward after it passes the hurdle, ensures an active landing of the lead leg and continuation of efficient sprinting.

The hurdle clearance stride is a good indicator of the efficiency of hurdle clearance. Ralph Mann, former world record-holder and now a well-known biomechanicist, compared the hurdle clearance strides of "elite", "average", and "poor" male hurdlers. His findings proved that shorter clearance strides with a higher percentage of the stride in front of the hurdle correlate to higher level performance (see Table A).

**Table A**

| | Hurdle Clearance Stride | Distance Before Hurdle | Distance Beyond Hurdle | Per Cent Before Hurdle | Per Cent Beyond Hurdle |
|---|---|---|---|---|---|
| "Elite" Hurdler | 3.50m/11'6" | 2.22m/7'4" | 1.28m/4'2" | 63.5% | 36.5% |
| "Average" Hurdler | 4.02m/13'2" | 2.44m/8'0" | 1.58m/5'2" | 60.6% | 39.4% |
| "Poor" Hurdler | 4.54m/14'11" | 2.65m/8'8" | 1.89m/6'2" | 58.4% | 41.6% |

The hurdler should swing back an *extended lead arm* in opposition to the trail leg to maintain balance over the hurdle. He should not "drive" or "snap" the elbow back, as this shortens the moment of inertia of the arm (relative to the trail leg) and creates rotation imbalances.

Rotation problems are also caused by reaching too far with the lead arm and are magnified on the curve in the long hurdle race. The trail arm (on the side of the lead leg) should deviate as little as possible from normal sprinting action.

## START TO FIRST HURDLE

The acceleration pattern and stride pattern to the first hurdle are of vital importance as they establish the hurdler's rhythm through the first few hurdles. In covering the 45m to the first hurdle, the hurdler should predetermine through practice the number of strides he or she will take that results in a good transition to sprinting between the hurdles.

Most elite male hurdlers use 20- 22 strides to the first hurdle. In any case, if the hurdler takes an even number of strides to the first hurdle, the lead leg should be in the back block at the start; if the hurdler takes an odd number of strides to the first hurdle, the lead leg will be in the front block.

The following table can be used to determine the optimal number of strides to the first hurdle with the resultant stride pattern between the hurdles:

**Table B**

| Number of Strides to 1st Hurdle | Resultant Strides Between |
|---|---|
| 20 | 13 |
| 21 | 13 |
| 22 | 13-14 |
| 23 | 14-15 |

The resultant stride length from a 21-step approach to the first hurdle leads most efficiently to an effective stride pattern of 13 strides between hurdles. A 22-stride approach to the first hurdle results in a slightly shorter stride length between hurdles which may lead to the hurdler elongating or reaching to get an effective 13 strides between the first two hurdles. A 20- stride approach can lead to an effective stride pattern between hurdles which requires the hurdler to shorten or "chop" his strides to get an effective 13 to the second hurdle. A 23-stride approach to the first hurdle will most often result in a 15-step pattern between hurdles.

Counting the number of strides to the first hurdle (i.e., consciously counting each time the lead leg or trail leg contacts the track) can be a valuable aid for the beginning hurdler (or even the elite hurdler in the early stages of the competitive season).

Block clearance at the start of the race should result in an acceleration pattern over the first 30m of the race that is not unlike that of a 400m sprinter. By the 30m mark the hurdler should be focused on the initial hurdle and make any slight adjustments that might be necessary.

As a suggestion, when the long hurdler practices starts, he or she should practice at a distance of 80m. This forces the hurdler to go over the first two hurdles, and results in practice not only of the start but of the effective stride pattern.

## STRIDE PATTERNS

The 400m hurdles is undeniably a race, which, more than any other, requires extensive racing experience as a prerequisite for success. That is, the more times the athlete can run the race in a competitive environment, the more efficient the stride pattern can be expected to be, resulting in faster times.

**Without question, the ideal stride pattern would be a consistent pattern of an odd number of steps between all hurdles.** This odd step pattern (13's, 15's, 17's, 19's, etc., all the way) allows the hurdler to take all hurdles with the same lead leg (preferably the left-see comments on lane positioning on the curve). An even step pattern between hurdles forces the hurdler to alternate his or her lead leg on consecutive hurdles.

It is rare for the hurdler to be able to accomplish a consistent number of odd strides all the way through the race. In our 1992 Olympic Trials, only three male hurdlers were able to accomplish 13 strides for the duration of the race (Nat Page in both the semis and finals, McClinton Neal in the semis and Kevin Young in the semis). In every other instance, the hurdler is forced to make a transition to a greater number of strides between hurdles. A transition takes place when a hurdler changes down to a shorter stride length (because of fatigue) which results in one or two more steps between hurdles.

At the Olympic Trials in New Orleans in 1992, the median value for the hurdle at which this transition took place was the seventh hurdle. An athlete with a lesser degree of

anaerobic endurance (i.e., an athlete in poorer condition, or at an earlier stage of the season) would be expected to have to make this transition earlier in the race.

**There are three forms of transitions**. The preferable transition is a ***single alternate,*** an example of which would be the left lead-legged hurdler transitioning from 13 strides to 14 strides, requiring him to then hurdle with a right lead leg over every other hurdle for the rest of the race.

In a ***dual alternate*** transition, the hurdler who is leading with his left and taking 13 strides between would take 14 strides and use a right lead leg, then 14 again to get back to the preferred left lead leg, and then finish the race with his left lead leg.

The ***double cutdown*** is most often used by the inexperienced hurdler who is unable to hurdle with his alternate lead leg. In this case the hurdler who is taking 13 strides between hurdles and leading with his left lead leg would cut down to 15 strides between (so as not having to hurdle with a right lead leg). The disadvantage of this type of transition is that the stride length must be drastically shortened in just a few meters of hurdle clearance from 2.45m (8'0") to 2.13m (7'0"). Table C shows the relationship between the number of strides between hurdles and the stride length.

Table C

| Strides between Hurdles | Required Stride Length |
|---|---|
| 12 | 2.68m (8'9") |
| 13 | 2.45m (8'0") |
| 14 | 2.27m (7'6") |
| 15 | 2.13m (7'0") |
| 16 | 1.98m (6'6") |
| 17 | 1.85m (6'1") |
| 18 | 1.72m (5'7") |
| 19 | 1.60m (5'1") |

Very few elite hurdlers ever use a double cutdown transition in a race situation, as their ability to alternate lead legs allows them to use the more effective single or dual alternate transitions. **The most valuable technique you can teach the developing hurdler is the ability to alternate lead legs over consecutive hurdles.**

Regardless of the type of transition which takes place in a race, the long hurdler should have a race plan which dictates for him or her where the transition will take place, and should be conscious of this point in the race. At the planned transition point in the race, the hurdler should consciously try to increase the stride frequency while reducing the stride length. This change in the stride pattern should be initiated ***before*** the hurdler is forced to change due to fatigue.

The predetermined stride pattern is called the hurdler's ***effective stride pattern***. Of course, variables such as wind conditions and type of track surface will have an influence on the effective stride pattern (and consequently on where in the race the transition takes place). More often than not the inexperienced long hurdler is forced to make ***additional late-race adjustments*** due to early onset of fatigue resulting from too fast an early pace. **The ability to make additional late-race adjustments is greatly enhanced if the**

**hurdler can alternate lead legs efficiently**. (Seven of the eight finalists in the men's 1992 US Olympic Trials effectively alternated lead legs within the race.)

**It is very important to be able to make any of these adjustments well in advance of the hurdle, instead of trying to rush an adjustment in the last few strides before the hurdle**. Minor step adjustments may be made by moving slightly in or out in the lane on the turn, or consciously shortening the stride during the first few strides coming off the previous hurdle. This is where racing experience becomes so valuable. Experience develops the depth perception of the hurdler so that he/she can make adjustments in stride length and frequency at the subconscious level far in front of the approaching hurdle (and with little loss of velocity cause by "chopping", "shuffling" or "reaching").

## LANE POSITIONING/HURDLING ON THE CURVE

The long hurdler who leads with the left leg has a definite advantage over a right lead-legged hurdler. The hurdler with the left lead leg can run the entire curve on the inside of his or her lane. The hurdler with the right lead leg must move more to the outside of his lane to efficiently (and legally) clear the hurdles on the curve. If the hurdler with the left lead leg is able to run 24" closer to the inside lane line than the hurdler with the right lead leg for 20 strides (4 for each of the 5 hurdles on the curve), he will gain an entire meter (or .12-.13 seconds) on his opponent.

In addition to effecting a shorter path between the hurdles on the curve, a left lead leg will allow the hurdler to avoid dragging his or her trail leg around the inside and below the top of the hurdle, resulting in disqualification.

It's worthwhile to mention here that many world class hurdlers have hurdled with a right lead leg. Seven of the 16 semifinalists in the '92 US Olympic Trials led with their right leg through the majority of their stride pattern. Previously mentioned Ralph Mann was a world record-holder in the late '70s with a right lead leg.

## DISTRIBUTION OF EFFORT

The hurdler's distribution of effort throughout the race can be effectively measured by the coach by using a stopwatch to determine the "touch-down times." These times can be charted and reviewed with the hurdler to evaluate his or her race. It's important to note that every hurdler, from beginner to world-class, loses velocity over the course of the race, as denoted by increasing touchdown times. Major discrepancies in the chart of a race can point to errors in judgment of transitions and late-race adjustments, as well as where fatigue sets in.

The fourth hurdle in the 400m race is at the 150m mark, or precisely 3/8 of the way through the race. The touch-down time at this hurdle is an especially valuable indicator of the distribution of effort during the early stages of the race. Another good indicator , however more difficult to obtain, is the 200m split. Ideally, the differential in times for

the first and second half of the race should be no more than 5%, or about or 2.4 seconds in a 48-second effort or 2.5 seconds in a 50-second effort.

## RUN-IN

Many 4OOm hurdlers make the mistake of "finishing" the race at the tenth hurdle, still 40m from the finish line. Making required adjustments in stride length and stride frequency well in advance of the final hurdle enables the hurdler to clear the hurdle efficiently. The hurdler then needs to begin a drive to the finish line, concentrating on sound sprinting mechanics. A high level of anaerobic endurance that results from including a large volume of speed endurance work in the training program is the key to a fast run-in from the last hurdle to the finish.

FROM: **Hurdle Times**, a newsletter published by the USATF Men's Development Committee and re-printed in TRACK COACH #131.