Training to Overcome the Speed Plateau

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By Jürgen Schiffer

AUTHOR

Jürgen Schiffer, PhD, is the Vice-Director of the Central Library of the German Sport University in Cologne and the Documentation Editor of NSA.

Introduction

The axiom that sprinters are born and not made is still popular with many coaches. However, the widespread notion that speed is an inherited trait that cannot be measurably improved by training is not true. Although there is no doubt that genetic gifts above and beyond the norm are required to become a great sprinter, speed capacities can be maximised using scientifically based training methods. However, training for success in the sprints can be challenging and complicated. Elements include high-velocity running, speed endurance, strength and power, flexibility, neuro-muscular programming and mental preparation.

One of the biggest challenges faced by most athletes and coaches is what is known as the speed barrier or speed plateau, where the athlete has extreme difficulty to increase his or her running velocity despite increases in the volume or quality of training. The purpose of this paper is to provide an overview of the current literature about this aspect, both as a general guide and a starting point for further discussion. It includes a description of the speed plateau, the basic training approaches for overcoming it and a detailed look at one of the most currently used methods: supramaximal or tow training.

The Speed Plateau

As an athlete advances in a speed development programme, it becomes increasingly important to select the proper drills and exercises specific to his/her particular event, because as skill and performance increase, the available range of exercises that optimally stimulate improvement narrows. Thus, the training programme shifts from general preparation to more specific preparation for the competitive activity. Sprinters, for example, require specific exercises that include running at maximal velocity for short (20-80m) and long (150-300m) distances. To be effective, these exercises require a great number of repetitions (TABACHNIK, 1992). High-velocity sprinting is the most event-specific exercise that sprinters can do and should be the backbone of the training programme during all phases of the training year (DARE & KEARNEY, 1988).

However, numerous repetitions of the same exercises form a dynamic stereotype in the central nervous system. The roots of this phenomenon, which in sprint training is called the speed barrier or speed plateau, are in the intensive, highly focused training that usually leads to monotony and creates both psychological and physical fatigue. In addition, maximal speed indicators are stabilised and, after some time, restrict the transfer toward a higher level of speed (TABACHNIK, 1992).

It is typical of the speed plateau that it includes space, time, and frequency characteristics of the movement. This means that the athlete learns to move at a certain speed, and not any faster, even though his or her abilities (such as strength, flexibility, or even reaction time) improve (KURZ, 2001). A distinct rhythmical structure of the running stride will be formed regardless of how intensive and many-sided the training routines employed are (BORZOV, 1983). It is worth mentioning that the speed plateau most often occurs in beginners who are introduced to narrowly sport-specific training too early, at the expense of general development (KURZ, 2001).

Consequently, coaches are faced with a paradox: In order to improve speed abilities, the athlete has to run at maximal velocity. But the more the athlete runs at maximal velocity in training, the earlier a speed plateau will be experienced. Standard training theory tells us that there are two approaches to avoiding or overcoming a speed plateau: 1) assisted sprinting and 2) variation and contrast training.

Assisted Sprinting

Description

In the assisted sprinting approach the aim is to encourage the athlete to exceed his or her highest running velocity, remember this new sensation, and then try to repeat it in the following workouts. For this purpose, the athlete can:

- run downhill on a slightly declined track, which, according to BORZOV (1983), is the easiest way to eliminate existing habits and assist in the development of new rhythmic structures;
- run following a leader;
- run with the wind;
- run while being towed with, for example, surgical tubing, the Ultra Speed Pacer, the Sprint Master, or the "Speedy"device (HÜCKLEKEMKES, 2002),
- run on a high-speed treadmill.

These relieved or assisted methods cause a "light up" of the central nervous system, bringing into play great numbers of neurons and altering the timing of the nervous impulses to the effector muscles. In other words, they create some anticipatory firing, which enhances intramuscular coordination. This is confirmed by JAKALSKI (2000), who states: "the neuron recruitment level is definitely increased after overspeed towing." Assisted methods also make the legs more responsive to ground reaction. It is theorised that the increase in horizontal momentum resulting from assisted sprinting alters the capacity for joint stabilisation at the ankle and knee, thereby allowing for a greater transmission of force (JAKALSKI, 2000).

It should be kept in mind that the running velocity achieved under assisted conditions must be such that the athlete at some time in the future will be capable of showing the same velocity under normal conditions (KURZ, 2001).

With both assisted and resisted methods, it is important to stay within the so-called 10% neural window. This means that athletes should not be slowed down or accelerated more than 10% from their current sprinting velocity because as the resistance becomes greater or lesser, "the body breaks down the correct biomechanical style of running, which will increase their chances of injury and decrease their stride length" (CUNNINGHAM, 2001). In terms of towing force, CLARK et al. (2009) suggest that towing forces in excess of 3.8% of the athlete's body weight should be avoided.

Dangers

Although assisted sprinting can improve stride rate and elastic energy production, some athletes have a tendency to allow themselves to be pulled while running passively. According to CISSIK (2005), this means that the athletes run with submaximal effort, which defeats the purpose of the exercise.

DINTIMAN et al. (1998) recommend continuous supervision when training with surgical tubing for assisted sprinting. Tubing can break if stretched too far, and belts can come loose if they are carelessly fastened. JAKALSKI (2000) also holds that "over-speed training using surgical tubing is dangerous […]. Not only is there an obvious risk of having the cable snap back on the runner, especially if the end slips out of a partner's hand, but because the tubing can't be released from the sprinter's body, as it returns to its pre-stretched position, athletes must often step gingerly in their coast-and-stop phase to avoid getting tangled. It is not uncommon to see sprinters forced into awkward and precarious movements at the end of a tow in an attempt to avoid tripping over long sections of uncoiled cable caught between their legs."

Downhill sprinting will increase horizontal velocity and stride length. However, declines greater than 3% may lead to excessive stride lengths that will result in increased braking during the sprint (CISSIK, 2005). Sprinting with the wind has major limitations because it is impossible to control either the velocity or availability of wind. Further, since the wind velocity is never constant, it is hard to keep sprinters within the 10% window (JAKALSKI, 2000).

In general, CISSIK (2005) recommends that when doing assisted sprints the following guidelines should be observed:

1) When being towed, distances should not be longer than 30-40m.

2) Downhill sprints should not exceed an angle of 2-3° to prevent changes in mechanics.

3) Athletes should not achieve velocities greater than 106-110% of their maximum velocity to prevent changes in running mechanics.

4) Sound technique must be emphasised during assisted sprinting.

The latter point is also emphasized by JAKALSKI (2000): "If an athlete has an unstable motor pattern, sprint-assisted work will only make his mechanics worse by magnifying errors. Unless coaches have a clear method for keeping athletes within the 10% zone, runners can generate so much speed that they begin braking actions in an effort to avoid falling forward. As soon as athletes initiate any kind of braking action, they are being taught to stay on the ground longer, and their bodies quickly adapt to this incorrect stressor." Because of the potential risks when doing assisted sprints, JAKALSKI recommends avoiding these exercises, unless athletes are highly advanced in training age.

Variation and Contrast

Description

The other approach to overcoming the speed plateau is the variation or contrast method. This method is based on the fact that the speed the central nervous system forgets the various characteristics of the dynamic stereotype is different for each characteristic. Spatial characteristics (form of movement) are remembered longer than temporal characteristics (speed and timing of movements). If the speed exercises are not performed for a certain time, memory of the time links characteristic for running at a certain velocity may disappear even if the form of movement is still intact. It takes 10-14 days after speed training is stopped for an athlete's running velocity to noticeably decrease. If during this period of rest from sport-specific speed exercises the athlete does directed general speed and strength exercises, his/her speed may increase afterwards (KURZ, 2001).

According to JAKALSKI (2000), contrast training, i.e., combining assisted and resisted running activities within a training session and then finishing with regular maximum velocity sprinting, is a unique way to target the athlete's neuro-motor pattern. When using this method, it is very popular to use exercises that are similar to the competitive activity and improve special muscle strength. It is here that resistance running becomes relevant. Examples include:

- uphill running;
- running in sand or in water;
- running with a weighted belt;
- pulling, for example, a sled, tire orparachute.

The rationale behind resisted sprints exercises is that they force the athlete to exceed the usual level of driving effort, wich improves muscle power, specifically take-off power and special muscle strength, which in turn leads to an improvement in stride length in normal running. It is believed that the exercises will recruit more muscle fibers and require more neural activation. Over time, this increased recruitment and activation will be transferred to non-resisted sprints, leading to an increase in running velocity (CISSIK, 2005).

One should also keep in mind that a coach cannot introduce this kind of training, have the athlete do it a few times, and then think a training stimulus has been evoked. Sprinters should contrast-train two times per week for a six- to eight-week period. They should never do back-to-back sessions, because the nervous system takes longer to recover than the cardiovascular system. There should be at least 72 hours for recovery between contrast training sessions.

Dangers

According to LETZELTER (1995), “competition exercises with additional loads are, as the ‘most specific of specific exercises,’ important training means. In sprinting, this applies in particular to towing resistance runs. However, precise information on the length of the runs and the level of additional loads is not available. Also missing is biomechanical information on the kinetic and dynamic influence values that bring about changes to the sprinting movements.”

With that said, LOCKIE, MURPHY & SPINKS (2003) have compared 15m sprints where the athletes dragged unloaded sleds, sleds loaded with 12.6% of body weight, and sleds loaded with 32.2% of body weight. The 32.2% load resulted in a lowering of running velocity by almost 23%, a decrease in stride length by almost 24%, an increase in trunk lean by 15% (leading to an incomplete hip extension), and an increase in ground contact time by almost 20% (leading the athletes to spending more time on the ground). This confirmed earlier results with female sprinters showing that sled towing runs over 30m with 2.5kg, 5kg and 10kg loads “did not only produce slower times, but also changed stride frequency and, even more, stride length. Also noteworthy were increased support times, changes in the upper body lean and the tendency of ‘sitting’ strides” (LETZELTER, SAUERWEIN & BURGER, 1995).

These findings show that overdoing resisted sprint exercises can have detrimental effects on sprinting mechanics. Therefore, CISSIK (2005) recommends that these exercises should be used sparingly, with little resistance, and during specific times in the year in accordance with the following guidelines:

1) The resistance should not slow down the athletes by more than 10%; any more than that will alter the mechanics of running and potentially create bad habits.

2) Resisted sprints should cover 15-20m and provide for a gradual release to free running for 20-25m.

3) Proper sprinting mechanics must be emphasized throughout the performance of the exercise or the athlete may inadvertently be taught to run slowly and with bad technique.

As far as training children and adolescents is concerned, it is proposed “that horizontal resisted sprint methods (towing a sled) are only appropriate for fully mature, high-performance or elite sprinters. There are two theoretical reasons for this. First, if the resistance alters stride mechanics, as acute observations have shown, then an athlete who is still developing a solid foundation in sprinting movement should not be exposed to this type of training. Quite obviously, an elite athlete with a decade of experience in sprinting is unlikely to suffer biomechanically from short interventions of this type of overload, as their motor abilities are hardened and much less prone to adaptations that the resisted load may impose. Second, it would seem illogical to implement such special training methods for athletes that have yet to optimise their force and power outputs using general and specific strength and power training. Importantly, prematurely advancing an athlete to this type of specialised training may retard their ultimate performance levels. Although there has been anecdotal evidence from coaches that some level of short-term success using these methods with developing athletes, the athlete’s overall potential may be sacrificed by introducing these advanced overload methods prior to the mastering of proper sprint kinematics, and optimising the adaptation of the muscular and nervous system through general and specific training" (see SHEPPARD, 2004 and MÄDE, 2007).

Tow Training and Treadmill Training

Of all the assisted sprinting exercises, perhaps the most currently widely used are supramaximal or tow training and treadmill training. The following sections provide descriptions of the more popular products currently in use.

History of Tow Training

Although the use of tow training can be traced back as far as the 1920s and the era of Paavo Nurmi, it is generally agreed that the man primarily responsible for bringing it to a level of sophistication was Australian coach Cecile Hensley. In the mid-1950s, Hensley worked with sprinters and middle-distance runners and was constantly in search of new ways to make his athletes run faster. After exhausting the list of conventional speed-training methods, he came upon the idea of towing athletes behind his car.

As a coach and physiologist, Hensley knew that one of the keys to running velocity was stride rate, the number of steps one could take in a given period of time. One of the mechanisms that controls stride rate is the central nervous system. Hensley believed that tow training might condition the brain or central nervous system to alter the rate of impulses to the muscles and thus induce an accelerated stride rate. A few years later, research studies indeed showed that tow training could increase the athlete's stride rate and running velocity. By that time, however, Hensley had already used the tow training method to help develop several world-class athletes out of a band of formerly less-than-outstanding performers. That was in 1956, and although the sports world has not exactly witnessed a tow training renaissance, the method has been and continues to be used rather extensively in many countries (MILLER, 1984). According to DINTIMAN et al. (1998), "towing to force runners to take more steps than would otherwise be possible has improved stride rate and 40-yard dash times by more than 0.6 second."

However, despite the theoretical and demonstrated benefits of over-speed devices, it must not be concealed that some coaches categorically refute their use. FRANCIS (1997), for example, says that over-speed methods "are dangerous due to altered running mechanics and overstretching of muscles, and are based on the fallacy that stride length and stride frequency must be enhanced simultaneously". The only method of over-speed training he advocates is running with the wind.

Surgical Tubing

Surgical tubing can force the athlete to take faster and longer steps and complete a 40m sprint at world-record velocity simply by providing a slight pull throughout the high-speed portion of the sprint. A 6m to 7.5m piece of elastic tubing is attached to the sprinter's waist by a belt. The opposite end can be attached to another athlete or to a stationary object such as a tree or a goalpost to allow the athlete to train alone. The athlete first backs up to stretch the tubing 15m (about 20m total from the partner or stationary object) and then runs at three-quarter speed with the pull until he/she learns to adjust by keeping his/her balance and using proper sprinting form. After four or five practice runs, the athlete should be ready for the full stride (DINTIMAN et al., 1998).

Surgical Tubing Drills

1) One end of the tubing is attached to a goalpost and the other to the athlete's waist with the tubing tied in front. The athlete stretches the tubing by walking backward about 20m. He/she then jogs forward toward the goalpost with the pull. This drill is repeated four times, two with a three-quarter speed run and two with a full-speed sprint. Within the next three sprints, the athlete backs up an extra 4-7m each time to increase the pull and the speed of the sprint.

2) The last part of the preceding drill is repeated, emphasising a high knee lift.

3) The athlete completes 4-5 all-out sprints using a 3 min rest interval. The athlete should allow the tubing to pull him or her at approximately half a second faster than his /her best 40m time. It takes only a slight pull to produce this effect. Two marks should be placed 40m apart so that the sprinter can be timed as he/she is being towed.

4) The athlete should choose a faster athlete and race him/her while being towed.

5) The athlete should do the quick feet drill by measuring one of his/her strides before placing 20 sticks at a distance of 60-90cm shorter than his/her normal stride. The athlete should then repeat the first drill described in this section, concentrating on rapid stride frequency.

6) The athlete should complete the two-person drill by attaching one end of the tubing to his/her waist and the other to his/her partner's back. He/she should then have his/her partner sprint 20-25m ahead against the resistance, and then stop. The athlete should now sprint toward his/her partner in the over-speed run. He/she should continue for 2-3 more repetitions before reversing the position of the belt. The prevously towed athlete is now sprinting against resistance (sprint loading), while his/her partner is sprinting with assistance (over-speed training). This drill should be the last drill in the over-speed workout because it does not allow adequate time between each sprint to fully recover (DINTIMAN et al., 1998).

Precautions for Surgical Tubing Drills

1) The tubing must be inspected before the first run of each workout by allowing the tubing to slide through the hand while backing up. Any rough marks should be carefully examined. If a nick is detected, the tubing must be discarded and replaced with another tubing.

2) The knots on both belts must be in spected and retied if they are not tight or appear to be coming loose.

3) The knot that ties the tubing to the belt must be examined to make certain that it is firmly in place and secure.

4) After having attached the belt to the waist, a knot must be tied with the remaining portion to make certain it cannot come loose.

5) Standing with the tubing fully stretched for more than a few seconds must be avoided. During this stretch phase, knots can come loose and tubing can break.

6) Tubing that attaches to a belt around the waist should be preferred to a harness. With only slight differences in height between the athlete being towed and his/her partner, a broken tubing or a loose belt could snap upward and strike the sprinter in the eye. Tubing attached to the waist that does come loose when stretched is unlikely to produce any serious injury.

7) The first several workouts should be run wearing shoes without spikes. Spikes are only allowed after the athlete has fully adjusted to the high speed and can complete each repetition with correct form.

8) Surgical tubing should be used on a soft grassy area only (DINTIMAN et al., 1998).

The Ultra Speed Pacer

The Ultra Speed Pacer is a simple pulley device that relies on leverage. The pulley (fulcrum) is fastened to a fixed object in the gym or on the athletic field. Each side of the rope going through the pulley is attached to an athlete using a belt. As one athlete sprints at a 45° angle away from the pulley, the other athlete is forced to sprint toward the pulley while receiving considerable pull. After a few trials, both partners will easily determine how fast the angle athlete should run to increase or decrease the pull. The device has the potential to provide a strong pull and produce very high stride rates, stride lengths, and sprinting velocity. Because this device merely provides a straight pull at various velocities, one cannot use the drills described for surgical tubing with this device (DINTIMAN et al., 1998)

Table 1: Over-speed training using surgical tubing or the Sprint Master (from DINTIMAN et al, 1998)

Week	Reps	Over-speed distance (m)	Rest (minutes)	Progression
1	3-5	10-15	2	Three-quarter speed runs only to acclimatise
2	3-5	10-15	2	Maximum speed
3	5-7	15-20	3	Maximum speed
4	7-9	20-25	3	Maximum speed
5	7-9	20-25	3.5	Maximum speed
6-9	7-9	25-30	3.5	Maximum speed with weighted vest that progresses from one to five pounds over three weeks. Used for the final two reps of the workout only.

The Sprint Master

The Sprint Master, which was developed by John Dolan and Michael Watkins, is precisely engineered to pull athletes at speeds faster than any human can sprint. It attaches to the goalposts of a football or soccer field or to the wall in a gymnasium and provides controlled, variable speed for each athlete. It is safe and allows the athlete to merely release his or her grip if balance is lost. The Sprint Master also allows full arm use while being towed at speeds of up to one second faster than the athlete's best flying 40m time.

According to DINTIMAN et al. (1998) operating the Sprint Master is easily learned. Speeds can be individually determined for each athlete, and the operator can make the pull safely. However, most of the towing drills described previously for surgical tubing cannot be used with the Sprint Master because this device allows only straight-ahead sprinting at various speeds.

The following steps should be used to start an over-speed program with the Sprint Master:

1) Athletes should use the workout schedule shown in the table below two to three times per week (every other day).

2) The athlete should have his/her coach or friend pull him/her at approximately half of a second faster than his/her best flying 40m time. The operator quickly learns how to judge pace and can group athletes of similar speed together. It is also quite simple to place two marks 40m apart and time athletes as they are being pulled. The set screw on the machine can then be fixed at the proper speed.

Table 2: High-speed treadmill sprint program

Purpose	Speed	Repetitions
Acclimation	90% of maximum	6-20 at 2-minute intervals for 10 seconds
Entry practice	75% under maximum 90% under maximum At maximum speed	10-30 for two seconds
Improved stride rate	0.4-0.8m/sec and 1.3-1.7m/sec above maximum speed	2-6 for 3-5 seconds allowing full recovery after each

Table 3: Eight-week sprint-assisted program (based on Dintiman, Ward & Tellez)

Week	Workout	Overspeed distance	Repetitions	Rest interval
1	1	½-speed runs toward the pull for 15m emphasising correct sprinting form.	5	1 min
		½-speed backward runs toward the pull for 20m.	3	1 min
	2	¾-speed runs for 20m with perfect sprinting form.	5	2 min
		¾-speed backward runs toward the pull for 20m.	3	2 min
2	3	¾-speed runs for 25m.	5	2 min
		¾-speed backward runs toward the pull for 25m.	3	2 min
		¾-speed turn-and-runs at a 45° angle for 25m (left and right).	3	2 min
	4	Same as workout 3.		
3	5	¾-speed runs toward the pull for 15m.	3	2 min
		Maximum-speed sprints toward the pull for 15m.	5	2 min
	6	¾-speed runs for 20m.	3	2 min
		Maximum-speed sprints for 20m.	6	2.5 min
4	7	¾-speed runs for 25m.	3	2 min
		Maximum-speed sprints for 25m.	6	3 min
	8	¾-speed sprints for 30m.	3	2 min
		Maximum-speed sprints for 30m.	6	3 min
5	9	¾-speed runs toward the pull for 15m.	3	1 min
		Quick feet, short step, low knee lift sprint for 15m with rapid arm-pumping action.	3	2 min
		Quick feet, short step, high knee lift sprint for 15m with rapid arm-pumping action.	3	2 min
		Maximum-speed pulls for 30m rapid arm-pumping action.	4	3 min
	10	Same as workout 9.		
6	11	High-speed stationary cycling. With the resistance on low average, warm up for 5-7 min until you perspire freely. Pedal at ¾ speed for 30 sec.	3	1 min
		Pedal at maximum speed for 2 sec as you say "one thousand and one, one thousand and two, one thousand and three."	7	2 min
		Pedal at maximum speed for 3 sec as you say "one thousand and one, one thousand and two, one thousand and three."	3	2 min
		Pedal at maximum speed for 5 sec.	6	2.5 min
	12	Same as workout 11.		
7	13	Repeat workout 11.		
		Two-man pull and resist drill for 90m.	2	4 min
		Maximum-speed sprints for 25m.	6	3 min
	14	Same as workout 11.		
8	15	¾-speed runs toward the pull for 15m.	3	1 min
		Quick feet, short step, low knee lift sprint for 15m with rapid arm-pumping action.	5	2 min
		Quick feet, short step, high knee lift sprint for 15m with rapid arm-pumping action.	5	2 min
		Maximum-speed pulls for 30m.	5	3 min
	16	Maintenance programme:		
		¾-speed runs toward the pull for 15m.	2	2 min
		Quick feet, short step, high knee lift sprint for 15m with rapid arm-pumping action.	2	2 min
		Maximum-speed pull forward for 20m, plant right foot and sprint diagonally left for 20m. Repeat, planting the left foot and sprinting diagonally right for 20m.	3	2 min
		Maximum-speed pulls forward for 30m.	3	2 min

3) When being pulled, the athlete should grasp the tow-rope handles and accelerate slowly for 10-15m. The Sprint Master will then exert its proper pull as the athlete reaches full speed and will continue to pull him/her for the recommended 20-25m; longer distances tend to produce fatigue and cause the athlete to lose his/her balance. The athlete should pump his/her arms as in normal sprinting form instead of placing the hands and arms in front of the body and being pulled in water-ski like fashion.

4) The athlete should practice the art of letting go of the rope handles if he/she loses his/her balance. Very few runners fall at any towing speed once the operator learns the technique.

DINTIMAN et al. (1998) recommend the over-speed training programme using surgical tubing or the Sprint Master given in Table 1.

Treadmill Sprinting

According to DINTIMAN et al. (1998), the treadmill is an excellent piece of equipment for over-speed training, because it improves stride rate and speed in short distances.

The following guidelines were developed for use on the treadmill as an over-speed training technique:

1) Athletes use a standard warm-up procedure and stretching prior to entry on the treadmill.

2) A harness that also attaches to the support rails and allows free arm movement, balance, and safety is used. One spotter is also placed on each side of the treadmill.

3) A one-week acclimation period is used to allow sprinters to adjust to entry on the tread-belt at high speeds and to treadmill sprinting.

4) Because the tread-belt accelerates slowly and would introduce a fatigue factor if athletes are required to jog, stride and sprint until higher belt speeds are reached, the tread-belt speeds are preset prior to entry. After 6-8 practice attempts, sprinters can easily enter at high speeds. The so-called greyhound effect allows athletes to reach maximum speed in approximately two seconds.

The sample high-speed treadmill sprint programme presented in Table 2 has been used in a number of experiments and has proved effective.

Although generally supporting treadmill sprinting, DINTIMAN et al. (1998) admit that this method is not without special problems. The sprinting action produces a slight breaking or slowing effect each time the foot strikes the tread-belt; however aiding factors predominate and allow a faster rate for most individuals even without training. The braking effect when each foot strikes the tread-belt has been found to be greater for heavier athletes (over 90kg) and for athletes of all sizes in the initial stages of training. It tends to be eliminated as acclimation occurs and format instruction is given. At speeds beyond one's maximum velocity (in early training sessions), the braking effect almost reduces tread-belt speed to the athlete's maximum velocity. However, most of the problems of treadmill sprint training can be overcome for athletes of all sizes by using an ample number of practice sessions at various velocities (acclimation), seeing that athletes master proper sprinting form, and avoiding a tread-belt speed too far beyond the subject's present maximum velocity (the point at which proper sprinting form cannot be maintained). Ongoing research with high-speed treadmill sprinting continues to show improvements in stride rate and length, with this effect carried over to unassisted sprinting.

A longer-term, versatile sprint-assisted program is presented in Table 3.

All the methods and devices discussed are described in more detail by DINTIMAN, WARD & TELLEZ (1998) and by FACCIONI (1994). More detailed information can also be found in KOSZEWSKI (2000) and LETZELTER (2001).

Finally, it should be stressed once again that the use of assisted means in sprint training should only be conducted with highly coordinated athletes to be effective. This means that the athlete must already be technically quite proficient (see MOUCHBAHANI, GOLLHOFER & DICKHUTH, 2004).

Please send all correspondence to:

Dr. Jürgen Schiffer

j.schiffer@dshs-koeln.de

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