The Sprints

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Introduction

Until about 1960, the consensus was that sprinters are born not made; you either have the ability to sprint or you don’t. Only with Armin Hary (FRG), the 1960 Olympic Champion over 100m, and particularly with Valeriy Borzov (URS), the 1972 Olympic Champion over 100m and 200m, was there a realisation that even the most talented sprinters could be developed beyond what was previously accepted so as to reach their true potential when performance was most important (DOHERTY, 2007). With this, the traditional view of the sprints as simple, natural events has been replaced by the understanding that sprinting is a skill, which has to be learnt. Today the sprints are therefore regarded as technical events.

Moreover, analysis of the sprinting action shows that there are significant differences in technique between today’s top sprinters and medium-level sprinters (SEAGRAVE, 1996; VONSTEIN, 1996).

The purpose of this paper is to provide an overview of the main aspects and discussion points around this discipline as a starting point for more detailed study. The points covered will be:

• history;
• some physiological and neuromuscular aspects of sprinting;
• sprinting mechanics;
• sprint striding technique;
• race phases;
• training.

History

First races and records

Racing short distances has been described in the literature of almost every people. There are artefacts proving that sprinting was included in the ancient Greek Olympics. Interestingly, excavations at Olympia, Delphi, Corinth, and other cities of the ancient games have revealed well thought out devices for achieving a fair start - the toughest problem in sprinting. For example, at the Delphi stadium, 20 blocks of marble for starting are now in place. In each there are two grooves in which the racers set their feet, and adjacent to those grooves, a socket, in which a so-called “husplex”, i.e, a post and arm was set. A string went from each arm to the starter's pit. By pulling all strings at once, the starter could lift the arms together and release the sprinters (DOHERTY, 2007).

Modern sprint races have their origin in professional racing, which was prevalent in England during the 19th century (DOHERTY, 2007). At first, various methods for starting co-existed in a rather hybrid fashion until eventually the inconveniences attending the start “by mutual consent” (contenders often tried to “out-fox” each other by resorting to various stratagems, thus delaying the start sometimes over an hour) finally led to the idea
of using a pistol. In 1887, the American Charles Sherrill was the first to use a crouch start.

The times of early races were recorded under most difficult circumstances and for several decades there were the oddest minimum fractions: halves, quarters and, only later, fifths of a second. According to QUERCETANI (2006), the question as to who was the first to break 10 seconds for 100 yards is still subject to debate among historians. Some favour American John Owen, who at age 29 was credited with 9 4/5 sec at the AAU Championships held at Analoastan Island, Washington, DC, on 11 October 1890. This time, registered on three watches, was later accepted by the AAU as the official US record. Others tend to accept the authenticity of an unratified 9 4/5 sec achieved by another American, Victor Schifferstein, at a meet in St. Louis on 9 September 1888. QUERCETANI points out that three years earlier, in Melbourne on 7 February 1885, Irishman Thomas Malone achieved an even faster 9 3/5 sec but doubts its credibility. The first sub-10.0 performances for the 100m were achieved by Jim Hines and Ronnie Ray Smith, both USA, in Sacramento on 20 June 1968 (MEGEDE, 1987).

Development of starting techniques

According to DOHERTY (2007), techniques for foot placement in the starting holes, a high support on the fingers, and an effective ‘set’ position were all worked out in the first decade of the 20th century. Starting blocks were introduced in 1928-29 to facilitate more reliable starting (PARRY et al., 2003). Early in the 1930s, the so-called ‘kangaroo’ start, also known as the ‘bunch’ start because the feet are close together, was developed. DICKINSON (1934) proved that this position was faster than any other for clearance of the blocks and by the 1950s it was the most common of all starting methods (DOHERTY, 2007).

Today, there are basically three block placement positions relative to the starting line in use:

1. The ‘bunch’ start (front block approx. 40.5 cm from the starting line, with approx. 28 cm between blocks). Characteristics: Allows fast block clearance but produces low velocity, because the athlete spends very little time producing force.

2. The ‘medium’ start (front block approx. 53.5 cm from the starting line, with approx. 40.5 cm between blocks). Characteristics: Allows the athlete to start with high velocity, because of extended time for applying force to the blocks.

3. The ‘elongated’ start (front block approx. 53.5 cm from the starting line, with approx. 66 cm between blocks). Characteristics: Although it allows the greatest application of force, this start also requires tremendous strength and is therefore not advantageous for most athletes.

According to GAMBETTA et al. (1989), the ‘medium’ start is the most generally recommended starting position.

Development of finish techniques

According to DOHERTY (2007), experimentation with finishing technique started early in modern sprinting. By 1900, Arthur Duffy of Great Britain had invented the ‘lunge’ finish, which consisted of throwing the body forward with the chest out and the arms far down and back. American Bernie Webers tried to improve Duffy’s method and developed the ‘shrug’. This was accomplished by throwing one side of the body into the string with one hand held high, and the other held back behind the body. The forward lean of the ‘lunge’ was maintained but the tape could be broken roughly 12cm sooner, since the side of the body could be brought that much nearer the string than the chest. As far back as 1904, J.W. Morton attempted a ‘throw’ at the finish. About 20 yards from the tape he took a long breath, pulling himself together for a final effort. In the case of a close finish, at about eight feet from the tape he threw himself off the right leg, striking the tape with the left breast and
saving himself from collapsing with the left leg. During the 1920s, Charley Paddock (USA) made occasional and successful use of a full jump at the finish.

Some physiological and neuromuscular aspects of sprinting

The primary energy system used in events of 100m or less (or up to 15 sec duration) is the ATP-PC system (adenosine triphosphate – phosphate creatine). In events longer than the 100m (or 15 to 40 sec) the main system is ATP-PC + lactic acid. The oxygen or aerobic system plays little part in sprint performance; it is, however, a factor in recovery (GAMBITTA et al., 1989). In the 200m, for example, the energy system percentage requirements are estimated at: phosphate – 30%, lactic – 60% and aerobic – 10% (ROBINSON, 1997).

Although the sprints are regarded as technical events, speed is, more than the other physical abilities, genetically determined. Olympic sprinters have a greater proportion of type II fibres (also called fast-twitch fibres) than the average person, in excess of 60% in the propulsive muscles of the legs. Type II fibres can be classified into IIa fibres, oxidative glycolytic, and IIb fibres, which are the ultimate speed producers and rapidly fatigue. The structure of any specific muscle is not definitive. Each muscle has both fast and slow fibres but contains what is known as ‘bridging fibres’. These are fibres that can be trained to undertake a specific role. Should the muscle be conditioned to work slowly, then those fibres will be transformed into type I (also called slow-twitch fibres). Should they be conditioned to work quickly then they will undertake that role, i.e. they will develop into type II fibres (PAISH, 2002).

However, the preponderance of type II fibres alone will not produce speed; the muscles also need to have the appropriate fast-acting nerve supply, which is also a genetically determined trait. The neuromuscular system recruits appropriate motor units and develops the coordination needed for the high rates of firing that occur. This system is maximally taxed in sprint training (GAMBITTA et al., 1989).

Sprinting mechanics

For sprinters, muscle power, neurological innervation, and length of limbs are the most important factors to consider. These factors affect the two main components that determine running velocity: stride length and stride frequency.

Stride length

Stride length is governed by the power the sprinter exerts during the ground contact period. Stride length in turn has an effect on the angle of force to the ground. When sprinters overstride, or place the landing foot too far forward of their centre of mass (CM), they create braking forces that slow them down. Although in principle, it is useful for sprinters to try to lengthen their stride, by overstriding they may actually cause their stride to shorten. The best way to improve stride length is not by changing technique but rather by improving the ability to produce power. Natural increases in stride length occur when greater power is applied to the ground due to improvements in stride frequency.

Stride frequency

Stride frequency depends on the functioning of the central nervous system (the firing ability of the nerves stimulating the muscles), the muscle fibre type, and the length of the limbs. The more FT fibres a sprinter has, the greater stride frequency he or she can attain. Shorter limbs can move with greater frequency. Longer limbs have a lower frequency. Short sprinters therefore typically run with a very powerful stride and on average run short races faster. Most tall sprinters run faster in the longer sprint races, in which both speed and endurance are needed (COH & TOMAZIN, 2005; FRYE, 2000).

The ratio between stride frequency and stride length is unique to each individual and
automatised (i.e., the higher the frequency, the shorter the stride length, and vice versa). Maximum running velocity is the result of an optimal ratio between the stride length and frequency. In biomechanical terms, sprinting is a cyclic movement with central neuromuscular regulation, which also manifests itself through the peripheral locomotor system (COH & TOMAZIN, 2005).

**Sprint striding technique**

**Traditional versus modern sprinting technique**

In traditional coaching theory and practice, the emphasis is on the driving phase of the legs behind the body's CM. This way, the body is pushed forward by an extension of the hip, knee and ankle joints. Speed, therefore, is limited mainly by the strength of the extensor muscles of the thighs (m. quadriceps femoris). However, VONSTEIN (1996) holds that this approach disregards the results of technique and functional-anatomical analyses, which show that the “braking phase” that takes place in front of the CM is actually more important for producing maximal velocity than the striding phase taking place behind the CM. In fact, today's top-class sprinters running at maximum velocity typically exhibit a technique that differs slightly from traditional sprint theory. The differences are particularly significant in the maximum-velocity phase of the race. According to TIDOW & WIEMANN (1994), modern sprinting technique can be described as follows:

- the sprinter's body position is almost upright; the athlete has the appearance of running ‘very tall’;
- a relatively high knee action is followed by a very active striking or clawing movement of the foot on the track;
- there seems to be only a slight knee extension. However, the ankle and especially the hip joints are fully extended.

DICK (1987a) calls this technique, which was well illustrated by, for example, Carl Lewis, Linford Christie, Irina Privalova, and Florence Griffith-Joyner, the ‘sprint lift’ and describes it as follows: “The leg action is characterised by a high lifting/prancing effect. It is a light, fast movement that is associated with a quicker, more active and lighter striking/clawing movement of the foot onto the track.” (p. 40)

In addition to a very tall posture with a slight forward lean and an active foot plant or a foot that is moving backward under the body upon landing, FRYE (2000) identifies the following criteria of an effective technique:

- high heel recovery as the drive foot leaves the ground;
- a support foot that touches down as close as possible to a point under the CM;
- the ankle of the forward swinging leg should cross the support leg above the knee;
- arms that are bent at the elbow, swing backward as if reaching for the hip pocket, and swing forward to a chin position into the midline of the torso without crossing the mid-line;
- relaxed hands, shoulders, neck, jaw, and face;
- a dorsally flexed ankle joint (toe up) just prior to the foot landing;
- an erect head with the eyes focused on the finish line;
- a run on a straight line with very small amount of lateral movement.

**The importance of the support phase**

The fact that it is ground reaction forces that enable an athlete to sprint implies that only when the foot is on the ground during the supporting phase that forces can act and thus influence horizontal velocity. Therefore, the quality of the ground contact or support phase is critical to sprinting. The support phase has to be as short as possible with an optimal ratio between the braking and propulsion phases (COH & TOMAZIN, 2005). The importance of the support phase was also shown by WEYAND et al. (2000), who conclude that runners reach higher top velocities not by repositioning their limbs more rapidly in
the air, but by applying greater forces to the ground (see also JAKALSKI, 2002).

An effective support phase is characterised by small negative forces and large positive forces. Since, from a subjective point of view, the ground is moving backward while the body is moving forward, negative forces can be small only if an athlete succeeds in synchronising his leg/foot speed and direction with the ‘ground speed’. According to VONSTEIN (1996), an optimal foot movement has a curve like a ‘kidney bean’. The foot curve and direction is closely related to the body’s posture, which depends on the position and stability of the pelvis. If the pelvis is tipped backwards, or if there is too much forward lean, sprinting at maximum speed is hindered because there is an increase of negative forces. Instead of leaning forward, the athlete should:

• run tall;
• keep the pelvis upright;
• maintain a good tension in the abdominal and dorsal muscles;
• move from the hip and knee joint with an active striking or clawing foot movement.

The recovery phase

Shortly after the toes of the driving foot leave the ground, the thigh begins an accelerating swing forward, then upward, which, according to DYSON (1986, p. 111), “increases the forward force exerted by the ground, thus increasing the speed with which the centre of gravity is moved away from the supporting foot.” According to DOHERTY (2007), this is perhaps the source of the value that some coaches place on bringing the leg forward quickly and forcefully, with the thigh high and the foot reaching forward. By the time the foot reaches the ground, the body has moved forward so that the CM is above the foot.

Race phases

Traditionally, sprint races have been divided into four phases (GAMBETTA et al., 1989)

1. Reaction time - the time between the firing of the gun and the start of muscular reaction to it.
2. Acceleration - the rate of speed increase from the starting position to the attainment of maximum speed.
3. The maximum-speed phase - consists of the rapid repetition of neurophysiological actions and reactions.
4. The decreasing-speed (speed-endurance) phase - the portion of a sprint race where either neuromuscular fatigue or metabolic fatigue causes the sprinter to slow down.

In addition, DICK (1987b) has coined the term ‘pick-up acceleration’ for the 30 to 60m section of the 100m. The pick-up acceleration phase represents the transition to maximal velocity and is characterised by stabilising stride length and contact times that are shorter than the flight phases (COH et al., 2006).

The importance of the acceleration phase

Acceleration ability is regarded as the parameter with the greatest influence on competition results (STEIN, 1999). Sprinters can only run at the velocity to which they have accelerated, or to put it the other way round: maximum velocity is always the result of the previous acceleration phase. For elite sprinters, the distinction between initial acceleration (immediately following the start) and pick-up acceleration (from 30 to 60m) is particularly important and several studies have shown that this phase is a decisive performance factor in the 100m.

For example, BARTONIETZ and GÜLLICH (1992) showed that within a homogeneous group of highly qualified sprinters the superiority of the fastest is most marked in the pick-up acceleration phase. Comparative competition analyses by VONSTEIN & LEHMANN (1996) showed that absolute top sprinters are differentiated from German sprinters mainly by a better pick-up acceleration and a higher and longer period of maximum velocity. Although the acceleration performances of the German sprinters were above average, their pick-up acceleration performances up to 60m and their maximal
speed performances up to 100m were below average. According to MICHEL (2001), world-class sprinters clearly demonstrate their superiority in the pick-up phase with a ‘rocket-like’ acceleration after the first 10 to 15m. Although well-developed speed endurance plays an important role in sprint races, lack of it can be compensated for by strong pick-up acceleration in the second phase of the start.

According to FRYE (2000), the technical model during the acceleration phase, including the start, should have the following characteristics:
- Acceleration is achieved by driving or pushing with the drive leg, which requires a good forward lean from the ground up (the amount of lean an athlete exhibits is directly proportional to acceleration. If a line is drawn from the foot of the drive leg through the CM, that line also should extend through the shoulder joint and head and should be at approximately a 45° angle from the ground);
- The free leg drives low and fast to place the foot down under the body and may even fall behind the CM depending on how quickly the athlete accelerates (without proper acceleration the athlete will stumble because of his or her extreme forward lean);
- The heel recovery of the drive leg will be very low coming out of the blocks in order to get the foot down fast so as to drive again and overcome inertia;
- With each succeeding drive step, the athlete’s speed increases until he or she reaches top velocity;
- Along with the stride-by-stride decrease in acceleration, the athlete’s heel should rise higher as he or she gets into the normal sprinting stride;
- The arm action during the acceleration phase is similar to that during the sprint striding phase;
- As the athlete moves from the acceleration phase into the normal stride, the technical model for the sprint striding phase applies (running tall!).

The finish phase
As a poorly timed lunge at the finish can cause the athlete to lose a close race, FRYE (2002) suggests that the following characteristics of a proper finishing technique should be striven for:
- The athlete maintains good sprint posture and a normal stride action through the finish line;
- The athlete maintains the same sprint stride as in the middle of the race;
- Good ankle dorsal flexion is maintained;
- The landing of the foot is moved backward under the CM;
- The athlete keeps his or her strides quick instead of long;
- The vigorous drive of the arms is continued;
- As the athlete reaches the finish line, he or she lunges forward in order to lean at the tape (this must be done just as the athlete takes his or her last stride through the finish line);
- There are two leaning models: a) the athlete steps onto the finish line with the head lowered and both arms thrust backward to create a forward falling action, b) 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).

Training
Today, it is generally accepted that sprinting performance, like endurance or strength performance, can improve considerably with training. Strength training plays a key role in this process and specialised strength training is particularly important for sprinters. Maximum-strength training with repeated maximal strength applications (especially in terms of intramuscular coordination) should initially precede special speed-strength development. In the subsequent transition phase, dynamic force application methods must have priority. These methods can be complemented by particularly effective variations of plyometric strength training (STEIN, 1999).
According to DELECLUSE (1997) the powerful extensions of the hip, knee and ankle joints immediately following the start action are the main accelerators of the body's mass. However, the hamstrings, the m. adductor magnus and the m. gluteus maximus, make the most important contribution in producing maximum speed. Different training methods are proposed to improve the power output of these muscles. Some aim for hypertrophy and others for specific adaptations of the nervous system. This includes general (hypertrophy and neuronal activation), velocity-specific (speed-strength) and movement-specific strength training (sprint-associated exercises). Energy expenditure during the foot-ground contact phase is less when the resultant muscle forces applied culminate in large horizontal forces at the foot-ground interface with little or no energy being used to control unnecessary movements or muscle force imbalances. Thus, using resistance training to prevent unnecessary movements of core regions of the body (the pelvis, for example) and to minimise muscle strength imbalances reduces energy expenditure and ultimately improves sprinting velocity, efficiency, or both.

A second way to increase running velocity is to improve the power-producing ability of the muscles responsible for providing force against the ground. Because power is a function of both force and velocity (or strength and speed), increasing an athlete's strength should improve the ability to produce power. Resistance training can be an effective method for improving strength. Given that adaptations to resistance training have been shown to be specific to the exercises used, those that mimic sprinting technique may be more beneficial than 'traditional' resistance-training exercises (BLAZEVICH, 2000).

When developing training strategies, it should be kept in mind that strength, power and speed are inherently related, because they are all the output of the same functional systems. As heavy resistance training results in a fibre type IIb to fiber type IIa conversion, the coach has to aim for an optimal balance between sprint-specific and non-specific training components. To achieve this, the specific strength training demands for each individual, based on performance capacity in each specific phase of the sprint, must be taken into consideration (DELECLUSE, 1997).

DONATI (1996) states that the main aim of strength training for sprinting should be to stimulate and develop the neuromuscular recruitment capacity, rather than to build up massive muscles. From this point of view, long weight training sessions are a mistake; much more emphasis should be placed on faster exercises using only the body weight as resistance. Moreover, the traditional exercises used in strength training have little in common with the actual movements of running. They are useful in building up a foundation of muscular strength but they do not develop the ability to recruit the maximum possible number of fast-twitch muscle fibres. Therefore, special ‘associated’ exercises, which more closely reproduce the movements of running and which can be modulated to improve stride length or stride frequency, should be added to the training programme (see also GARDINER, 2005).

The training of acceleration ability

In an investigation of the capacities of world-class sprinters based on evaluation of their velocity-distance graphs, LETZELTER (2000) showed that the development of sprint strength should have a particular focus on the improvement of starting and pick-up acceleration. STEIN (1999) holds that the relevant muscle groups must be taxed at the highest intensity for the optimisation of acceleration ability. The decisive parameter to be developed is the specific speed-strength level, which must be based on a very high level of maximum strength. Horizontal jumps have a particularly beneficial effect. Short jumps, such as ankle jumps, one- or two-legged single, triple or five jumps are as effective as long jumps, i.e., bounding runs up to 80m, or resistance jumps. Furthermore, it is important...
that the acceleration distances in training must be such that maximum velocity is reached. This means that distances of about 20m may be sufficient in youth training, but at elite level the distances should be between 45 and 60m. As the energy for these efforts is supplied by the anaerobic-alactic system, the efficiency of which is highly dependent on the length of the rest periods, the number of repetitions and repetition series must be kept low (1 minute rest for each 10m run). Resistances must also allow the typical competition movement structure to be maintained.

The following special training contents can be used as examples:
- sprints from a crouch or standing start under normal conditions up to 60m (depending on the athlete's performance level);
- starts under facilitated conditions (downhill or being pulled);
- starts under more difficult conditions (uphill or against pulling resistance);
- ins-and-outs;
- pushing trolleys, boxes, etc.

The training of maximum cyclic speed

Apart from acceleration ability, maximum cyclic speed is the major factor in sprint performance and the maximum velocity achieved is regarded as the key selection criterion for sprinters (STEIN, 1999).

The main training method for improving maximum cyclic speed is the repetition method, with the athlete focusing on good technique, high velocity and acceleration levels and complete rest periods. According to STEIN (1999), the training of maximum cyclic speed requires the highest intensities, short loading durations, an energy supply that is either alactic or only slightly lactic, long rest periods within the training sessions and good neuromuscular preparation. Further requirements are the improvement of intermuscular coordination as well as a high quality of movement technique and movement rhythm. Training should only be started at maximal or supramaximal intensities when good movement control is achieved.

General non-cyclic and cyclic hopping, jumping and sprint exercises can also be used for improving maximum cyclic speed, provided these exercises are similar to the competition movement as far as their coordinative structure is concerned. The following special exercises designed for the sprint can be used to teach movement technique and frequency on the basis of the competition movement:
- coordination or innervation exercises from the so-called sprinting ABC (e.g., ankle running on the spot, fast-foot running on the spot, running with heels flicked to one's bottom, hopping or bounding runs);
- flying sprints (maximum-velocity sprints over 10-30m from maximum-acceleration runs);
- ins-and-outs;
- acceleration runs with the athlete reaching maximal velocity at the end;
- coordination runs.

According to CUNNINGHAM (2001), the 'secret' of pure speed lies in the concept of over-speed. Athletes can only improve their speed if they run fast in practice, but they should not merely run fast, they should run even faster than their current personal record. They should aim to reach a velocity up to 10% higher than normal through facilitated conditions. Anything over this leads to a breakdown of technique, which in turn teaches an incorrect, inefficient style of running, decreases stride length and increases the chance of injuries. Supramaximal velocity can be achieved by:
- running down moderately sloped hills;
- pull-support runs (surgical tubing or pulley devices);
- running on motor-driven treadmills.

Another way of providing facilitated, but also resistance, running is the 'speedy' system, which consists of two harnesses, a rope and a pulley, with the advanced version also providing a means of regulating the amount of facilitation or resistance. The merit of this system is that it simulates uphill
and downhill running but can be employed on a fast track surface, which is essential for quality sprinting. In addition, automatic disconnection from the harness allows the pulled runner to try to convert the assisted speed into unaided speed (SEBESTYEN, 1996).

In supramaximal training special attention should be paid to the loading of the neuromuscular system. With elite athletes such training should not take place more than two or three times within a microcycle. Also, instead of using standard maximum loads, the loading should be varied to prevent the development of a motor stereotype with a resulting speed barrier.

The controversy about resisted and assisted sprint training

Some coaches have been cautious about special training methods. In most cases, they are concerned with the potential for biomechanical changes manifested as a result of training with resisted or assisted methods. This is certainly a valid concern, as several studies have outlined the biomechanical changes that take place under such conditions (SHEPPARD, 2004). For example, the results of a study dealing with the biomechanical consequences of supramaximal speed training using certain assisting techniques (e. g. pulling systems) conducted by LETZELTER (2001) showed that when using such systems, a reduction of the support times and increased braking effects cannot be avoided.

According to MOUCHBAHANI, GOLHOFER and DICKHUTH (2004), assisted sprinting should be used very individually, depending on the athlete's capabilities and technical abilities. Inter- and intramuscular coordination are necessary prerequisites in maximising the benefits from assisted sprinting. The over-speed achieved should be maintained for a maximum of 10-15m. It is important that the athletes run with higher stride frequency without shortening the stride length. A useful guide is:

• Sprinters (men) with a 100m best of 11 sec and slower should not be assisted more than 40 to 45m.
• Sprinters faster than 11 sec can be assisted up to 50 to 60m.

BARTONIETZ (2001) found that using braking parachutes in sprint training changes the technique as follows:

• the support leg is touched down at a steeper angle and is more flexed at the knee;
• the amortisation of the knee joint is reduced;
• the push-off from the knee joint is more pronounced;
• the forward lean of the trunk is more pronounced;
• the thigh of the swinging leg is higher and the movement amplitude of the upper arms is greater;
• the forward swing of the lower swinging leg is less pronounced.

The after-effects of using braking parachutes are as follows:

• the support leg is touched down in a more extended way;
• there is an increase in amortisation and push-off;
• there is an increase in the forward lean of the trunk;
• the movement amplitude of the upper arms increases;
• the “reaching” movement of the lower leg is more pronounced.

LOCKIE, MURPHY & SPINKS (2003) explored the effects of sled towing – a common resisted sprint training technique - on acceleration sprint kinematics in field-sport athletes. They found that a heavier load generally results in a greater disruption to normal acceleration kinematics than a lighter load and concluded that a lighter load is likely best for use in a training programme.

As resisted and assisting sprinting is not yet been entirely understood from a coaching or sport-science perspective, resisted methods
should only be used with fully mature athletes, who have established a very solid foundation in sprinting. For reasons of caution, SHEPPARD (2004) proposes the use of the wind for both assistance and resistance. Running with the wind, instead of downhill, eliminates the concerns of some about the potential for increased braking forces during foot contact. Running into the wind does not stress a particular point on the body (i.e., the hips) that may affect the sprinter's movement patterns.

### Sample training week

GAMBETTA et al. (1989) provide sample training programmes for high-school sprinters running 100m in 10.7 to 11.0 sec and 200m in 22.6 to 23.0 sec. The following week comes from the special preparation phase.

Objectives: 1) To improve speed acceleration; 2) to improve absolute speed; 3) to improve jumping power; 4) to improve strength.

**Monday:**
- Warm-up
  - 2 x 30m acceleration from block start
  - 2 x 30m towing with rubber cable
  - 2 x 60m acceleration
  - 1 x 120m from standing start
- Jumping power:
  - 2 x 50m speed bounds
  - 2 x 10m hurdle rebounds
- Weight training:
  - Clean, 3 x 6 @ 40% effort
  - Push-jerk, 3 x 6 @ 40% effort
  - Step-up, 3 x 10 each leg @ 50% body weight

**Tuesday:**
- Warm-up
- Extensive tempo endurance:
  - 3 x 50m – 50m – 200m – 100m
  - Rest between runs by walking same distance as run

**Wednesday:**
- Warm-up
  - Jumping power: 5 x 10 hurdle rebounds
  - 60m @ 90% effort
  - 60m @ 95% effort
  - 100m @ 90% effort
  - 60m @ 95% effort
  - 2 x 30m from 30m flying start

**Thursday:**
- Warm-up
  - Jumping power combined with acceleration: 5 x 4 bounds plus acceleration to 30m
  - Weight training: same as Monday

**Friday:**
- Rest

**Saturday:**
- Warm-up: short
- Weight training: power clean, 3 x 1 @ 90% effort
- Jumping power: 2 x 10 hurdle rebounds
- Absolute speed: 2 x 30m towing

**Sunday:**
- Competition: 100m plus 200m
REFERENCES


