Sprint training

Mark Baughman
Mike Takaha
Tom Tellez
University of Houston

Sprinting, the ability to run at maximal or near maximal speeds for short periods of time, is the product of three factors: 1) stride frequency; 2) Stride length; and 3) Anaerobic endurance. With proper coaching and training, an athlete can enhance his performance level by improving each of these factors. The primary areas of coaching concern are: 1) Running technique; 2) Running training; 3) Flexibility; 4) Racing; 5) Practice set-up; and 6) Strength training. By improving in some or all of these concerns, an athlete will be able to improve his performance level.

Factors of sprinting

Stride frequency

The ability to move the legs faster through the full running motion is limited by the physiology of the athlete. Each individual has a different ratio of white (fast twitch) to red (slow twitch) muscle fibers. The higher the ratio of white to red, the higher the ability to move quickly. If the ratio is more red than white, the ability will be more aerobic in nature, and the athlete will be suited for longer distances. It seems apparent that stride frequency is basically an inherent trait. A person with a low ratio of white to red fibers will be a poor candidate for a sprinter.

There are some biomechanical factors which will affect the stride frequency. Improper technique will cause a slower turnover of the legs. A low heel kick on the recovery phase of the stride will cause the leg to be a longer lever, which will reduce the angular velocity. Also, overstriding, or "reaching," making the foot placement in front of the body, will cause a slower turnover. Another factor is the length of the legs themselves. An athlete with longer legs will have a slower turnover than the athlete with shorter legs. However, this factor should be offset by the greater stride length of the athlete with the longer legs.

Stride length

With proper technique, a sprinter can achieve an optimal stride length. It should be one that is as long as is mechanically efficient. The foot should strike the ground with the lower leg at 90° to the ground. If the foot comes down in front of the leg, the result is one of braking. The legs' strength is in pushing, not pulling. By overstriding in this manner, the athlete must wait to begin the pushing action until the center of gravity passes over the foot.

Flexibility and strength will enhance the stride length. If the leg is "free" to move through the range of motion of running, an optimal stride is possible. If there is a restricted range of motion, due to low flexibility, the stride length will be lessened. As strength increases, the amount of force applied to the ground with each stride should increase. This will cause the person to travel farther with each stride.

Anaerobic endurance

Anaerobic endurance is the ability to sustain maximal effort. There are two metabolic systems used when sprinting: the ATP-PC and the lactic acid systems. The ATP-PC system is the most powerful energy producer in the body. It is used at the start and through the acceleration phase. Its effects last for five to eight seconds. With training, an athlete can approach the upper end of the range. The lactic acid system is about one half as powerful as the ATP-PC system. Its effects last for 40 to 50 seconds and is used after the ATP-PC system is depleted. It is utilized during the maintenance of the races.

Coaching concerns

Running technique

Proper running mechanics are of the utmost importance in maximizing performance. As stated earlier, overstriding, or "reaching," must be avoided. It causes the person to decelerate until he attains a position where he can push, and decreases stride frequency.

At the beginning of the run, the emphasis should be on pushing backward and downward to set the body in motion, overcome inertia and gain speed. The body should have a lean, relative to the ground, but there should be no trunk flexion, as that will restrict hip flexion and cut down the stride length. As the rate of acceleration slows, the body position becomes more upright and the emphasis becomes more a downward push off the ground, to utilize the body's momentum.

The arms work in opposition to the legs, with the right arm and left leg coming forward as the left arm and right leg go backward, and vice versa. The shoulders should be as relaxed as possible, with the swing coming from the shoulder joint as the shoulders stay square with the direction of the run. The swing should be strong, but relaxed to help provide force for the legs. The hands should be relaxed. On the upswing, the hand should come to a point just in front of the chin and just inside of the shouder. As the arm swings down, the elbow will extend slightly, and at the "bottom" of the swing, the hand should be slightly behind and below the iliac crest. The elbows should stay close to the body, not swing out, away from the body.

The head should stay in a natural alignment with the trunk throughout all phases of sprinting. Leaning the head forward or backward will cause trunk flexion, which will decrease the range of motion of the hips. Also, this will cause a tensing of the neck and shoulder muscles, and the athlete will not be able to stay relaxed with the arms.

The athlete should not be coached to plantar flex the foot at the ankle at the point of take-off. This will cause a low heel kick and slow the speed of the leg during the recovery phase. The foot must be brought up from the ground by flexing the knee, so that the foot is close to the buttocks. This shortens the lever of the leg to allow for more angular momentum to be conserved. An active plantar flexion will inhibit this action.

Running training

The best single way to practice an activity is the activity itself. If you are limited by amount of time and other factors, actual sprinting in training will be the best way to get the athlete ready to race. However, if at all possible, it would be much more advantageous to give the athlete a well-rounded program, including technique sessions, weight training, flexibility and running.

When doing running workouts, attention must be paid to proper running mechanics and relaxation.

Running training must address both of the anaerobic endurance systems. Short sprints of 30 to 100 meters and starts will train the ATP-PC system. The lactic acid system will benefit from longer runs of 150 to 800 meters. In all short sprints, an acceleration pattern, similar to the one to be used in the race itself, should be practiced. The acceleration should be gradual and long, with maximum speed reached at about 60 meters.

A method of training which is as much a strength workout is resistance running: running up hills, stadium steps, etc. It is important to remember that proper running mechanics must be used when doing this type of workout.

Flexibility

Stretching should be an integral part of each day's warm-up and warm-down activity. Stretching should be done when the muscles are warm, therefore, an easy jog should precede stretching. Stretching should be done in a slow, static manner, never ballistically, as that can cause injury, rather than prevent it.

All muscles which are to be stressed, and their antagonists, should be flexible prior to activity. Attention should be paid to hamstring, groin, quadriceps and calf areas for running workouts. Upper body stretching should be done in conjunction with weight lifting sessions, along with the leg stretching. After every workout, either running or lifting, the athlete should warm down by stretching and jogging, to alleviate tightness.

Racing

The acceleration pattern is the most important factor in racing itself (**Figure 1**). Other racing components are reaction time, block clearance, maintenance of maximum velocity and degree of deceleration.

The acceleration pattern should be one that is gradual and long. Most world class sprinters reach their maximum velocity between 60 and 70 meters. Since maximum speed can only be carried for one to two seconds, an athlete who accelerates too quickly will be decelerating over a longer portion of the last part of the race. The athlete should feel power in the acceleration phase. Too often, there is a tendency toward trying to be quick, sacrificing stride length and power for turnover. You must find the optimal stride length and turnover rate to allow for the greatest efficiency over the given distance of the race. An athlete who starts with a very quick turnover will accelerate too quickly and will begin to decelerate when others are still in their acceleration phase.

Reaction time and block clearance relate to the start. The athlete should be cued to movement at the sound of the gun. The movements at the start should be ones that allow the person to get into a running position, to allow the athlete to accelerate. There should be pushing off of both blocks with the shoulders rising to allow the hips to flex, as the arms drive up and back. It is most important to remember that the purpose of the start is to begin a race of a given distance (100 meters, 200 meters, 60 yards, etc.). The athlete cannot start with the idea of going as fast as possible as soon as possible. He must learn to get into the proper position to accelerate.

Maintenance of maximum velocity and the degree of deceleration will be products of how the first part of the race is run and the previous training. With a proper acceleration pattern and conditioning, the athlete should be able to maintain for 1.5 to 2 seconds. As the athlete begins to decelerate, relation should be emphasized. If the athlete tightens up, deceleration will increase.

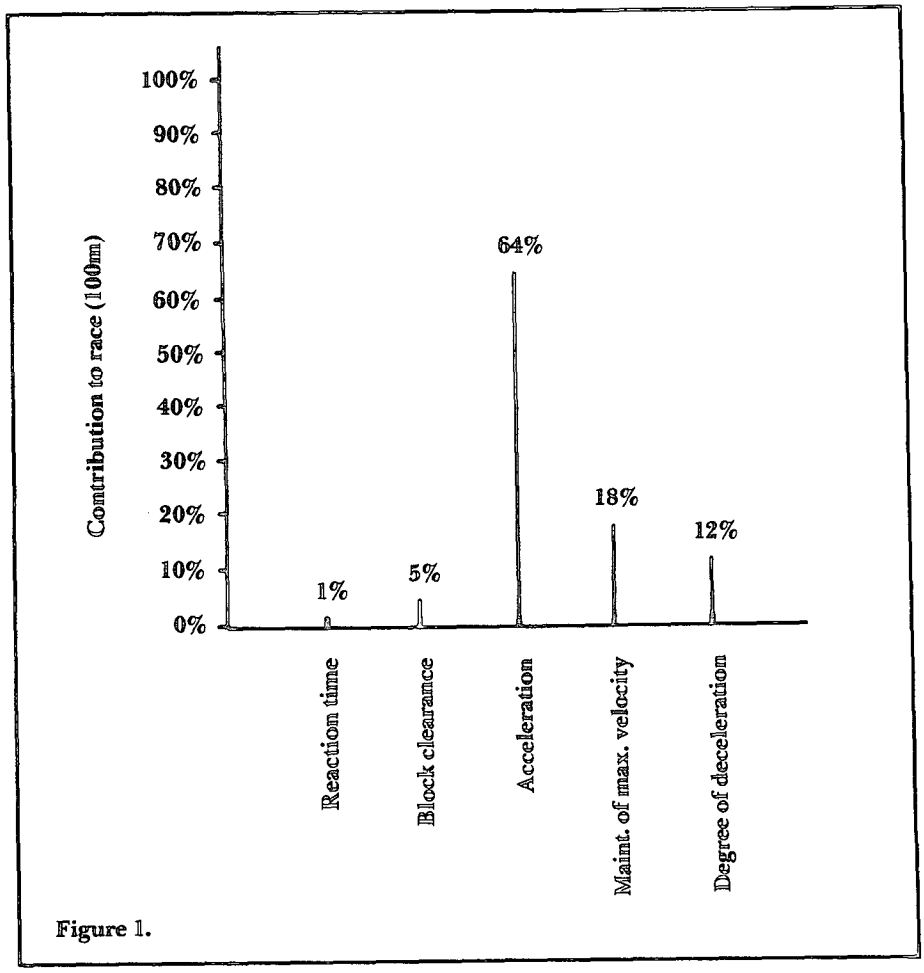

Figure 1.

Sprint Training

Again, the acceleration pattern will affect deceleration. The longer the acceleration, the shorter the deceleration will be. If the athlete accelerates too quickly, the deceleration period will be longer. The longer the deceleration period is, the slower the athlete will be going at the end of the race.

Practice set-up

Every practice, as well as competition, should be preceded and followed by an adequate warmup and warmdown.

A practical cycle must be set up. It should allow the athlete to work at a maximum level, allowing for adequate rest and recovery. There should be hard, medium and easy days. Hard days should not come back to back, as that will not allow the body to recover.

There are three basic phases of the year: Conditioning, Pre and Early Season, and Competitive. During the conditioning period, there should be three days of lifting and two of running. In the pre and early season, two days of lifting, two of running and one of resistance running are recommended. The schedule for the competitive period will include one lifting day with the other days taken by running, competition and rest.

During the conditioning period, long distance running (two to three miles) should be done to get the athletes into shape so that they can do the workouts later. While the aerobic system is of little value during the actual racing, the athletes must have a level of cardiovascular fitness to allow them to do the workouts. The distance running will also help to get the legs prepared for the harder running to follow.

In terms of planning workouts, it may be advantageous to set up a two-week schedule, trying not to repeat the same running workouts during that time. One problem with doing the same workouts every week is that the athletes tend to become bored or tired of the workouts. There are various workouts that can work the body in the same manner.

As you reach the final part of the season, you should have workouts that are specific to the competition to come. The short sprinters (60 yards and 100 meters) should work on their acceleration pattern, starts and technique. Four hundred meter runners should work on race pace and speed. If the 200 runners are 100 runners, they need to run some longer sprints (150m, 200m, 300m, etc.) to help them prepare. If they are 400 meter runners, they need to work on starts and acceleration patterns.

The coach should set a desired pace for all running sessions. Obviously, there will be times when you must make adjustments due to weather and other factors, but, in general, times for similar workouts should gradually decrease as the season goes on.

In the case of missed workouts, the coach should decide which sessions are the most important ones. If it is early in the year, the athlete should lift at least twice a week, with a day between. If the more important running workout is missed, it should be made up on the easy or medium day, in place of that day's workout, but the athlete should not have two hard workouts on consecutive days.

Strength training

At the University of Houston, strength training is an important part of our spring training, both off season and in season. We utilize periodization in scheduling workouts throughout the year. The different periods of training vary in length, load and intensity, depending on the purpose of the particular period. The exercises we use are primarily major muscle group activities performed with free weights.

Our primary training exercises consist of three types of lifts. The bench press is used to develop upper body strength, with the incline bench press as an alternative exercise. The back squat is used to develop strength in the legs and back, with front squats as an alternative. The third type of lift we emphasize is the power clean or snatch, which is a total body exercise, developing dynamic strength in the lower and upper body. The majority of effort in a workout is used on these three areas.

As secondary training exercises we have our sprinters train with arm curls, hamstring curls, stomach curls and bent knee sit-ups. These exercises isolate particular muscles that act as antagonists to those used in the primary lifts and require special exercises to avoid muscle imbalances.

There are three different type phases used in our cyclical approach to strength training. Phase one consists of low intensity and high quantity: for example, three sets of ten repetitions at approximately 60% of the athlete's single repetition maximum (1RM). This phase is used for four to six weeks at the beginning of our off season program to condition the athlete for strength training. The low intensity of this phase also allows for practice of proper lifting technique, which we demand from all athletes. Phase one is also used twice later in the year as a recovery phase for one to two weeks at a time.

Phase two is the main training phase, consisting of moderately high intensity and moderate quantity; for example, four sets of five repetitions at 75–85% of 1 RM. This phase is used four times throughout the year and lasts from four to six weeks.

Phase three consists of very high intensity and low quantity; for example, sets of one to three repetitions at 85–100% of 1RM. This is a peaking phase, which is used after phase two and in season when long, fatiguing workouts are not desired. This phase lasts only one or two weeks.

During phase one in the fall, our sprinters lift three times per week. This helps in three areas. A habit of lifting needs to be established early, and a system of every other day workouts lends itself to good habits. Frequent workouts in this phase get the athletes through the initial soreness period more easily. Third, a good technique base is formed in this phase.

Through the majority of the remainder of the year, our sprinters lift two days per week, along with one day of resistance running. Toward the end of the season, workouts may be limited to only once per week, depending on the competition and travel schedule. Late in the season, maintenance of strength is the goal.

There are definite benefits with the use of free weights in strength training for sprinters. Since free weights are not restricted in movement, as are machines, greater coordination is required in the exercises. This leads to strengthening of many supportive muscles that are not the primary movers in a given exercise. It helps to avoid bilateral strength imbalances. Research indicates greater carryover to athletics when strength gains are made with free weights.

There are certain dangers in weight training. Most of these are directly related to either improper lifting technique or unsafe conditions. During phase one of our training, technique is one of the primary goals. Strict lifting, or not using extra movements to cheat during a lift, is essential both for safety and maximum benefits of a particular exercise. An example of this is common in the bench press; if an athlete bounces the bar off the chest and then arches the back while pressing, the athlete is not only lessening

(Continued, page 66)

Teaching the Power Clean

hips prior to jumping, whether with a barbell or in a simple verticle jump. The most important concept for the athlete to learn is the shift of the balance from the center of the foot to the front of the foot.

The final portion to be learned is the simple task of raising the barbell from a starting position on the floor to the knees. The starting position is shown in **Photo 7**. Feet are flat, shank portion of the leg is inclined forward so the knees are approximately over the toes. Depending on femur length, it is generally suggested that the hips be slightly higher than the knees. Center of balance is near the front of the foot. The back is flat, shoulders over or slightly ahead of the bar when viewed from the side. Arms are straight and the head is in a neutral position. By simply activating the quadriceps and hip extensors, the bar is brought off the floor. A slight movement of the bar toward the shins is expected, which will usually result in a center of pressure (balance) change from the front of the foot to the middle. It is more important that the hips move upward only, guarding against the tendency to let the hips move rearward, which would place the center of pressure too close to the heels. This would lead toward a rearward motion of the shoulders and a general failure to execute a vertical jumping motion. One cannot jump upward efficiently when the balance is on the heels.

When the bar approaches the knees, the previously learned low and high block power clean movement is again used.

Depending on the skill level of the athlete, each of these various steps can usually be learned within 1–6 workouts. One can see how learning the power clean in a reverse order is extremely simple and effective. Along with the actual learning process being worthwhile, the use of low and high block power cleans also allows for increased variation in workouts, something which is critical for the advanced athlete in order to avoid physical and mental burnout.

While no lifting motion may replicate completely the sport motion necessary for a particular skill, the power clean is an outstanding example of how free weights can be used to approximate the leg and hip effort present in so many sports. It is a multiple muscle group exercise which can be used to train athletes in a short period of time, particularly in the case of an in-season circuit workout. When properly taught, the power clean is a safe and effective excercise for all athletes. ○

Photo 7. Starting position of the power clean.

Sprint Training

(Continued from page 36)

the overload on the muscles of the upper body, but is risking rib cage injuries, lower back strain and possible chest and shoulder injuries by loss of control of the weight. All lifts must be performed under control with the main effort coming from the intended muscle group.

Safe conditions in the weight room are aided by the use of spotters on all lifts, having equipment that is in good condition and the use of safety equipment, such as a squat rack, when possible.

An example of our periodization schedule:

September	Phase 1 4 weeks
October-November	Phase 2 5 weeks
November	Phase 3 2 weeks
November-December	Phase 2 4 weeks
Winter Break	Phase 1 3 weeks
January-February	Phase 2 4 weeks
February-March	Phase 3 3 weeks
(1 per week—indoor championships)	
March	Phase 1 2 weeks
April	Phase 2 4 weeks
May-June	Phase 3
(1 per week—outdoor championships)	

The periodization cycle is used only for the primary exercises. The secondary exercises are trained at a phase 1 level throughout the year. ●

Cybernetics

(Continued from page 33)

Also, we have found these instruments to be safe, portable and easy to operate. With appropriate training, a practitioner can learn the basic fundamentals of treatment within two weeks. Given the level of knowledge relative to physical therapy, athletic training, and strength and conditioning, there are no limits to what you may achieve.

The age of cybernetic electrotherapy is well-at-hand and I strongly urge you to beat your competition by learning how to apply these tools in the world of sport. Future research will want to concern itself with the following:

1) Time-efficient protocols for the care and treatment of athletic injuries;
2) Pre-stimulation techniques for optimal performance;
3) The application of the "Acu-sleep" procedure to enhanced concentration and skills acquisition;
4) Development of maintenance schedules for injury prevention and strength enhancement. ◎