Periodization For Sprinters
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1 Introduction

1.2 History

The 100 sprints was always an exciting event at the Olympics. It traces its roots back to the original Olympics in Greece. In the original Olympics the Greeks began the races standing upright. They placed their toes in a stone sill at the start line.
Later a starting gate was used to prevent false starts. The gates were similar to those used in horse racing today. In Athens, the first modern 100-meter dash was held at the summer Olympics in 1896. The tracks were not fast at this time, and ropes separated the lanes. Each sprinter had their unique style of running as well as starting.
In 1920, the Olympics were a little better. The athletes shared a similar style of running and ropes were discarded to separate the running lanes.

1.3 Sprinting

To understand the basic physics of running, you can think of your limbs as levers. A levers velocity is dependent on the length of the lever, not the mass at the end of the lever. If a lever is shorter in length, the speed of the mass at the end of the lever is faster. The feet act as the mass at the end of the lever. The sprinters legs are the levers. In order to shorten the levers, you bend your knees. Thus creating acceleration which when coupled with force directed downwards and backwards lead to forward propulsion. There are several phases in sprinting, for instance the acceleration phase is the most important phase in a race. During this phase, after the sprinter has left the starting blocks, the athlete increases the length of their stride and decreases the amount of strides taken per second. Male sprinters usually have a stride rate of 4.6 strides per second, with female athletes little less with 4.8 strides per second. Elite sprinters reach their highest speed at around the 60-70 meter distance, in a 100-meter race, for men. Professional women sprinters reach their top speeds at around the 50-60 meter distance. Top runners usually cover 20-30 meters at top speed.

1.4 Leading Nations/Individuals

The leading nations/Individuals are as follows. Unfortunately Sweden is not apart of this list. In order for this to change, there must be a sharing of information and training strategies coupled with talent identification.

Time	Athlete	Country
9.58	Usain Bolt	Jamaica
9.71	Tyson Gay	USA
9.84	Asafa Powell	Jamaica
9.91	Daniel Bailey	Antigua
9.93	Yohan Blake	Jamaica
9.93	Ivory Williams	USA
9.93	Richard Thompson	Trinidad
9.94	Michael Rodgers	USA
9.97	Churandy Martina	AHO

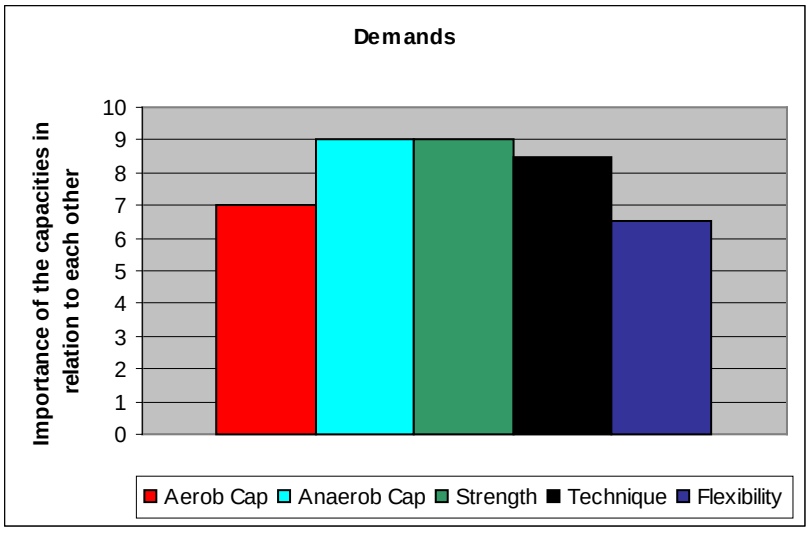
1.5 Future Prognosis

My future prognosis of sprinting in Sweden is that there is a wealth of talent here that needs to be found and nurtured. If this talent is cultivated there is more than a good chance that Sweden could produce a world-class sprinter with a sub 9.9 sec time. As an example nobody could of imagined that England could have produced sprinters with a sub 9.9 sec 100 meter time such as Linford Christie. Who was still actively competing when he was in his mid thirties! Also there needs to be a sharing of information, on a national level as regards to the test scores in the demands & capacities for elite level sprinters. So that up and coming trainers (GIH students) for instance can measure and successfully plan periodization schedules that can maximize an athletes potential.

2. Demands

Internationally Sweden is not considered or noted as a country that produces top rated sprinters. When compared with the sprinting elite Swedish sprinters are almost a half second behind in finishing times. That is why it is interesting for me with this work to compare the different capacities of an international level sprinter with a Swedish national level sprinter. This comparison will show how far Sweden is behind in physical ability in comparison to world's elite, and from this can we make a plan to better Swedish sprinters. Which in the long run will take them closer and closer to that sub 9.9 sec time. Below (Table1) is the demands needed of a sprinter from my earlier work in Demands and Capacities of sprinting.

Table 1 shows the different Capacities importance for a Sprinter



2.1 Aerobic Capacity

100m sprinting predominately uses the Anaerobic ATP-PCr system 95%, Anaerobic glycolitic system 3% system and the Aerobic system 2%.[1] This being said sprinters have been known to run repeats of 150/300m distances, which is referred to as speed endurance work and is a very important part of a sprinters training. Also aerobic training is important for recuperation between bouts of sprinting/running.

[1] Physiology of Sport and Exercise Ed 4. Pg197

2.2 Anaerobic Capacity

The anaerobic capacity is very important for a sprinter since, as previously mentioned sprinting is predominantly anaerobic in energy source. The two different energy sources are Anaerobic Alactic system and Anaerobic lactic systems, which are both, trained through specific distance running with alternating intensities. 100 meter sprinting uses the powerful Anaerobic Alactic system, this energy source last approximately <8sec. The test that is used to judge the power of a sprinter is the Counter movement jump (CMJ). A world-class sprinter should be able to make a height distance between 65-75cm. Plyometrics which is used in training of a sprinter alters the power output during the (CMJ) thus improving jump height i.e. power.[2]

2.3 Strength

There are different types of strengths, which are needed to be a sprinter, Maximal Strength, Explosive Strength and Strength Endurance. Maximal Strength is the amount of force that can be generated from one all out effort, irrespective of time. Explosive Strength is strength per unit of time, and is also known as Speed Strength. Strength endurance can be explained by the ability to able to perform a movement repeatedly for a period of time without the onset of fatigue or loss of form. Strength can be measured by 1repitition maxes in the squat press power cleans etc.

2.4 Technique

Sprinting has a high technical demand on athletes. The coordinative and the technical demand (neuro muscular) can only be judged from a subjective viewpoint. Most important is that a sprinter has good start technique and sprint running technique so as to be able to repeat the movement pattern repetitively (cyclical pattern) without loss of form.[3]

2.5 Flexibility

Recent studies have shown that stretching programs can significantly influence the viscosity of the tendon and make it significantly more compliant, and when a sport demands stretch-shortening contractions of high intensity as is the case with sprinting stretching may be important for injury prevention[4]. Also active dynamic stretching seems to increase 20-m sprint performance.[5] The sit and reach test is a common measure of flexibility, and specifically measures the flexibility of the lower back and hamstring muscles

[2] POWER-TIME, FORCE-TIME, AND VELOCITY-TIME CURVE ANALYSIS OF THE COUNTERMOVEMENT JUMP: IMPACT OF TRAINING. PRUE CORMIE,1,2 JEFFREY M. MCBRIDE,2
AND GRANT O. MCCAULLEY 2 (19/11/09) 178 January 2009 - Volume 23 - Issue 1

[3] Friidrottens kravanalyser 2008-2012, unpublished material, Pg 24

[4] Stretching and Injury Prevention An Obscure Relationship
Erik Witvrouw,1 Nele Mahieu,1 Lieven Danneels1 and Peter McNair2

[5] The Effect of Different Warm-Up Stretch Protocols on 20 Meter Sprint Performance in Trained Rugby Union Players. FLETCHER, IAIN M.; JONES, BETHAN. The Journal of Strength & Conditioning Research:

2.6 Anthropometry

Anthropometry pertains to the size length and build of the body and this naturally is relative when taking into account a sprinters body form. Between the years of 1988-2008 the average length of a sprinter was between 175-189cm and weight was between 64-86kg.[6] This characterizes the way most sprinters generally look, medium height with powerfully athletic builds**.**

3. Identification Of Chosen Capacity

I have chosen to focus on strength as the capacity I wish to delve deeper into. Sprinting as a sport demands a great deal of power, and this power can be enhanced with a greater strength base. This is not to say that a power lifter could outrun a sprinter or even keep up with him/her it just means with that if a sprinter has a great strength base, they could with correct power training coupled with technical sprint work improve there overall sprint times. Also by repeatedly stimulating muscle, you increase the rate of response of the central nervous system. The recruitment patterns become more refined and as a result, gross movement patterns become more efficient and effective. Changes that occur within the muscle because of strength training are classified as Myogenic and neurogenic. A myogenic result to Strength training is muscle hypertrophy, which is an increase in the cross-sectional size of existing fibers. This is achieved by increasing number of myofibrils and sarcoplasmic volume. Neurogenic results come from the repeated stimulation of muscle is that there is an increase in the rate of response of the central nervous system.

4. Goal of Essay

My goal with this essay is to build more knowledge of the paradigms of strength training in relation to periodization. Thereafter use this knowledge to build a periodization schedule for a sprinter.

5. Method

The facts and information gathered for this work, came from scientific data bases (Google Scholar, Sport Discus) as well as Printed books available in the GIH Library and also the Swedish Olympic Committee (SOK).

[6] Friidrottens kravanalyser 2008-2012, unpublished material, Pg 14

6. Results

Delecluise et al wrote in the article, on the *Influence of high-resistance and high-velocity training on sprint performance*, that the purpose of their study was to analyze the effect of high-resistance (HR) and high-velocity (HV) training on the different phases of 100-m sprint performance. They conducted training on two groups HR and HV and compared them to the control groups RUN and PAS. The HR and HV group trained 3 days a week for 9 weeks. Strength-training sessions done twice weekly on HR or HV and one running session. By means of a principal component analysis on all speed variables, three phases were distinguished in the 100m sprints. Phase 1 is the initial acceleration (0-10 m), building-up running speed to a maximum (10-36 m), and maintaining maximum speed in the second part of the run (36-100 m). The HV group improved significantly in total 100 m time in comparison with the RUN and PAS groups. The HR program resulted in an improved initial acceleration phase compared with PAS.[7]

According Tudor Bompa in his book *Periodisation Training For Sports* the maximum load training method when used to improve maximum strength is the most effective way to develop sport specific strength. For these specific reasons

- It increases activation of the motor units, which leads to a high recruitment of fast twitch muscle fibers.
- It is the determinant factor to increasing power. It also has a greater neural output for sports of which speed and power are the dominant factors.
- It is critical for the improvement of short and medium muscular endurance.
- It improves synchronization and coordination of muscle groups during performance.Maximum load training has a learning component, simply because all physical actions have a sequence of events. The better the muscles are when involved in coordinated contraction the better they learn to recruit fast twitch muscle fibers leading to outstanding performance.[8]

In the article *Training for Power Events* Schmidbleicher. D writes that increases in muscle size (hypertrophy training) are always accompanied with increases in muscular strength.[9]

In there article called *The Effects of Six Weeks of Squat, Plyometric and Squat-Plyometric training on Power Output*, Adams. K et al, state that there is an improved performance in power activities following a strength-training program.[10]

Gunter Tidow, comes to the conclusion in his article *Strength for Athletics*, that In order to

[7] Influence of high-resistance and high-velocity training on sprint performance. DELECLUSE, CHRISTOPHE; COPPENOLLE, HERMAN VAN; WILLEMS, EUSTACHE; LEEMPUTTE, MARK VAN; DIELS, RUDI; GORIS, MARINA

[8] Tudor Bompa, *Periodization Training For Sports*, Pg 173

[9] Training for Power Events Schmidbleicher. D. In Strength and Power in Sport. P.V Komi. Ed. Boston: Blackwell Scientific . 1992 pp. 381-395.

[10] Adams, K., J.P. O'shea, K.L. O'shea, and M Clinstein. The effects of six weeks of squat, plyometric and squat-plyometric training on power Output. J Appl Sport Sci. Res. 636-41. 1992

increase the neuronal capacity, contractions against high resistance must be made. Weight loadings higher than 90% and up to 100% promise the best results.[11]

William J. Kraemer wrote in his essay *Fundamentals of Resistance Training: Progression and Exercise* that, single-joint exercises, leg extensions/leg curls, have been used to target specific muscle groups and they also reduce the risk of injury since the technical aspect is reduced. Multiple-joint exercises, bench press, squat, hang pulls, and power clean, Involve more coordination and the latter exercises are more complex which gives rise to neural activation due to the larger muscle mass involvement and subsequent amount of weight used. These exercises have generally been regarded as the most effective exercises for increasing power and muscular strength. Thus, the amount of muscle mass involved in a movement e.g. power clean significantly impacts the acute metabolic demands and anabolic hormonal response.[12]

A study by SCHMIDTBLEICHER, D. et al, concluded that that heavy load (80–100% of 1RM) training resulted in greater increases in movement speed and rate of force development over lighter load training in their study *Changes in contractile activity properties of muscle after strength training in man.* [13]

Blazevich et al in the article, *Effect of the movement speed in resistance training exercises on sprint and strength performance in concurrently training elite junior sprinters* After 7 weeks of high and low velocity resistance training on strength and sprint running performance in 9 elite sprinters, with differing movement velocities, consisting of hip extension/flexion, knee extension/flexion and squats at 30 50 70 and 90% of 1 rep max, found that there was a significant improvement in 20 meter acceleration[14]

Table .2 Generalized Periodization Scheme of Strength-power training (basic application)

Phase Objective	General Prep Strength Endurance	Special Prep Basic Strength	Competition Strength Power	Peaking Active Rest Maintenance
Intensity	Low To Moderate	High	High	Very High-Low
Volume	High	Moderate-High	Low	Very Low
Repetion's	8-20	4-6	2-3	1-3
Sets*	3-5	3-5	3-5	1-3
Sessions	1-3	1-3	1-2	1
Days/Week	3-4	3-5	3-6	1-5
Intensity Cycle	2-3/1	2-4/1	2-3/1	-

Strength-endurance is a more accurate objective of the GP phase than hypertrophy because increased anaerobic capacity is its primary objective. Body composition changes are secondary. Basic strength, strength and power, and peaking maintenance are a continuum of

[11] Günter Tidow. ASPECTS OF STRENGTH TRAINING IN ATHLETICS

[12] WILLIAM J. KRAEMER1 and NICHOLAS A. RATAMESS2. Fundamentals of Resistance Training: Progression and Exercise Prescription. 1Human Performance Laboratory, Department of Kinesiology, University of Connecticut, Storrs, CT; and 2Department of Health and Exercise Science, The College of New Jersey, Ewing, NJ

[13] SCHMIDTBLEICHER, D., AND G. HARALAMBIE. Changes in contractile activity properties of muscle after strength training in man. Eur. J. Appl. Physiol. 46:221–228. 1981

[14] Effect of the movement speed in resistance training exercises on sprint and strength performance in concurrently training elite junior sprinters, Blazevich AJ, Jenkins DG, J Sports Sci 2002 Dec;20 (12):981-90

training objectives during subsequent periods. Peaking applies to sports with climax. *Sets: excludes warm-ups. Intensity cycle: ratio of heavy to light training weeks.[15] As shown in Table 2.

Below is a table with the required restitution between each strength-training pass. Based upon the amount of weight lifted[16]

Table 3. Recommended Restitutions between Strength training sessions.

Strength Load	Physical Stress (% 1 RM)	Rest period (Hours)
Heavy Strength Training	85-100	72 hrs
Medium Strength Training	65-85	48
Light Strength Training	50-65	24
Endurance Training	<50	8-12

7. Integration of Results Into Periodization Schedule

7.1 Demands & Capacity

Table 2. Is in reference to a demand Analysis comparison between two Swedish National level junior sprinters and the requirements needed to compete as an International Elite Sprinter.

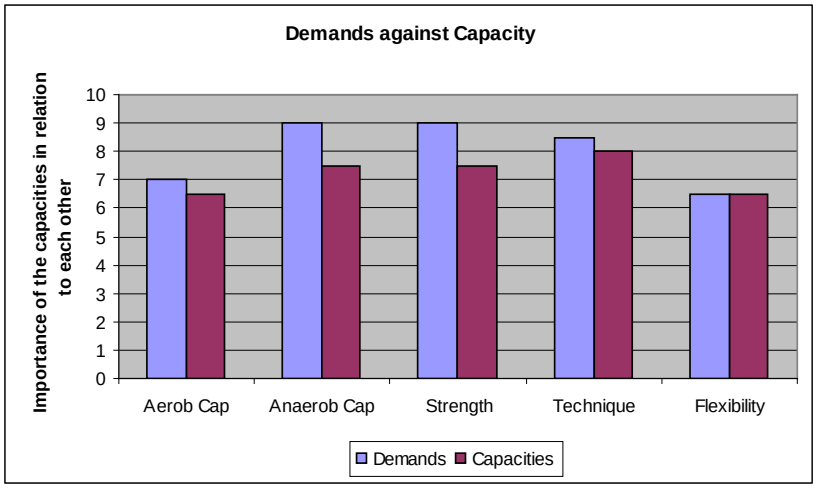
Table 2.Test scores of the capacities needed for a Potential Olympic medal (World Class) SOK.[17]

	Athlete 1	Athlete 2	World Class
Standing 60	6.75 s	6.79 s	6.40-6.50 s
Block 30		4.00 s	3.85-3.95 s
Flying 30	2.88 s	2.90 s	2.55-2.65 s
150m Standing	-	-	14.3-14.8 s
Standing Fwd J	2.95 m	2.87 m	3.30 m
10 Step Hop			38.0-41.0 m
CMJ Hop			65-75cm
100m time	10.26 s	10.54 s	9.9s
5 Step Standing			16-17.50 m
5 Step Moving	17.33 m	18.50 m	

Regarding the comparison between the test scores for the two Swedish athletes one can see that they are lacking substantially in strength/power capacity. The world junior record is 10.01 sec by Darrel Brown of Trinidad which was set when he was 19. My view is that with a stronger strength base moving onto power training not withstanding technique training, could

[15] Peridization Strategies. Michael H. Stone, PhD U.S. Olympic Committee Colorado Springs, Colorado
[16] GIH, Gymnastik och Idrottshögskolan, Compedium Strength Training.
[17] *Friidrottens kravanalyser 2008-2012*. Unpublished material (uppdaterad 2009-11-17)

see these junior sprinters reach these test scores within several years.



7.2 Trainings Principles

Periodization principle: Periodization is the all encompassing theory of how to combine the theory of adaptation, progressive overload, diminishing returns, rest and recovery, into one year long schedule

Overload principle: The human body is involved in a constant process of adapting to stresses or lack of stresses placed upon it. When you stress the body in a manner it's unaccustomed to (overload), the body will react by causing physiological changes (adaptation) to be able to handle that stress in a better way the next time it occurs

Variations principle: The Principle of Variation promotes more consistent improvements over time because it prohibits boredom through variation of program. Repetitions, sets, exercise order, speed of execution, and much more can be varied in training time.

Overload principle: States that a greater than normal amount of stress or load on the body is required for training adaptation to occur. Once overload has been achieved, the body will adapt to this stimulus, which requires you the trainer to change the stimulus yet again in order to progress to the desired training goals, which could be an increase in endurance strength or size.

Progressions principle: Training intensity should increase over time. One of the four principals of weight training, progression is the act of gradually adding to the amount or type of stimulus applied to the muscle during each exercise.

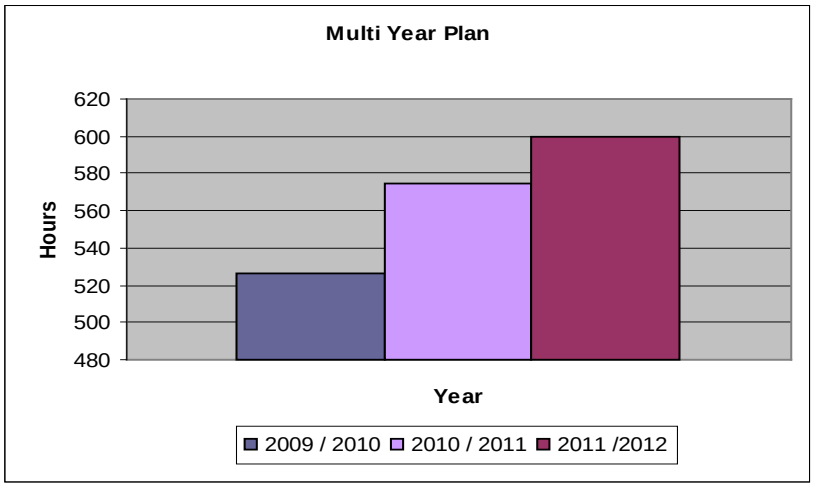
Continuity principle: Pertains to the athlete, simply stated it means that the athlete must continually train to keep his/her physical abilities. If not over time the athlete looses the higher levels of strength, power or endurance made in the preceding months.

Specificity principle: States that training must go from highly general training to highly specific training. The principle of Specificity also implies that to become better at a particular exercise or skill, you must perform that exercise or skill. To be a good sprinter one must sprint.

7.3 Periodization Plan

7.3. 1 3 Year Plan

My multi year plan, is focused on the participation of the athlete in the 2012 Olympics in London England. The athlete will steadily increase his amount of training hours yearly; this is based upon quality and not quantity.



In year 1, concentration is on strength training so as to build up a greater physique and power base. Plyometric training will be emphasized.

In year 2, there will be a natural progression of technique training with extra emphasis placed upon anaerobic sprinting. Since the sprinter has developed a good physical base from the previous year strength/power training hours will see a rise.

In year 3, all training hours will see more of an even split of time. Athlete and trainer will together strive for quality of training.

7.3. 2 Macro cycle

In year 1, concentration is on strength training so as to build up a greater physique and power base. Plyometric training will be emphasized.

7.3. 3 Mesocycle

I have chosen to focus on the General preparation phase, which is 15 weeks in length as my presentation project.

8. Discussion

The improvement of performance in athletics over the past few years has been phenomenal. We are seeing an unprecedented breaking of new world records (100 meter sprint) etc. And this is all due to training, in all its guises. When we speak about a sprinter we usually refer to how powerful they seem to be. This being the case what is power? From a biomechanical standpoint power is P= (force x distance) ÷ time taken. With this as a template the force must be the power the sprinter drives into the ground, the distance is the 100 meters and the time taken is the seconds from start to finish. Force can be physical energy or intensity. For this essay I have decided to focus upon physical strength, which is the ability of a person to exert force on physical objects using muscles.

Strength training has made the most positive contribution to athletic improvement bar none; strength training influences every athletic program on this planet, no matter what the sport. Athletes now find it necessary to lift weights, so as to participate better in conditioning programs in order to prepare themselves for the rigors of the athletic competition. This goes hand in hand with the results found by delecluise et al, where he states that strength training athletes (sprinters) just twice a week lead to an increase in speed over a 100 meters. A muscle will only strengthen when it is worked beyond its normal operation in other words overloaded. Once overload has been achieved, the body will adapt to this new stimulus, which requires the trainer to change the stimulus (intensity) yet again in order to progress to the desired training goals, whether that is an increase in endurance strength or size.

Not so long ago, most western athletic trainers assumed that strength training would turn there athletes into muscle-bound behemoths, which naturally depending upon the sport would lead to counterproductive technique. The method of hypertrophy training used by the coaches of yesterday probably was more centered on the body building method of hypertrophy (symmetry).
This is true in certain respects if the athletic trainer is just concentrating on hypertrophy training just for the sake of being big. Schmidbleicher. D writes in his article on hypertrophy where he states that that increases in muscle size (hypertrophy training) are always accompanied with increases in muscular strength. What he means is that with increased sports specific hypertrophy there is an increase in strength. Sports specific Hypertrophy focuses mainly on improving the size of the prime movers required in that sport by increasing the protein amount in the muscle. It requires high loads and high sets with minimum rest so as to improve the thickness of these prime movers. Now it has been proven that athletic performance depends either directly or indirectly on qualities of muscular strength.

SCHMIDTBLEICHER, D. et al, concluded that that heavy load (80–100% of 1RM) training resulted in greater increases in movement speed and rate of force development. To understand this factor one must understand the phasic nature of the response to strength training loads. Simply put the body goes through adaptive reconstruction which in the case of strength training is a temporary decrease in strength and speed followed by a subsequent increase in strength and speed after the intensity has lessened (adaptation) therefore the effectiveness of strength training is not immediate, but will come with time.

Many sport science studies have also found a high correlation between an athlete's jumping ability and agility in relation to their relative body strength. Adams. K et al, state that there is an improved performance in power activities following a six-week specific strength-training program. What this means is that an athlete who strength trains using different methods of muscle activation (plyometrics, squat and squat plyometrics together) etc, will possess the ability to jump higher and move faster because there power output has risen. This is the ability to get the muscles to work productively together for maximum power output/force production. The maximum force that a muscle can develop is attained during a rapid eccentric contraction. When a concentric contraction occurs (shortening of the muscle) immediately followed by an eccentric contraction (lengthening muscle) then the force generated can be dramatically increased. This in combination with squat training which is a prerequisite for all sprinters, since it activates some of the most important prime movers (quads and gluteus) of the lower body which are naturally important in sprinting. The idea is that because muscles work in pairs, contracting and expanding in concert, training them together will increase the muscles (prime movers) effectiveness. So naturally strength builds the foundation for all athletic qualities.

Strength training is a vital part of complete conditioning. The primary function of the bodies 600 muscles is to contract in order to move body parts. The stronger the athletes muscles, the more forceful the contractions the athlete will be able to produce.
So in closing one can relate strength training to sprinting by saying that proper running technique requires high levels of muscular strength. If the athlete cannot achieve forceful knee drives coupled with arm swings and abdominal stability he/she will not be a fast sprinter..

9. Attachments

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Ex_Säsongsplanering

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Macrocycle Intensity_

10. Käll- och litteraturförteckning

Friidrottens kravanalyser 2008-2012. Unpublished material (uppdaterad 2009-11-17)

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GIH, Gymnastik och Idrottshögskolan, Compedium Strength Training.

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WILLIAM J. KRAEMER1 and NICHOLAS A. RATAMESS2. *Fundamentals of Resistance Training: Progression and Exercise Prescription.* 1Human Performance Laboratory, Department of Kinesiology, University of Connecticut, Storrs, CT; and 2Department of Health and Exercise Science, The College of New Jersey, Ewing, NJ

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Bilaga 1

Vilka sökord har du använt?

Sprinting, Periodization For Sprinters,Strength training For Sprinters

Resistance training For Athletes, Resistance Training For Sprinters.

Strength training For Hurdlers

Var har du sökt?

PubMed,
Google Scholar and Sport Discus.

Sökningar som gav relevant resultat

Periodization For Sprinters,
Strength training For Sprinters
Resistance training For Athletes

Kommentarer

I Found Google Scholar to be excellent, Problem was there were to many Pdfs that where not exactly what i needed or where off on another tangent.