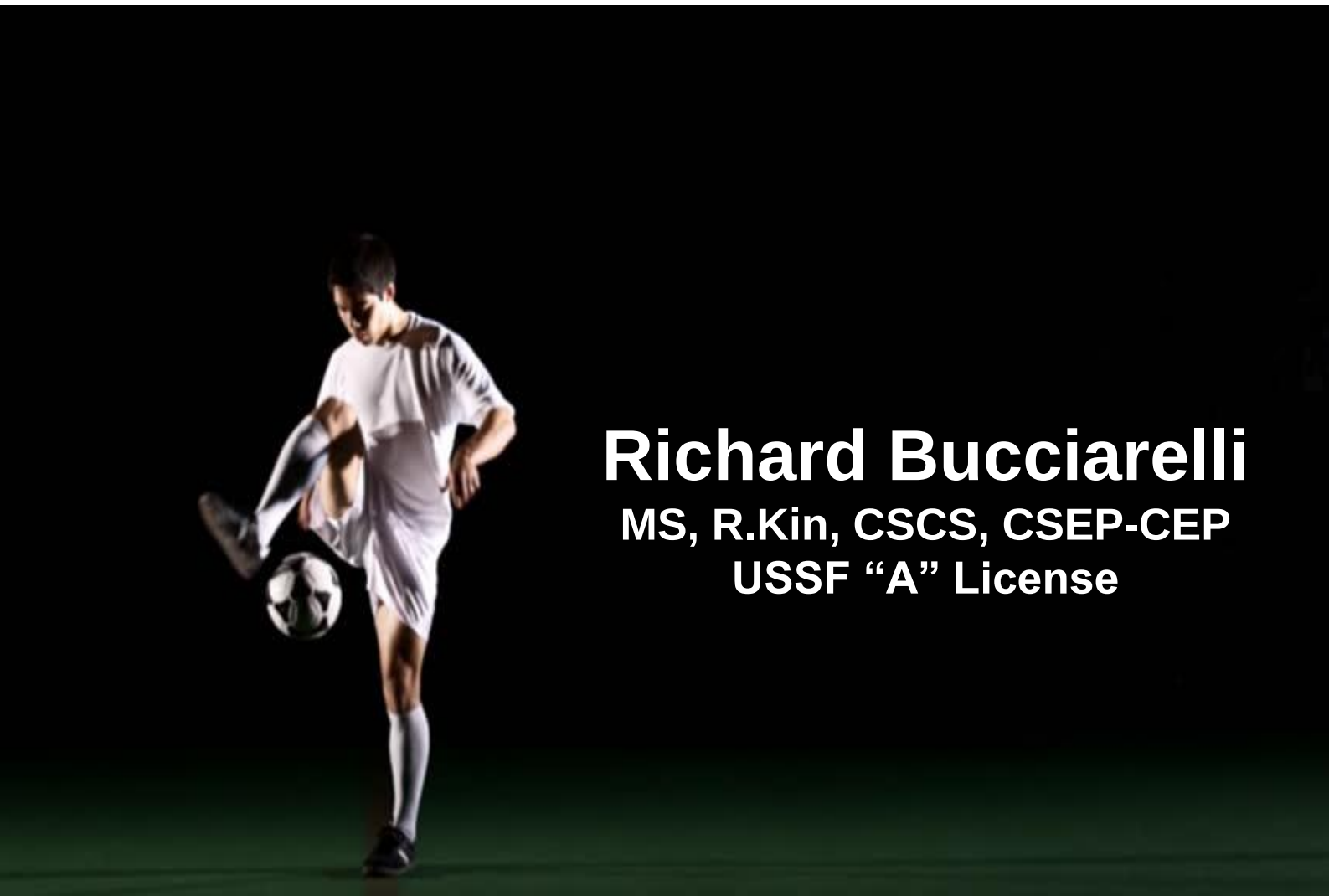
Speed Training for Soccer

By

SOCCER iQ FITNESS



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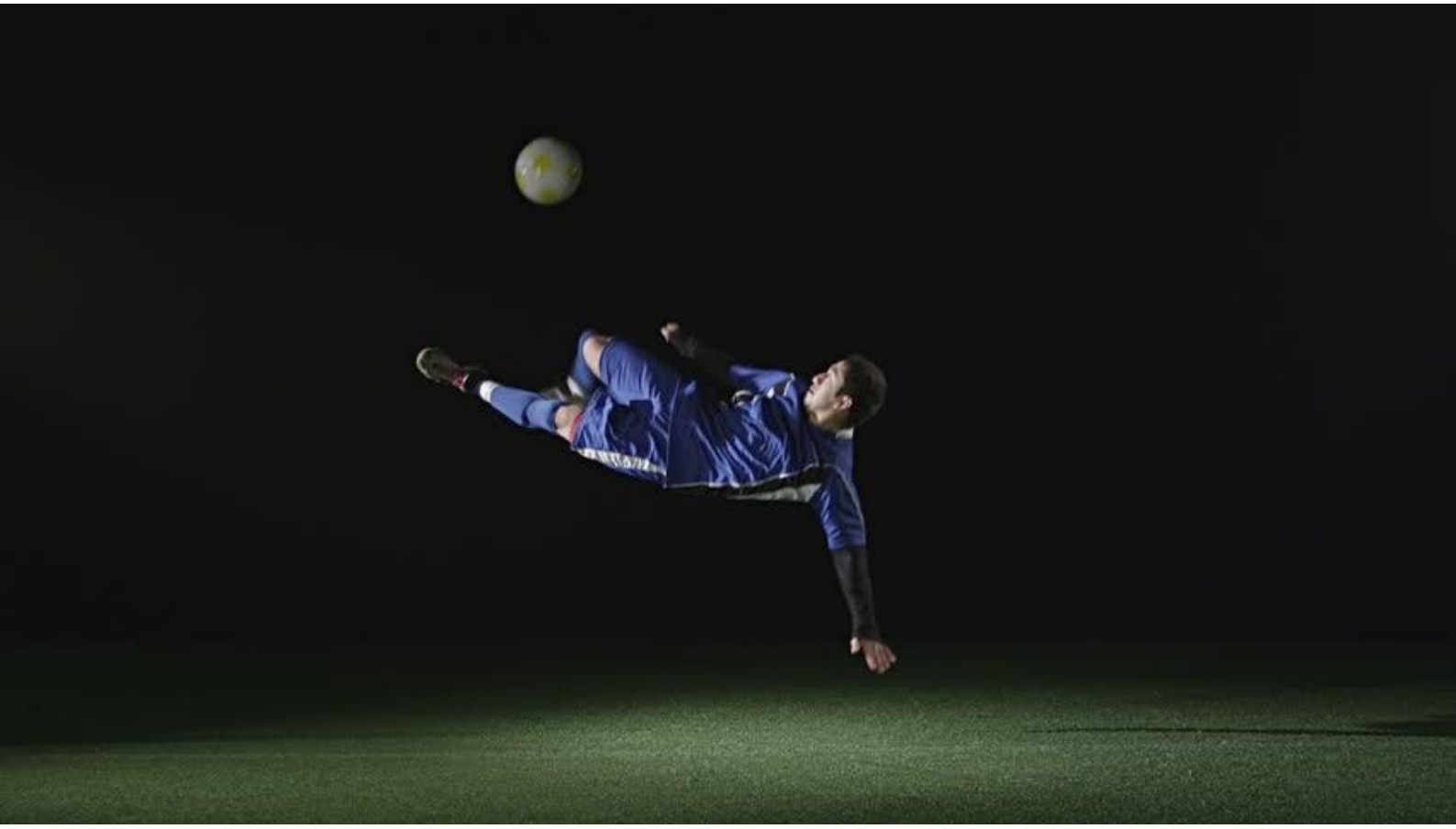
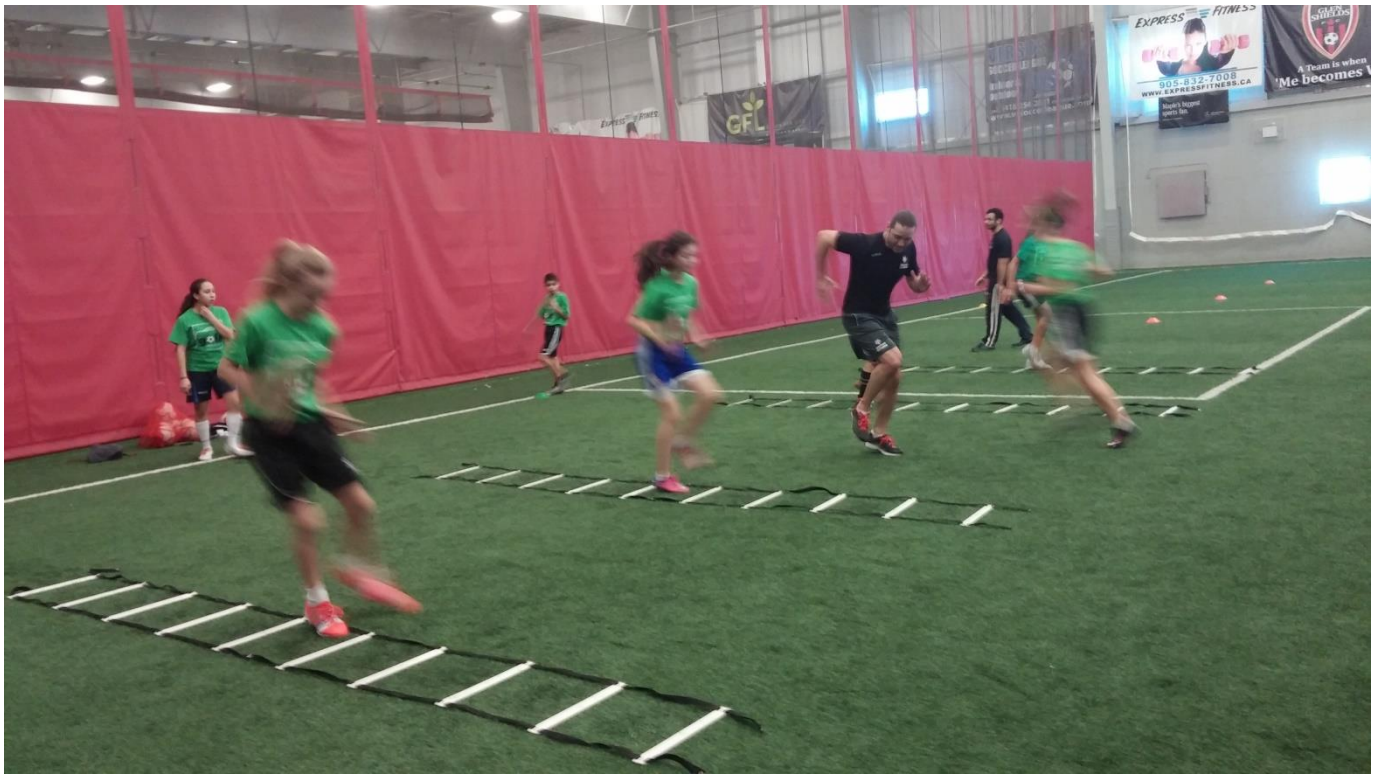
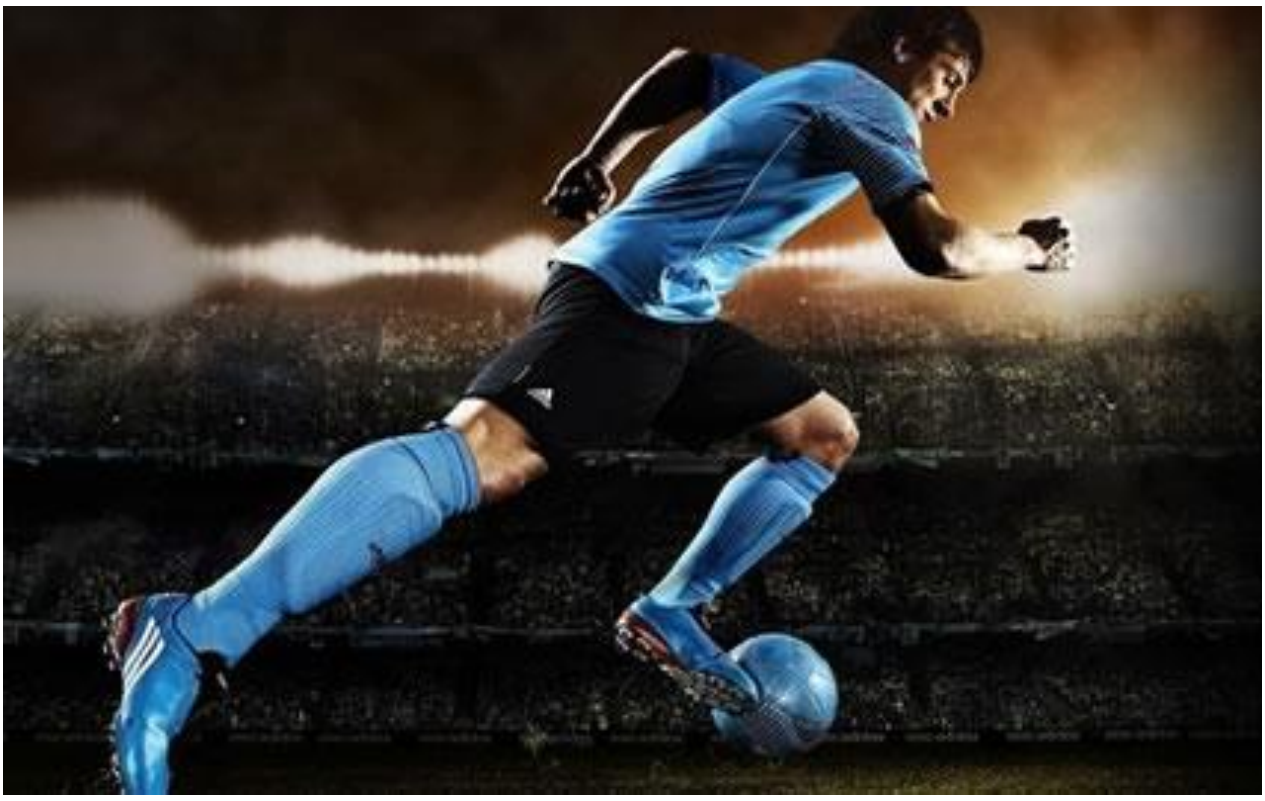


Introduction

I have been working as a fitness coach with elite level soccer players for 15 years. In that time, the one physical ability that seems to always have been of the highest importance to players, parents, and coaches alike, is running speed. Unfortunately, running speed – and how to train/improve it correctly – is probably also the most misunderstood physical ability in soccer. This 3-part article will provide a detailed summary of running speed and how to train to improve it. In Part 1, I will provide a definition of running speed, list the phases of a sprint in sports, and discuss what the scientific literature has to say about different methods of speed training. In Part 2, I will discuss the physiology of speed training, and finally in Part 3, I will shift focus to the biomechanics and specific coordination aspects of running speed.



Part 1

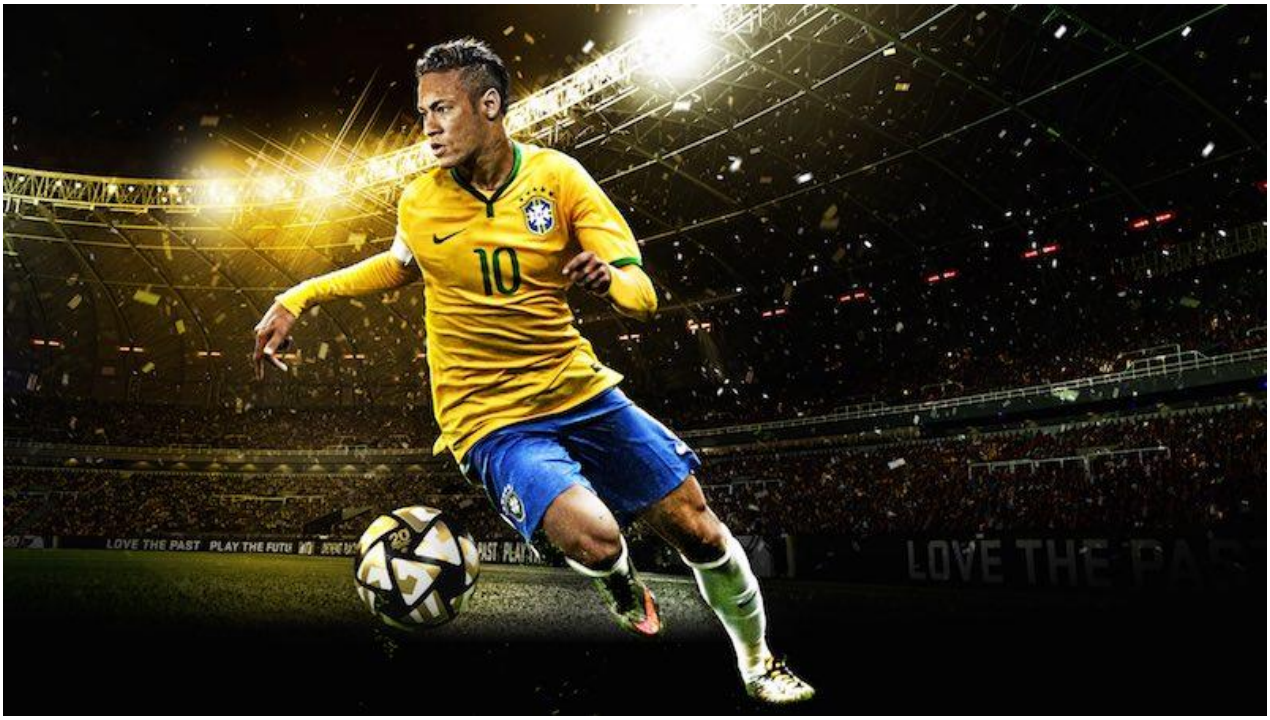


Running Speed Definition

Running speed is the product of stride length and stride frequency. Stride length refers to how long the running stride is, whereas stride frequency refers to how quickly the legs move over a given distance. In general, an improvement in stride length and/or stride frequency should result in an improvement in running speed.

Improving Stride Length

Stride length can be improved by making muscles bigger/stronger (strength training) and also by making them more powerful (power training). Strength training exercises like squats, lunges, and dead lifts, are simple and effective ways to make the muscles bigger and stronger, and numerous studies have demonstrated that resistance training programs that include these exercises can improve running speed in soccer players (Silva et. al., 2015). Power training includes explosive lifting exercises (like power cleans or hang cleans); plyometric (jumping and bounding exercises aimed at speeding up the time the foot is in contact with the ground); and also resisted running exercises (sled pulls, elastic loading devices, or incline running). Combining explosive lifting with plyometric training and resisted sprinting has been shown to be effective at improving both speed and jump height in post-adolescent soccer players (Lloyd et. al., 2015). Sled pulls have also been shown to be effective at improving short distance sprint speed in soccer players (Martinez-Valencia et. al., 2015). At Soccer Fitness, we have used high speed/high incline treadmill running to improve stride length. In one of our recent studies we were able to demonstrate an improvement in 10, 20, and 35 metre sprint times in elite female soccer players following a high speed/high incline running treadmill repeated sprint training protocol (Bucciarelli et. al., 2014).



Improving Stride Frequency

Stride frequency, as opposed to stride length, is a bit more difficult to train for. Training to improve stride frequency must involve some type of assistance provided to the runner in order to make the legs move more quickly that they can voluntarily (commonly termed "over-speed training."). Typical/traditional methods of over-speed training have involved downhill running (which uses the force of gravity to assist the runner) or elastic loading devices attached to a training partner (which use the force generated by the partner, as well as the stretch in the elastic loading device, to assist the runner). Assisted sprint training using an elastic loading device has been shown to improve short-distance (5-10 meters) running speed in elite level soccer players (Upton, 2011). At Soccer Fitness, we have used a high speed running treadmill with an un-weighting harness as a means of over-speed training, and we recently finished a study that demonstrated a significant improvement in 10 meter running speed following a training protocol with this equipment (Bucciarelli et. al., 2015).

Phases of Sprinting & Application to Training

A combination of strength training and power training (to improve stride length), and over-speed training (to improve stride frequency) can be used to improve running speed in soccer players. But what actual part of a sprint in soccer is affected by what specific types of training? To answer this question, an understanding of the different phases sprinting is required. There are 4 phases of a sprint in soccer, as well as in any other sport:

1. The start phase: the phase where the athlete begins sprinting (could be from a static start or a "flying" start)
2. The initial acceleration phase: the first 5-10 meters of the sprint
3. The carry-over to constant-speed phase: the period from the 15 to 30 meter point of a sprint, when the player reaches top speed
4. The deceleration phase: where the player begins to slow down/stop (this phase will not be discussed in this article).

The application of different types of speed training with the goal of improving these different phases of sprinting in soccer is where most coaches and fitness coaches make errors. This is typically because of a failure to understand which specific phase of sprinting is affected by which specific type of training. Strength training, and some types of power training (including explosive lifting, plyometric training, and resisted sprinting with sleds) are basically only effective at improving running speed in the start and initial acceleration phases of sprinting. In the start and initial acceleration phases, athletes are in a very low position, and the types of exercises that mimic this low position and add resistance to it (squats, power cleans, sled pulls) are the most effective at inducing improvements in the execution of movement from the position. Incline running, on the other hand, can be effective at improving the carry-over to constant-speed phase of sprinting, because this phase requires athletes to be in an upright position, with maximal range of motion in the hips and knees. When an athlete sprints up a hill or on an incline treadmill, they can maintain an upright posture, with the added resistance to the running movement coming from the incline itself. Over time, this leads to athletes developing the ability to overcome resistance while running in an upright posture, which translates a lot better into the carry-over to constant-speed phase of sprinting, an improvement which is impossible to achieve when adding resistance to an athlete in a low position. The absence of evidence linking strength training, explosive lifting, or sled pulls to improvements in longer-distance sprints (past the initial acceleration phase) supports the argument that these training methods are not likely to cause improvements in that phase of sprinting.

Quick Tip

Coaches and fitness coaches of elite level soccer players should always try to use a science-based approach when devising speed training workouts for their athletes. In order to improve soccer players' speed through all phases of a sprint. a wide range of exercises and training methods must be selected. Each of these exercises and training methods should be undertaken with a full understanding of which particular phase(s) of sprinting they will affect and (hopefully) improve. Failure to include exercises that focus on specific phases of a sprint will likely result in a lack of improvement in running speed during that particular phase.

Part 2

In Part 1, I provided a definition of running speed, listed the phases of a sprint in sports, and discussed what the scientific literature has to say about different methods of speed training. In Part 2, I will discuss the physiology of speed training, including best practices to maximize training effect while minimizing training volume. Finally in Part 3, I will shift focus to the biomechanics and specific coordination aspects of running speed.

Running fast and sprinting is, by definition, an anaerobic activity. This means that the intensity of the exercise (running/sprinting) is so high that the body cannot deliver energy to the muscles through the use and metabolism of oxygen (the aerobic system) and as a result, the anaerobic energy system must produce the energy needed to perform the runs/sprints. The primary anaerobic energy system used in sprinting in soccer is the anaerobic a-lactic system, because this system provides energy for high intensity work lasting from 0-10 seconds (basically the average duration of a sprint in soccer). The system is termed "a-lactic" because there is enough rest between sprints/high intensity runs to avoid the production of lactic acid, which is a painful by-product of high intensity exercise and not something that soccer players want to deal with.

The actual sources of energy in the anaerobic a-lactic system are 2 different high-energy compounds, adenosine tri-phosphate (ATP) and creatine phosphate (CP) located within the exercising muscles. Without getting into all of the details, it is important to know that as soccer players begin training or playing, they will start to perform high intensity runs and sprints, and when this happens, they will start to deplete the stores of ATP and CP in their muscles. When muscular ATP and CP stores get too low, muscular strength and power decrease significantly, and the only way to recover this strength and power is to rest, in order to allow the body to replenish its ATP and CP stores. Interestingly, the recovery of muscular ATP and CP is dependent not on the anaerobic system, but rather on the aerobic system. This means that soccer players who have a high aerobic capacity (better endurance) will be able to replenish their stores of muscular ATP and CP faster, and thus they will be able to recover better between fast runs and sprints, and eventually to perform more runs and sprints throughout a training session or match.

While the information presented above may seem complicated, having a good understanding of the physiology of sprinting in soccer is essential for proper speed training to be planned and executed. The most common mistake made by coaches and fitness coaches conducting "speed" training sessions with their players is that they do not allow the players enough rest between repetitions to facilitate the replenishment of muscular ATP and CP stores. When this type of "speed" training (with insufficient rest periods) is used, the athletes end up running at significantly lower speeds than their maximal capacity because, as mentioned previously, when muscular ATP and CP stores get too low, muscular strength and power decrease. Thus, the end effect of not giving players enough rest between sprints in training is that they actually end up training to be slower, not faster.

So how much rest between sprints is enough? The easiest way to explain planning rest periods between high intensity running and sprinting is to us a "work-to-rest ratio'" which describes the ratio of time spent "working" (running) to time spent "resting." In general, optimal recovery of muscular ATP and CP can occur with a minimum work-to-rest-ratio of 1:6. This means that if a sprint lasts 2 seconds, then 2 x 6 = 12 seconds of recovery is necessary before the next sprint; if a sprint lasts 5 seconds, then 5 x 6 = 30 seconds of recovery is needed, etc. Bangsbo et. al. (2006) provided a good review of the best way to structure speed training session, including optimal work-to-rest-ratios, as part of a weekly periodization plan for a professional soccer team.

Ultimately, improving running speed in soccer can only occur if players train by running/sprinting at or very close to their maximal capacity. Training at or near maximal capacity, in turn, can only occur if players are given enough recovery between repetitions of runs/sprints to allow for replenishment of muscular ATP and CP stores. Coaches and fitness coaches who wish to improve their players' running speed must have a good understanding of the physiology of speed in soccer, and plan the work-to-rest ratios in their training accordingly.

Part 3

In Part 2, I discussed the physiology of speed training, including best practices to maximize training effect while minimizing training volume. Finally in Part 3, I will shift focus to the biomechanics and specific coordination aspects of training for running speed. In this part, I will present information as it applies to each of 4 phases - Start Phase, Initial Acceleration Phase, Carry-over to Constant-speed Phase and Deceleration Phase.

The Start Phase

Recall that, in the definition of this phase above, it may begin from a static start (no movement) or from a "flying start" (athlete already moving, and then speeds up). Typically, in soccer, players begin sprinting while already in motion (the "flying" start). They may start from a walking or slow running start, or they may speed up into a full sprint after already having been running at a moderate or high speed. In any event, the optimal mechanics to maximize force production during the start of a sprint do not change very much, regardless of how the athlete begins running. In general, the following coaching points should be used when training soccer players for the start phase of a sprint:

1. Stay as low as possible. This allows for optimal range of motion of the powerful hip and thigh muscles (glutes, hamstrings, quadriceps, and hip flexors), so that the propulsive forces from these muscles can be maximized. For a good visual, think of a sprinter in a track and field event, starting out of the blocks. Of course, in soccer and other sports you must start from an upright position, but getting low at the start mimics this type of starting position. Another useful hint to achieve a good initial low position is to tell players to think of "falling forwards". Right before their nose hits the ground, they should begin moving and start the sprint, thus allowing themselves to get into a low position and stay there for the first few strides.

2. Widen the stance slightly and point the toes slightly outwards. This widens the "base of support", which allows for more balance, and thus more force production. For a good visual, think of the initial stance a sumo wrestler takes prior to starting a wrestling match.

3. Keep the head down, and exaggerate the knee lift, and the arm swing movements. Try to lift the knees so high that they almost contact the chin (don't actually do this, just keep the head down and the knees up!). At the start of a sprint, as in any other phase of a sprint, the general rule is that a longer stride will be faster than a shorter stride. The more the knees come up at the start, the longer the stride will be. An arm swing that is also longer will help to add range of motion in the hips.

The Initial Acceleration Phase

In this phase, the optimal mechanics to maximize force production do not differ very much from those in the start phase (aside from a few exceptions). In soccer, the average distance of a sprint often falls within this range (5-10 meters) so the way players run in this phase is critical to their match performance. Below is a summary of the coaching points for the initial acceleration phase:

1. Continue to stay as low as possible, but bend both at the hip and the knee. A common mistake that players will make when they are told to "stay low" is to bend only at the hip, while keeping the knees relatively straight. This forward leaning posture makes it very difficult to raise the knees, and will end up shortening the running stride. Typically, I will ask the athletes I work with to start by running with their trunk at a 45-degree angle to the ground, and gradually increase that angle to 90-degrees (trunk perpendicular to the ground) by the 10 meter mark.

2. Gradually narrow the width of the feet and "base of support". Recall that, in the start phase, a wider stance allows for greater initial balance and thus, power production. In conjunction with the angle of the trunk to the ground starting at 45-degrees and progressing to 90-degrees, so too should the width of the "base of support" start wide, and progress to being much more narrow. This is because after that start phase, the feet must contact the ground closer to underneath the center of mass, in order to maintain stability as posture becomes more upright.

3. Focus on contacting the ground on the balls of the feet, or "big toes." This type of foot contact is important to bring the powerful muscles of the lower leg (gastrocnemius, soleus) into play to maximize propulsive forces. Sprinting on a flat foot or even worse, on the heels, significantly limits the force production of these muscles. The toes should also progress from an outward pointing stance at the start phase, to a forward pointing stance at the end of the initial acceleration phase.

The Carry-over to Constant-Speed Phase

In soccer, there are also several times during a match that players must make runs that progress into this phase (at distances greater than 10 meters). This phase is also the point at which some more pronounced changes in running mechanics must occur in order to maintain optimal production of propulsive forces (and avoid slowing down). The best way to train soccer players to perform during the carry-over to constant-speed phase is to focus on the following areas:

1. Maintain an upright posture, with the trunk perpendicular to the ground. This position maximizes hip flexion (raising the knee) and thus allows for the maximum length of the running stride. For a good visual, imagine how hard it is to lift the knee while bending forwards, versus how easy it is to lift the knee while in an upright position. Staying perpendicular requires the hips and pelvis to be pushed slightly forwards, with contraction of the core and abdominal muscles.

2. Flex the hips (raise the knees) to the point at which they are in line with the hip. While this happens, the ankle should be very close to directly underneath the knee. All of these mechanical adjustments must be made in order to allow the hip to move with the greatest amount of range of motion while flexing and extending, and also so that the powerful muscles of the hip, knee and ankle can contract with extension with maximum force as the foot drives into the ground. For a visual of how this powerful hip, knee, and ankle extension should look, think of a cat, pawing at something on the ground (the hip/knee/ankle extension should look just like this powerful pawing movement, and this movement ends with the ball of the feet, or “big toe” on the ground).

3. Keep the shoulder muscles relaxed, with a loose-swinging arm action. The thumb of the front hand should move in front of the chin, and the thumb of the back hand should move behind the hip (“back pocket”). A relaxed arm action allows for optima range of motion and power production in the hips, because the movement of each arm is directly coordinated to the movement of the opposite leg (for example, right arm and left leg, and vice versa). To train the relaxed arm swing, I have athletes imagine they are “whipping” the hands back to the “back pocket.” There is a natural stretch reflex that occurs in the muscles in the front of the arm, whereby when they are stretched, they contract and move forward.

The Deceleration Phase

In soccer, almost all sprints have a deceleration phase (where the player slows down), and this deceleration typically does not happen very gradually. As a matter of fact, decelerations from sprints in soccer are a critical component to optimal performance, as many of the key movements in games (striking/shooting, dribbling or defending in 1 vs. 1 situations, landing from jumps) involve rapid decelerations followed by just as rapid accelerations. Thus, coaching deceleration technique from sprints in soccer is vital to optimal performance of sprinting in soccer. Below is a summary of the best advice to give players regarding the deceleration phase:

1. Take small steps to slow down. This may sound self-explanatory, however, if you don't explain it to your players, they may not do it and the result will be a much slower deceleration and change of direction. Small steps allow for the feet to be placed under the body's center of mass while running sped decreases, which increases balance and stability and thus, increases the eccentric strength of the muscles hat slow the body down (primarily the quadriceps and hamstrings).

2. Bend at the knee to slow down. Trying to slow down or to change direction with a straight knee in soccer is asking for trouble. bending at the knee allows for the strong muscles in the front of the leg (quadriceps) to maximize their eccentric strength, and thus the braking forces they produce.

3. Stay relatively narrow and keep the toes pointing forwards while decelerating. A narrow stance and "base of support" with the toes pointing forwards (rather than outwards) will allow decelerations to occur as quickly as possible. The only way to maintain balance as speed decreases is for the feet to be placed under the hips, and thus a narrow stance allows for better balance and better ability to decelerate.

Conclusion

In conclusion, as I mentioned at the beginning of this article, training for speed in soccer is a complicated process, with a variety of different factors that must be taken into consideration when planning a training program. Coaches and fitness coaches who wish to improve their players' speed must have a strong working knowledge of the different phases of a sprint and how to train for them, including both the physiological, as well as the biomechanical aspects of sped training. With the right knowledge, experience, and attention to detail, coaches and fitness coaches can train their players to improve their running speed, which will likely have a direct positive impact on their overall match play.

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