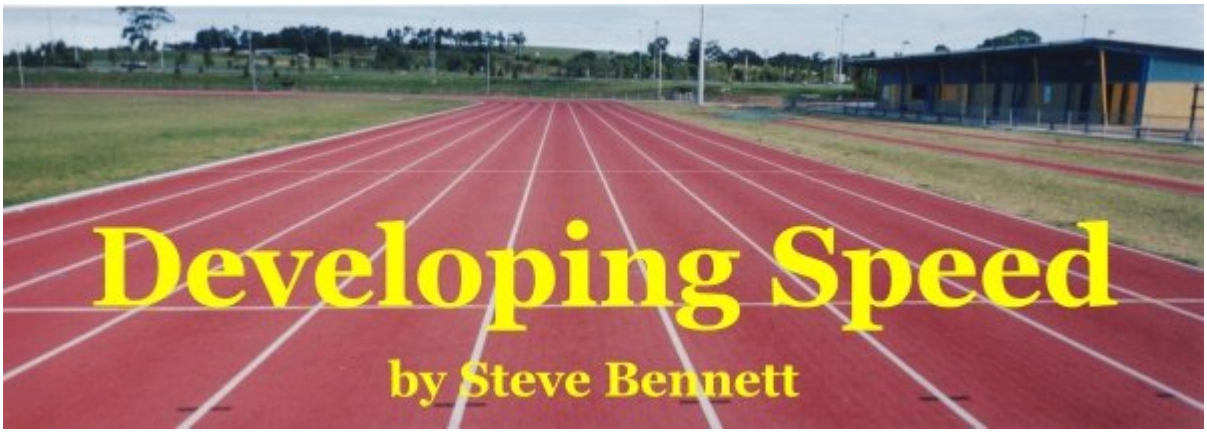

Introduction

This e-book aims to introduce a way of developing speed in experienced athletes who have already undertaken a few years of development.
Developing Speed has been written in a way that it still contains most of the points raised in **Training Kids for Speed.** However it expands on the Original E-book to include techniques and activities that are appropriate for more advanced athletes.

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The New Biomechanics of Sprinting

Athletes like Marion Jones and Maurice Greene display the latest technical model of sprinting. It should be every athletes goal to gradually develop the most effective technique. So what are the latest ideas?

To increase any athletes maximum speed means improving at least one of the following two things:
1. the number of steps the athlete makes per second (their cadence).
2. the effectiveness of each ground contact.

Improving cadence is very much related to decreasing recovery time (the time it takes to get the foot off the ground and back on the ground). Having a foot that hangs way out of the back of the body after ground contact is a common problem that increases recovery time. It is often caused by the athlete dropping their hips which causes a noticeably increased lower back curve (a butt out position). This creates a situation where the athletes compensate for their lack of knee lift by pushing more out the back. There are a number of problems associated with this excessive rear-side running action:

- Increased recovery time which results in a slower step-rate.
- Increased load on hamstrings which have to assist in the recovery action. Greatly increasing risk of hamstring injury.
- Decreased knee lift because knee lift is inhibited when hips are low and there also isn't enough time for them to be lifted higher with the late recovery. This consequently results in less powerful foot contacts.

Many of the worlds top athletes are now trying to decrease rear-side mechanics. The plan has been to prevent the thigh from swinging back any further than just 20 degrees behind the plane of the trunk.

(note the Marion Jones photo she is in maximum hip extension). To do this requires that the athlete maintains high hips. Therefore minimizing the increase in lower back curvature. To do this the athlete needs a high level of strength and control of the muscles that maintain good pelvic stability particularly the lower abdominals. To develop this strength takes a few years of training in the right way.

It is important that the leg folds up close to the butt on recovery *but* in an athlete that is recovering early enough the foot should be closest to the butt when the thigh has already swung forward. Athletes that are recovering late have thighs that are vertical when the foot is at its closest to the butt. Performing butt kickers drills with a vertical thigh is very counterproductive in developing good recovery mechanics. It is best to make sure that the drills are always done so that the knee is forward when the foot is at its closest point to the butt and also fully dorsiflexed almost all the time.

Good leg recovery involves a cyclic action where the athlete strives to keep their big toe as close as possible to their shin (dorsiflexion), high hips, early recovery and recovers their foot over the height of their opposite knee. The action looks and feels like "stepping over long grass". This cyclic recovery action allows the athlete to develop a much more powerful acceleration of their lower leg moments later. Many athletes run by recovering their foot by pulling it through low and straight up. This is much more energy costly and slower.

When an athlete is in the position of their highest knee lift and they are maintaining high hips as well as a dorsiflexed foot. They are in a situation where they can generate using the gluteus maximus muscles a large amount of vertical force resulting in an explosive acceleration of the knee downward. If they have a dorsiflexed foot their lower leg can swing freely (without contraction of the hamstrings). The result is a rapid flinging backward of the foot, this is often called negative foot speed. It has been reported that elite sprinters can swing their feet backwards at speeds in excess of 50kph (30mph). Maintaining dorsiflexion until the foot hits the ground increases the quickness of ground contact and also helps contact to occur further underneath the body minimizing breaking forces. Some athletes have incorrectly developed a technique that produces high negative foot speed but they do not maintain appropriate dorsiflexion of their foot until ground contact. These athletes are at great risk of hamstring injury because they strike too far forward in front of their bodies which severely loads their hamstrings.

Active Foot Strike
Athletes should be aiming to impact the ground with a foot that is moving backwards. This is not unlike the impact when a kid is riding a scooter or a skateboard. The ground is moving backwards at a fast rate and when the foot first makes contact with the ground there is usually a jolt of deceleration before there is any propulsive force applied. This braking force can be decreased by creating a technique that has the foot moving backwards before it impacts and also making contact far enough back under the body.

Dorsiflexion
For the athlete to make an active footstrike and have a quick contact with the ground. It is essential that the athlete maintains dorsiflexion of the ankle (keep toes as close to shin as possible). This pre-stretches the calf muscles and prepares them for a much quicker more elastic impact. Maintaining dorsiflexion also causes foot strike to occur later under the body.

A common (sometimes taught) error is for the athlete to point their toes away from their shin in an attempt to run on their toes. This method has a variety of negative consequences:
- Usually unless the athlete is super strong they will simply increase contact time because their foot will be forced into maximum dorsiflexion after contact anyway. As a consequence controlling this rapid forcing back of the foot on impact puts a tremendous extra load on the anterior tibialis that often leads to lower leg injuries like shin splints, tibia stress fractures and even achilles tendonitis.
-The athlete running up on their toes (attempting not to let their heel hit the ground) is in much more

of a pushing position. This means they will need to lean further forward to get maximum power out of an action that is more dependent on muscles in the front of the thigh. By leaning forward the athlete will also minimize the effects of the overstriding that they have because running with a pointed foot will cause foot contact to occur further forward.
-The forward lean usually is accompanied by an increased lumbar curve in the lower back. This often causes a situation where the athletes pelvic position will make it less possible to have muscular activity from the important Gluteus Maximus muscles due to inhibited activation. The Gluteus Maximus in Elite athletes works very powerfully in concert with the hamstrings to create the backward sweeping action of the thigh and result in a fast backward "flinging" action of the foot. If the Gluteus Maximus is inhibited and/or weak, the hamstrings then are forced to take over the load. Often this means athletes that run in this way have lots of problems with their hamstrings accordingly.

Arm swing should involve having the elbows swing in front of the plane of the trunk. Not swinging them far enough forward limits knee lift and results in greater rear-side mechanics to compensate.The angle of the arms should be mostly about 90 degrees at the elbow. The only time this angle should increase is when the hands are behind the body and then they may open up to no more than 120 degrees. The opening up of the angle makes it easier for the athlete to have a more relaxed arm action and also allows the legs to complete the cycle of movement.

Forward lean
Athletes should aim to run at maximum speed with a very slight forward lean that is evident throughout the whole body. They need to keep their hips up and have the right balance of front-side and rear-side running action. Leaning too far forward will result in the athlete increasing the rear-side action and introducing all the associated problems.

Head position
Athletes need to keep their chins down. Having a head that tilts backward often is accompanied by an increased lumbar curve and lower hips. This will decrease knee lift and negative foot speed.

Running Tall
Athletes need to aim to run tall. This means they keep their body long, their hips up and can have a high knee lift. Many athletes run low and have legs that are quite bent as they pass under the body. This causes them to have effectively shorter legs and a shorter stride length. The key to improving tallness of the runner is to develop more strength and to always practise running tall.

Relaxation
All athletes should aim to develop relaxation. This means focusing on using muscle that are required for running and stabilization. It importantly means learning to switch off all unrequired muscles as much as possible. There are many situations where athletes can practise relaxation and seek to develop a good feeling when running that many athletes call rhythm. Developing athletes particularly need to develop this skill because it is common for people to equate running at maximum speed with maximum tension. This is why this area needs careful and regular attention. Tempo sessions aim to develop endurance and desirable movement habits while relaxed. Relaxation is much more easily attained during Tempo sessions because all running is done at lower intensities.

Starting Technique

It is most important to distinguish between the technique when starting/accelerating and for running at maximum speed. Acceleration involves a significant pushing action where the quadriceps and calves are much more active. There is also as high a degree of forward lean as possible. The stronger and more powerful the athlete the more able they are to be leaning forward and apply a pushing force to the track. Many athletes and most kids are unable to apply enough force to start with the ideal technique because they are unable to push to straight their front leg when leaving the blocks or get

anywhere near this in the steps that follow. However they should be encouraged as much as possible to strive for a strong forward leaning pushing action in the first 5-8 steps. It is important that the forward lean is evident throughout the length of the body not just a piked position from the hips or simply a head that is hung low. Its degree and effectiveness will improve as the athlete develops more strength and power.

The common mistake made by many athletes is to try to just stand up and run as soon as possible with the maximum speed technique. Standing up tall early puts the body in a position where it is unable to generate the same amount of force to the track in a pushing action and also prolongs the period of time that the sprinter will need to spend maintaining the technique for maximum speed. This often causes athletes who stand up too early to lose more speed at the end of races while fatigued than their peers who maintained a better acceleration body position for longer.

I believe with young kids it is better to do lots of fun reaction drills, acceleration drills etc. rather than lots of formal starts. Often they will be practising out of blocks a technique that is compensating for their lack of strength/power anyway and to a degree could be considered as therefore practising bad habits.

Becoming strong in the gym in the mid-torso region as well as in the prime mover muscles is the best way to have a large positive impact upon starting & acceleration performance.

Sprinting & the Nervous system

Considering the function of the Nervous system in Sprinting is very important. It has a limited capacity to recover from certain types of activity. This needs to be understood when planning training and especially when leading into competitions. Dan Pfaff coach of some of the Worlds leading Sprinters (Bruny Surin, Obadele Thompson and Donovan Bailey) has made the statement like "it is as if the human nervous is powered by a 9v battery and is therefore easily flattened". Sometimes in the days after certain types of training an athlete is unable to run with as fast a cadence as usual, often also accompanied by lower maximum power output. It is in this situation that an athlete is said to be "flat".

Young athletes have nervous systems that are very limited in their capacity. Because of this young athletes will be unable to sustain maximum cadences or maximum power for very far at all. The upper limit is maybe only as far as 5s. The time a young athlete can actually spend at absolute maximum speed will probably be below about 3s. In training they may be able to do about 3-6 experiences of maximum speed in a session at the most before they are flat. The time to recover after nervous system flattening sessions will likely be at least 72hrs. This makes it only possible to train for maximum speed once a week if the athlete is racing that week or twice a week if they are not racing.

More mature athletes will have a larger capacity for doing nervous system stressing training. The key is to make sure that high quality training is able to be performed regularly. It is very easy to make the mistake of training in a way that ensures the athlete stays flat for weeks on end. It is a very important role of the coach to make sure that this situation is avoided.

Training to minimize the effects of neural fatigue by improving the capacity could involve a range activities:

- Focusing on acceleration over 30m with total volume of sprints up to 300m
- Focusing on maximum speed development over 30-50m with total volume up to about 300m. It is very important that proper mechanics be used and reinforced. They don't all have to be at maximum effort.
- Multiple jumping and throwing.
- Short hill runs of 30m.

The most important thing to recognize is that athletes cannot develop more maximum speed by

attempting training at maximum speeds when neurally fatigued. They simply would be practising bad habits and an inferior motor pattern. They would also be prolonging the period of flatness.

Racing requires Nervous system freshness for optimum performance. This means that the athlete should not perform training sessions that will produce lasting flatness that will persist to the competition date. Often athletes surprise themselves by performing better than expected after a period of minimal training stress, this in most cases especially in sprint events is because of the nervous system being "fully charged".

The way to find out an athletes tolerance to training and times required for recovery is to monitor it carefully. The athletes in my squad are clearly slower over a standing start 40m run by a noticeable amount on "flat" days. If a session of maximum speed sprints over 40m is planned and the athlete is indicating they are flat in their first run, then I often change the session into a more relaxed tempo session. We certainly also avoid doing any maximum speed work in the 4 days prior to important races.

Many athletes are encourage by the very structure of their competitions to overcompete almost every week during their competition season. Racing in more than one event is always a compromize because of nervous system fatigue.eg. If an athlete competes on a given day in a 100m, 200m, 400m and LJ they will almost certainly have significant nervous system fatigue for at least 4 days. The only way that this can be minimized is by either choosing minimal events or "taking it easy" in some of them. If the aim is to develop excellence "taking it easy" should never be an option as this approach will likely result in the athlete losing their ability to focus with enough determination in high quality one off events so that they can be performed with ultra-high quality. It is best to train with great variety but compete with a high quality focus in minimal events during any competition meet. Vary the choices but always aim for quality performances every time the athlete enters any event. Awards for young athletes that reward maximum points earned in a given meet or season (that can be earned through overcompetition) are counterproductive to the goal of maturing quality athletes as seniors.

Cold Water
One way to improve nervous system performance especially in hot days is to get the athlete to step into a bucket of ice cold water or if this is unavailable have a cold shower after warmup and not long before running. This tends to help athletes to feel sharper and run with a quicker cadence when they feel flat.

L-Tyrosine
It is also thought that supplementing or eating foods that contain L-Tyrosine may be able to help. L-Tyrosine is thought to be converted by the brain into the stimulatory neurotransmitters dopamine, norepinephrine, and epinephrine. Because of this it is thought that L-Tyrosine may be able to improve nervous system performance. It is possible that the limitation that sprinters experience with their nervous system may be due to a decreased availability of neurotransmitters.

Strength Development

Athletes need to develop strength in a functional way. This means training with a variety of movements that are performed well. It is best to avoid training that isolates muscles like body builders do.

It is very important initially to develop strength in the muscles that provide stabilization especially postural strength.

It is best to perform an ever changing mix of activities. This is because it sustains athlete enthusiasm and ensures that the body keeps adapting. As an athlete reaches a higher standard then they will plateau in certain activities. Often the best way to move above a plateau is to do something else for a little while and then revisit the activity.

Many sprinters follow a double (or even a triple) periodized year. This means that instead of building all year to a single peak, that they focus on performing training that targets a specific area of development for a period of time and then changing to new area for a period of time and so on. Strength training is a big part of the periodization in sprinters.

Strength Training plan for a Double Periodized year

An example of how a year could be structured is below:

Phase 1 - Hypertrophy I / Conditioning 6 weeks
Phase 2 - Strength I - 8 weeks
Phase 3 - Power I /Conversion - 4 weeks
Phase 4 - Maintenance/Competition Peak I - 4 weeks
Phase 5 - Hypertrophy II / Conditioning 4 weeks
Phase 6 - Strength II - 8 weeks
Phase 7 - Power II/Conversion - 6 weeks
Phase 8 - Maintenance/Competition Peak II - 9 weeks

Phase 9 - Transition - Recovery 3 weeks

I believe it is better to train using a great variety of activities. This plan outlines changing emphasis it does not mean each phase is exclusive e.g. some med ball training may be done all year.

Hypertrophy/Conditioning Phase
Aims to create the right amount of muscle for the athlete and the event they are preparing themselves for. This would be aimed for by ensuring that there is enough time under tension in each exercise to create a stimulus for hypertrophy. Usually using 3-5 sets of 8-12. With sprinters we would tend to aim for functional exercises which are performed quickly as muc h as possible. We would try to avoid as much as possible using isolation exercises or slow lifting. The athlete is also comprehensively conditioned in this phase to being able to do good volumes of work on many muscle groups. This is also a very good time to do more ankle & foot conditioning as well as hip conditioning using hurdle drills etc.

The athletes supplement with small amounts of protein before,during & after all strength sessions. This ensures that there are always adequate amino acids circulating so that they spend minimal time in a catabolic state. This has allowed adequate hypertrophy to occur even in female athletes. The goal of the hypertrophy phase is not to get big for the sake of getting bigger, it is to get big enough to have the appropriate body type for the event and to create muscle that can give further gains in strength and ultimately power.

Strength Phase
The total number of reps in each set and overall is decreased to maximize the load being lifted. Usually 3-4 sets of 3-5 depending on the exercise.

Power Phase/Conversion
Exercises with a lighter weight than in the previous phase are used and the exercises are performed explosively. The athlete also is aiming to transfer as much power as possible into the specific running action. Some max strength work is continued but the emphasis is on power development.

Conversion/Maintenance
Training is performed to transfer as much strength as possible into the running action. The total loading of the activities are usually much lower in volume and the frequency in the week to allow for maximum quality in specific running training and for competition. The key aim is maintain strength but learn to use more of it.
Some max strength work is still performed but is greatly reduced in volume.

Track training during each Period.
Early in the first period emphasis is on tempo work and on short acceleration sprints to 30m. Max speed is the emphasis during power development phases. Speed endurance is emphasized more during the Maintenance phases. Generally there is a shift toward longer distances in each phase during the second period. The second competition period before the transition is the peak performance phase of the year.

Free Weight Training
During weight training young athletes are limited in what they can do with free weights by their ability to stabilize and therefore balance the weight. This means that the loads are often low initially in terms of total force. Machine weights do not develop stabilization strength and they allow the athletes to generate very high forces that are in a real situation beyond their ability to control. I believe it is best to start with free weights and get good advice from an instructor on technique. In fact, the more the athlete is monitored and shaped in technique the safer lifting will be as they become more advanced.

My strategy with athletes has been to use a great variety of exercises some of which are weighted to challenge stabilization and therefore develop increased strength in this area. From this type of training the athletes gradually improve their postural position and stability. This is something that has great transfer into improvements in the running action. Strength training initially should be focused on developing stabilization strength and core strength for sometime before it can sensibly progress to be really targeting the main muscles for propulsion (the prime movers).

Training in a way that improves running form and stabilization strength is an effective way to prevent injuries in any athlete. Many athletes that are advised to wait until their late teenage years to start strength weight training are missing out on an area of development that will likely help them avoid injuries.

I have found that athletes really enjoy the experience of gradually developing their strength in a variety of ways. The enjoyment being mostly a product of the perfected variety of things they have done and are doing.

Exercise Choice
There are many possible exercises that athletes should do. It is best to vary exercises regularly and learn perfect technique for each one.

Bench Press/ Incline Bench Press / Vertical Dumbell Press - we tend to vary the angles and maintain progress.
Full Squat / Parallel Squat / Half Squat / Quarter Squat - we would tend to start deeper lighter and build more intensity eventually ending up with very heavy quarter squats in the power phases of the year.
Reverse Hypers/ Back extensions / Upright Rows/ Seated Rowing etc - It is important to do strengthen the back.
Cleans/ Hang Cleans - this is a key exercise for many sprinters - it has to be done quickly but it needs the right gym and good instruction.
Weighted Step-ups - we often do these in sets of 4-6 on alternate legs - early in each period we do them on a higher box and we progress to higher loads eventually on a lower box. This is a great stabilization development exercise. Athletes who have poor stabilization strength will show it during this exercise.
Weighted Crunches/ Hanging leg lifts/ Russian Twists/Hanging leg holds with variations/ Cable pulls (Woodchops) - There are a great variety of exercises that target the full range of abdominal muscles. We work them using Pilates & Swiss Ball to enhance control and posture, we also work them for endurance and also we work them for high levels of strength using exercises that present high forces.
Pullups - we do a range of these and sometimes they are performed loaded with weight or at other times are performed very quickly.

Power Circuit
A power circuit we have been doing which has been great fun and effective is detailed below:

Warrmup - includes cable pulls across, hang snatches , back extension

10 ankle bounces with a 20kg bar
6 jump ups onto a low box with 40kg - explosive
12 ankle bounces with in & out movement with a 20kg bar
6 step-ups each leg with a stomping active contact with a 40kg bar
4 quarter squats (Female sub12.00s athlete to 150kg)
2 x 4 bounds on carpet - measured from a standing start.

The circuit is repeated 3 times. Transition between exercises is not timed or rushed. Quality is

valued.
The athletes then did a combination of Russian Twists, Hanging ab holds totally 5min some with straight legs - some with bent legs and med ball resistance, Reverse hypers, Inclined Med Ball catches. A quicktime video of some of the exercises is at www.athleticstraining.com/videos/midtorsogymdec2002.mov (it is 2.0Mb)

The choice of weight is based on the bounces being about 15% of quarter squat ability. The jump-ups and active step-ups were meant to be less than 30% of quarter squat ability over 4 reps.

Ankle Conditioning
If a runner has weak ankle dorsiflexors (muscles in the front of the shin) they will make a lot of noise when they run where those with well conditioned and functional dorsiflexors will make much less noise. It has been suggested that Kenyan athletes build up tremendous dorsiflexor strength and functionality because they spend their initial years of life running and walking endless miles while barefooted, instead of being in shoes. Consequently, many Kenyans are able to conserve energy during the stance phase i.e.. while their foot is in contact with the ground. This is because in addition to controlling plantar flexion, the dorsiflexors must also deal with the side-to-side motions of the foot and ankle during running, as well as the rotational motions which are a natural part of the running cycle. Any tendency of the foot to pronate must be controlled by the shin muscles. Any tendency of the foot to supinate must also be minimized by the dorsiflexors. It is important to condition the dorsiflexors to be able to cope with stress in the full range of directions. As well as improving efficiency, strengthening the dorsiflexors minimizes the risk of developing shins splints or stress fractures of tibia.

Exercise ideas for dorsiflexors (Anderson & Reynolds)
Shin Raises - athletes simply use their shins to lift toes up as high as possible when standing on their heels, perform 3 sets of 15. Progress can be made by varying both the range of motion and the speed. Athletes could also progress to doing them on one leg at a time.
Heel Step-Downs - Athletes step forward with one foot but by using eccentric contraction of the dorsiflexors they prevent the ball of their foot from descending any more than a few centimetres toward the floor. Maybe progress to 3 sets of 15 each leg. Athletes could increase the intensity of the exercise by taking longer steps and then to going down a high step.

Some ideas for shin conditioning during warm-ups are:
Walking on toes - Athletes walk high on their toes with their toes pointed straight ahead for 20 metres. Then 20m high up on their toes, but with the toes pointed outward with the rotation coming from their hips so that their whole leg rotates. Follow this with a high on toes 20m walk with toes pointed inward, once again by rotating from the hips.
Walking on heels - Athletes walk on their heels with their toes pointed straight ahead for about 20 metres and repeat like in the toe walks with their toes out for 20m and toes in for 20m.
Jogging on toes or heels - Progress can be made with both exercises by jogging gently while performing the above two variations. Further progress is made by skipping and this is of a much higher intensity.
Rhythm ankle bounding is performed by jogging along with very springy, short steps, landing on the mid-foot area with each contact and springing upward. In rhythm bounding the athletes ankles should act like coiled springs, compressing slightly as they land mid-foot and then recoiling quickly. This causes the athlete to bound upward and forward. Athletes progress toward performing a mixture of mini hops and rhythm bounding over 20m with around 100m of variations in total.
Dorsiflexion bounces are performed by jumping vertically and repetitively at close to maximal height, landing in the mid-foot area with both feet and then springing upward quickly after each contact with the ground. Athletes should dorsiflex their ankles on each ascent and slightly plantar flex their ankles just before making contact with the ground. Maybe start with ten dorsiflexion bounces progress to thirty and then toward doing them on one leg at a time.
Rhythm bouncing is jumping around moderately fast, with medium height, and with maximal

motion at the ankles, but minimal flexion and extension at the knees and hips. Combine these with some low fast bounces of less than a few cm. All Rhythm bouncing should be performed as if the landing surface is very hot. The athlete could start with ten bounces and progress to forty.
Advanced Rhythm bouncing involves jumping in various directions and then eventually developing the ability to do them on one leg. The challenge of doing them in different directions increases the ability of the shin muscles to handle the side-to-side and rotational stresses during running.

Foot conditioning
The muscles of the foot when well conditioned can contribute to running efficiency as well as prevent injury. Research by Unger & Wooden on the effects of an arch strengthening on athletes produced gains of 4cm in the vertical jump and 11cm on a horizontal jump.

There are many simple ways to develop and maintain good arch conditioning e.g. spending time barefoot walking, doing smart amounts of running barefoot etc. An exercise called 'Toe grasping' can be performed by having the athlete stand barefoot with feet hip-width apart. They should then curl the toes of their right foot and then their left foot down and under, as though they are grasping something with the toes of each foot. It is recommended to do 2 sets of 50 repetitions with each foot. The aim should be for the athlete to try to pull themselves across the floor. Initially I have had athletes perform this exercise by having the athletes flex their toes in a pulling action to "scrunch" a towel under their feet.

Developing Athletes & Advanced Athletes
Developing athletes should work at building high levels of core strength and postural stability. They should also do as much bulletproofing as possible eg heel/toes, swiss ball, pilates, theraband, sand pit mini bounces and general conditioning. They should learn how to lift and progress with the loads slowly and safely. Initially they should aim to develop the right body dimensions for their event by doing a significant amount of hypertrophy gym work. It is important however that while they are doing this they are exposing themselves to plyometric activities. Athletes that don't do plyometrics as they develop are more prone to injury from using this mode of training than athletes that grew up doing plyos.

Advanced athletes should already have developed all of the qualities listed above and should maintain good standards in all of these areas. However, they can now focus on increasing their strength and power levels as high as possible. They should already have trained for hypertrophy of muscles that are required to establish the right amount of muscle mass for their event. Because of this they may in fact do less hypertrophy gym work than an intermediate level developing athlete.

Never underestimate just how much an athlete can improve in the gym over a long period of time. As long as people train smart and vary the program it is possible for athletes to make huge improvement in strength- power and therefore speed over a long enough period of time.

Power Development

It is important for kids to develop their ability to be bouncy - their elastic ability. The majority of kids used to play jumping games i.e.. skipping, hopscotch, fly etc. In the schoolyard often these games were played in hard leather shoes on concrete with hardly any consideration of shin injuries because they were most likely very rare.

Kids naturally learn to skip quite young and love to just do it instead of walking or running. I have watched my son as a toddler happily skipping spontaneously on many occasions. It is this attitude of "plyo play" that we need to expand on.

All bouncing activities develop the kids muscular abilities to elastically store energy as well as improve their nervous systems co-ordination of similar activities. A kid that never plays these games or "bounces" in play will most likely never develop the elastic qualities as an adult to as high a level as his peers who did plenty of bouncing as children.

Typically running athletes with superior elastic abilities are the fastest. Even in endurance running events the winners are often the athletes with the best finishing kicks. Recent research has also shown that plyometric training increases endurance running efficiency meaning that athletes can run at a given speed with a lower energy cost.

The Principles of Plyometrics
From a physiological basis, if a muscle is pre-stretched or made to build up high tension, it will concentrically contract with a much greater force. Like when you flick an object with young finger after pulling the finger back and then releasing the tension. Plyometrics make use of this factor. The key in performing plyometrics is that the response from the ground must be immediate otherwise the exercise turns into a concentric contraction and does not involve the stretch reflex.

The theory behind plyometric training is to develop efficiency in the stretch/shortening cycle of muscle action. During the stretch (eccentric lengthening phase) of muscle action, a greater amount of elastic energy is stored in the muscle. This elastic energy is then re-used in the shortening (concentric) muscle action that follows, to make it stronger. The key is to shorten the switching time i.e. the time it takes for the muscle to change from the eccentric lengthening phase to the shortening work phase. The fundamental principle of plyometric training is that it is the rate, not the magnitude,

of the stretch that determines the utilization of elastic energy and the transfer of chemical energy into mechanical work. This means that this type of training does not need to be done in high volumes but instead it needs to be performed at manageable intensities of impacts.

Introducing Plyometric Training
Balance & Stabilization Tests and development of Basic Strength especially eccentric strength should come before serious plyometric training. Without adequate levels of eccentric strength, rapid switching from eccentric to concentric work becomes very inefficient. It is possible to evaluate eccentric strength through stabilization jump tests and observation of basic jumping exercises. A muscle contracts eccentrically when it acts as it lengthens to slow down the rate of muscle lengthening. e.g. when someone jumps vertically and lands their quadricep muscles contract eccentrically to prevent the athlete from falling to the ground. The quadriceps resist the downward motion by acting to try to keep the legs more straight. Concentric strength is the ability to contract a muscle to shorten it and apply a force to move a bone.

What to watch for during Plyometric exercises:
- If slow switching from eccentric to concentric work is observed, then eccentric strength levels are inadequate. Quick contacts displaying a rapid change of direction are essential.
- The foot strike must be on the full foot in order for the foot to help absorb the shock. It is incorrect to land completely on the heel or on the ball of the foot.
- The shock of the landing should be absorbed by a combination of the ankle, knee and hip joints working together that will absorb the initial shock of landing and transfer that force throughout the body's muscles.

Athletes should progress carefully with Plyometric Training. The method below was recommended by Vern Gambetta.
A/ Landing exercises
Standing long jump with two foot landing emphasis on "sticking" the landing. Athletes aim to land quietly on the full foot and absorb shock by bending at ankle, knee and hip. They could make progress to landing hops in a similar way. These training exercises improve eccentric strength.

B/ Stabilization jumps
Similar to landing exercises but hold for 5 seconds before initiating another hop or jump.
When athletes can stick and hold 3 jumps progress to be able to stick and hold 3 hops on each leg.

C/ Jumping Up.
Jumping up onto a box (not down).

D/ Bouncing Movements in the one place
Ankle-bounces progressing to tuck jumps with quick contacts. It is important to perform them with an erect torso, good balance and by landing in the one place.

E/ Short Jumps
Start with 3 consecutive standing long jumps with two foot take off and landing.
Athletes could progress to 5 jumps, then to going up stairs jumping every second stair.
Eventually they should aim to perform single-leg hops and build up to 10 hops. Aim for a cyclic action of hopping (using an active foot-strike).

Moving past this stage of development should not be rushed. To avoid injuries and for the exercises to be most effective it is important to learn to perform all movements technically very well.

F/ Long Jumps
Aiming to add more horizontal velocity. Develop the technique of alternate leg bounding and of single leg hops. Carry out 10-20 contacts.

This is as far as most athletes may need to progress. A program should be designed that has a variety of jumps from all stages. They should be performed within a range of volume and intensity that is suitable for the athlete.

G/ Shock (Depth) Jumps
To raise power to the highest levels shock jumps can be used. This consists of jumps off boxes or rebound jumps over hurdles placed at mid-thigh height or higher. The training stress is high and this method should not be used with beginners of any age. Jumps over hurdles is a common method of plyo training BUT it is important to recognize that this is an advanced form of plyometrics. The intensity of the shock is proportional to the height of the drop.

Some Plyometric Activities

Bounces over 104cm plyo hurdles

Alternate leg bounding from a standing start
4 bounds & a jump into a sandpit from a standing start. We usually do up to 5 attempts.
When alternate leg bounding the athlete needs to strive to stay upright , have a high knee action, flat footed active contact and a vigorous arm action. With most alternate bounding the athletes strive for maximum distance and the total distance is measured noting improvement throughout the year.
These are performed in racing flats on a Mondo surface and we have not had any problems with

injuries from it. Almost all plyometrics is done in racing flats or light trainers- the only exception is speed bounding.

Alternate leg bounding from a running start.
4 bounds & a jump into a sandpit from a 5m, 10m or a 8 stride run-upt. We usually do up to 5 attempts. Running start bounds are more advanced and the athlete needs to have a more active & quicker contact with the ground. As the athlete reaches a higher levels they may occasionally do 9 bounds & a jump from a 8 stride run-up.

Running & bounding up short hills on grass.
Running & bounding up hill is great conditioning for more intense bounding and can be a safe way to work the glutes very hard without stressing the lower leg to the extent that any other kind of plyometrics can. We often do repeats of 60m up a grass hill where the athletes run 20m then bound 20m and then run 20m - repeating this 10-20 times with a few minutes rest in between reps.

Hurdles bouncing with double leg
This is very valuable activity but athletes need to progress slowly to greater heights while maintaining very quick contacts. It is very common to see people doing this activity over hurdles that are too high and the athlete is collapsing and therefore jumping not bouncing over each hurdle. We do 8 sets of 3 hurdles and make certain that athletes are doing them with quick contacts. We do them in flats over plastic plyo hurdles on mondo. The most advanced athlete who is strong in the gym has been able to bounce over 3 at a height of 104cm. Athletes can aggravate their knees with this activity if they progress to quickly and collapse foward on impact. The solution is to start low and be quick off the ground.

Hops over hurdles with 2 strides in between
This is a very high intensity exercise that should only be done by athletes who have great stabilization strength and have high levels of eccentric strength. The athlete hops over a plyo hurdle and lands with an active foot then takes one stride with the other leg and then on the next foot contact with they hop again over the next hurdle. They hop on the same leg usually over 3-4 hurdles. Each contact should be powerful and active. We usually do 3 sets of 4 hops with each leg. I have a sub12.00s 100m female athlete who can do these over 105cm.

Hurdle bouncing with single leg
This is even more intense than hopping with 2 strides in between. Few athletes will be strong enough eccentrically to be able to bounce very high at all using the same leg over plyo hurdles. This activity tends to cause contact times to be arguably too long to be as beneficial for the athlete as many other

activities. It may stimulate increases in eccentric strength more than anything else and be great for Triple Jumpers. If you try this I recommend that you keep the height of bounces low and insist on contact times being very quick.

Speed bounding
Speed bounding involves the use of alternate leg bounding but values both speed and distance. The athlete bounds rapidly over a set distance usually of either 20m or 30m. An observer counts the number of strides required to bound the set distance and also records the time to bound the distance usually starting the watch from the athletes first movement. The speed bound index can be calculated by mutiplying the number of strides by the time in seconds. With my squad I usually count strides to the nearest quarter and time to the nearest tenth. eg over 30m a sub12.00s 100m female has covered the distance in 4.24s and with 12.75 strides. This is a score of 4.24 x 12.75 = 54.1

Speed bounding from a running start
This is the same as the above with the added stimulus of a running start usually of 10m or 8 strides. Athletes who are just strting speed bounds from a running start can start with a 5m start. The running start causes the contacts to be much faster which is more difficult for the athlete if they are not powerful, but the activity is much more specific to maximum speed sprinting. An example of a score is with a female sub12.00 athlete who has done 4.37 x 11.0 = 48.0 for a 10m running start and 30m of speed bounds.

Speed hopping
Speed hopping over a distance of 25m is an activity that athletes can also perform. The aim is for the athlete to cover the distance as quickly as possible and the time is recorded from the first movement of the athlete. Speed hopping is very much a skill that the athletes need to learn. We usually only do a maximum of 3 repeats of a 25m of speed hopping when we use it.

Periodization
The athletes in my squad use a variety of Plyometric activities throughout the different phases of the year:
Hypertrophy/Conditioning Phase - Alternate Bounding from a standing start, Standing Long Jump, Hill running & bounding
Strength Phase - Alternate Bounding from a running start, hurdle bouncing double leg, hopping with 2 strides between,
Power Phase- Alternate bounding from a running start, speed bounding, hurdle bouncing double/single leg, speed hopping, 4 bounds
Conversion/Maintenance Phase - speed bounding from a running start

During the power phase an example of a typical dedicated plyo session for an advanced athlete is:

Warmup (Mixed)
Speed Drills
6 x 3 hurdle bounces double leg (alternating with a light weighted vest 3kg & using no weight)
3 x Hops with 2 strides between over 4 hurdles each leg
3 x 25m speed hops
Warmdown

The use of speed bounds is usually integrated into a track session.

Some bounding can be performed in the Gymnasium eg 3 sets of 2 x 4 alternate leg bounds
These are often done as part of a power circuit and we have mostly done them straight after performing a set of 4 quarter squats.

Competition and Plyometrics

We usually reduce the amount of plyometrics or cease it all together during the peak competition period because it is very challenging to the nervous system and can very easily produce periods of flatness that will negatively effect performance in competition.

Endurance Development

General Endurance
In the early stages Developing athletes should do a variety of things throughout the year to gradually develop their overall stamina. Rather than doing large volumes of one particular activity it is better to aim for as much variety as possible to build endurance.

It is also a good idea to avoid putting the athlete in situations where their technique fails. I have found that varying the activities adds to the fun and maybe a good way to develop endurance is for the athlete to simply arrive at being fit without really thinking they have had to strive for it. They just focus on enjoying the process while doing it well.

Important psychological development can come from long activities and the sense of enjoyment an athlete can get may come from some suffering in striving for a goal. This type of situation should however not being typical of the approach toward developing endurance. e.g. Climbing a mountain bushwalk to be rewarded with the view from the summit is a great experience for anyone and there are some important lessons learned from it. However activities in short bursts like using boxing training type speed ball will be great fun that will also result in improved conditioning.

Some ideas for developing General Endurance

- Long Bushwalks - occasional events - great overall conditioning plus good mental training.
- Circuit Training - maximum variety of exercises - possibly competitive.
- Speed Ball - performed for fun
- Med ball exercises - maximum variety of exercises
- Cross country running - running easily to see the scenery quicker than walking, maybe simply run and walk.
- Playing team sports - great development as long as movement quality is valued and athletes are not expected to play slightly injured.
- Play activities - swimming, cycling, skateboarding, rollerblading, ice skating, roller skating,

skipping, paddling, rowing, dancing etc.

Specific Endurance Training

Once an athlete has acquired a good background of general conditioning which would mean they have a few years of accumulated activity, then they can more exclusively work at training specific endurance. However even at this stage athletes need to periodically perform more general endurance training and this is usually done in the first stage of any buildup period.

A variety of concepts to do with specific endurance are presented below:

Speed Endurance
Sprinting over any distance further than that required to accelerate to maximum speed involves speed endurance. An athlete can maintain absolute maximum speed for no more than about 3 seconds. In developing athletes it is probably no more than 2s. It takes a most athletes about 5s to reach maximum speed which is somewhere near the 30-40m mark. They can the then hold maximum speed for about 20m before there is a gradual decline in running speed. This means that the last 40-50m involves a gradual deceleration from the absolute maximum speed that is reached. If the athlete loses form dramatically near the end there can even be a rapid drop in speed in the last 20m. Elite male sprinters reach their maximum speed at closer to 60m and then hold it for 20m before losing speed over the final 20m.

The endurance that needs to be developed to improve performance in the 100m for developing athlete is the endurance of (near) maximum speed. There is however a big problem in this area of training for all sprinters. Most training that aims to improve endurance of near maximum risks "habituating" a slower maximum speed. e.g. When an athletes does 4 x fly60m sprints at maximum effort with 2min rests they are doing a speed endurance session. The theory is that the nervous system in this session gets 4 experiences of what it processes is the athletes absolute maximum speed. This potentially can cause a drop in the athletes effective maximum speed when they are fresh. Because of this conflict in training many coaches of elite athletes choose to focus firstly on developing maximum speed to a new higher level and then they train to put the required amount of speed endurance training at a corresponding higher speed on top of it as the major race season approaches. For some athletes the primary way that speed endurance is developed is in races only. This explains the growing breed of specialist 200m athletes as athletes that are focusing more effort on developing speed endurance at the slightly lower speeds evident in the 200m event. But because of the lower amount of maximum speed focus these athletes can have a lower standard of performance in the 100m than what is possible for them. They have however made their choice and in some cases it is a very good one.

Developing athletes should do only a small amount of training for endurance of maximum speed. It is best to gain the required speed endurance simply from races over 100m and 200m. It is important in doing it this way that athletes aim to maximize the quality of their performance. This means not racing too often or when tired. When athletes focus directly on improving speed endurance by the use of speed endurance sessions they will likely be improving short term speed endurance at the expense of developing more maximum speed during that training period. Plus they will also be most likely "training in" bad habits that will limit the athletes long term development and increase the risk of injury. It is best to cycle between periods of maximum speed development and speed endurance development with any athlete. With developing athletes it is best to hold as the highest priority the goal of avoiding training bad habits and maximizing opportunities to acquire good ones.

It is possible to train to improve endurance of near maximum speed indirectly by working to improve the athletes strength, power and their ability to hold good running form when fatigued. 100-200m reps performed at sub-maximal speed while holding a good sprinting position will help athletes stay in a faster position while fatigued in races. Doing some sprint drills perfectly over longer distances

than usual may also help to improve the endurance of good running form.

It is most important to always maintain focus on improving form and in developing steadily the maximum speed of the athlete. Performing training with the aim of developing endurance of high speeds always risks compromising this path.

Submaximal Speed endurance
Training to develop endurance of speeds lower than maximum avoids some of the problems outlined above. However it is very important than an athlete rarely practises in a situation where there is loss of form. Young athletes lose form very easily because of their relative lack of stabilizing strength as the athlete develops strength this should grow to be much less of a problem. Training at the various speeds that are raced over 400-1500m is appropriate. It is better to focus on shorter repetitions in training because athletes are able to maintain good form much easier for all of each run if the distance is kept short. As the athletes improve in ability to maintain good form it is then appropriate to perform training repetitions over progressively longer distances. A good session to start using with athletes are 100m-150m runs eg 4 x 150m rest 5min focusing on 400m pace. These can be performed starting and finishing in a variety of places on the track. This is a better session than having an athlete attempt 2 x 300m at 400m race pace because they will likely lose running form at about 200m and practise bad habits for the last 100m. It is often best with athletes to allow plenty of recovery so that high quality of movement can be maintained. It is best to teach that the primary goal of tempo training is to practise running smoothly and is not simply suffering to improve fitness.

I have seen that it is possible for early stage developing athletes to improve their 400m performance a large amount by improving maximum speed, relaxation/rhythm at race pace, general endurance, overall strength and plyometric ability. Training regularly for specific endurance by activating the anaerobic system fully is something that is not necessary in most athletes. When really wanting to put the icing on the cake in the peak of the comp season a great short session could be something as simple as 2 x flying start 150m or 200m runs with a 3min rest between reps. This may only need to be done 2-3 times in a season combined with maybe just 6 good quality 400m races for a early stage developing athlete to perform with a good result in a 400m race.

In conclusion, it cannot be emphasized enough the importance of seeking to develop relaxation and rhythm at race speeds without fatigue effecting movement patterns.

Advanced athletes
More advanced athletes can do a greater volume in their relaxed tempo sessions. My squad often use 2-3 x 300m about 3-4s slower than maximum speed in a performed in a relaxed way with 10min rest between reps.

They can also do a greater amount of training during certain periods that is aimed to developing endurance at near maximum speed. One session we have used often this season has been 2-3 x flying start max effort 80m runs - done with a 2-3min recovery period.

Improvement of Technique

There is only one way to develop good technique and that is to practise perfecting it. It also means avoiding practising bad habits because that is counterproductive. However developing athletes usually do not have the strength to run with perfect technique so there is a problem. The solution is to design training to minimize the opportunities to be practising bad habits and to maximize the training that develops good technical habits. The guidelines below may be helpful in creating this situation.

Guidelines for Improving Sprinting Technique.

- Practise sprinting mostly over short distances. >15.0s runners over 30m, 15.0s runners should do sprints over 30-40m, 13.0s runners over 30-50m, <12.0 runners over 30-60m etc.
- Make use of flying start sprints where the relaxed acceleration is followed by a short period of maximum speed sprinting.
- Practise sprinting at maximum speed only when fresh and not more frequent than every 72hrs.
- Perform maximum speed sprinting only in volumes that allow the highest quality of running to be evident. Stop after the first significantly slower rep or have a much longer rest. e.g. 2 x 3 x 30m sprints
- Rest between reps 3-8min
- Practise sprinting with perfect technique at sub-maximal efforts.
- Perform drills perfectly or avoid doing them until learned properly. Do them in short perfect segments.
- Combine drills with sprinting e.g. 3s high knees cycling drill accelerating into a normal run while maintaining the same body position and height.

- Develop the required specific strength so that the athlete can improve body position.
- See all run throughs in the warm-up as opportunities to practise running so that it can be perfected.
- Avoid racing fatigued and don't over-race. Either do it really well or don't race.
- Use regular video analysis of technique doing every aspect of training. Use it to learn how to shape better habits.
- Be patient and keep shaping the athlete's technique. It will take years.

Training Session Ideas

Medicine Ball

There are new varieties of bouncy rubber medicine balls that are the size of a volleyball or basketball. These can be used to do a large variety of conditioning exercises. Athletes can perform some exercises very fast and develop power especially in the mid-torso and arms. In addition, the experience of being able to train at coping with impact forces is also beneficial. They will improve the ability of an athlete to cope with rough races and have a better chance of staying on their feet when bumped. Many of the exercises are great for overall co-ordination and balance.

There are great range of exercises available at www.faccioni.com
Athletes can do one set of 10 of each of the exercises in any of the four sessions.
http://www.faccioni.com/fcubed.html

Medicine Balls can also be used in Throws for maximum distance.
There are a range of throws that can performed in training that can also be measured as indicators of increases in full body power.

Medicine Ball Testing Activity A (start with a 2kg ball progress to 3kg)
4 attempts at each
-standing underhand forward throw
-standing over the head backwards
-chest pass lunge and throw
-sideways twist and throw to the left
-sideways twist and throw to the right

My Foundation Squad does at least one session a week all year of an ever changing variety of medicine ball exercises.

Larger volume sessions can be done with Med Balls with advanced athletes. Charlie Francis

describes some large volume sessions done with Medicine Balls in his book Training for Speed. He writes that some athletes do 6-10 exercises sometimes totalling 800-1200 throws in a single workout.

Plyometrics - each activity may be part of a larger session.

Plyo Activity A
Alternate leg bounds
5 x 4 alternate leg bounds and jump into a sandpit- measure the total distance in each. rest between 3-5min

Plyo Activity B - perform as major part of the session combine with tempo training or technical drills. Measure total distance in each
Plyo Testing
3 x 4 hops left leg
3 x 4 hops right leg
3 x standing triple jump starting from the left leg
3 x standing triple jump starting from the right leg
6 x standing long jump
3 x hop-step-hop-step-jump

Plyo Activity C - best performed at the end of a session.
Sandpit Plyo
Perform in sandpit barefoot - more of an ankle conditioning activity than pure plyometrics. Safe to do quite large amounts of jumping in sand.
4 x 10 double leg hops - short rests
4 x 10 hops left leg
4 x 10 hops right leg

Plyo Activity D - perform early in a bigger session.
Hill Bounding
1-5 sets of 3 x 20m hill bounding rest between each 3min/longer between sets

Plyo Activity E
Hill Bound & Run
1-4 sets of 3 x (20m hill bounding +20m run) rest between each 3min/longer between sets

Plyo Activity F
Running start alternate leg bounding
Progress from standing start alternate leg bounds to running start bounds. It is best to start with a short run up and as skill/power improves to extend the run up.
5 x 5m run up and then 4 alternate leg bounds and jump into a sandpit - measure the total distance in each. rest between 3-5min
or
4 x 10m or more runup then 4 bounds & a jump into the pit
or
4 x 10m or more run-up then 9 Bounds & a jump into the pit.

Plyo Activity G
Hurdle Hops - 6-8 x 3 hurdles double leg bouncing in between. Make sure ground contacts are very quick and this means keeping the hurdles very low. Initially maybe as low as 30cm. Do not progress with the height so fast that it lengthens contacts times.

Plyo Activity H
Speed Bound Index
The athletes alternate bounds from a standing start for 30m. The number of steps taken is counted and rounded up to the nearest half. The time is also recorded from the athletes first movement to the nearest tenth of a second. The Speed Bound Index is calculated by multiplying the number of steps by the time taken. The lower the score the better. Improvement in this score is indicative of higher levels of sprint specific power. In a session an athlete should have no more than 5 attempts.

Plyo Activity H
Speed Bound Index from a running start.
Perform speed bounds over 20-30m from a 5m, 10m or 8 strides run-up

Dedicated Plyo Session
Warmup (Mixed)
Speed Drills
6 x 3 hurdle bounces double leg (alternating with a light weighted vest 3kg & using no weight)
3 x Hops with 2 strides between over 4 hurdles each leg
3 x 25m speed hops
Warmdown

Swiss Ball

The swiss ball can be used as a multipurpose bench, which has the training advantages of being an unstable environment. Any kind of training in an unstable environment is great for strengthening stabilizer muscles. The shape of the ball also allows for multi-angle training and allows greater range of motion on some exercises. These are important factors in properly training certain muscle groups e.g. the swiss ball crunch. It can be performed starting from a hyper-extended position over the ball. It is recommended that athletes learn the correct techniques. The best way to do this would be to attend Swiss Ball classes which are increasingly becoming a regular fixture at many fitness centres. Alternatively, there are a number of very good video workouts, which explain carefully the finer points of technique and present planned sessions. I have found videos to be very effective and enjoyable for the athletes in my squad. It is important to recognize Swiss Ball training as a way of improving functional strength and not just a toy for improving balance etc.

Many athletes enjoy doing exercises on Swiss Balls - choose a range of exercises, learn to do them properly and perform just 10 exercises of each.

I have found swiss balls great for helping athletes to improve posture and stabilization. But it is important to do more intense activities in the Gym to increase strength levels to a higher extent in the mid-torso. Swiss Ball training or unresisted mid-torso training alone is not enough.

Pilates

The Pilates variety of exercises have been an integral part of ballet training for many years. The basic principles of Pilates conditioning are to make people more aware of their bodies as single integrated units, to improve alignment and breathing, and to increase efficiency of body movement. The method consists of a sequence of carefully performed movements with some carried out on specially designed equipment. Each exercise is designed to stretch and strengthen the muscles involved accompanied by a high level of focus on learning to relax. Athletes in my squad that have done a significant amount of pilates have exhibited improved body awareness and control . I have noticed that they are able to learn to do drills much easier than other athletes. I also believe this area of training is exceptionally good for enhancing hip mobility and mid-torso strength.

Pilates can be done at studios where it is common to have personal tuition or there are a variety of good video workouts of floor exercises. My squad do Pilates video workouts at least once a week all year, one good one combines Pilates with some yoga stretching it is called a Mat Workout Based on the Work of J.H. Pilates by Denise Austin.

Gym

The Developing athletes in my squad do good variety of exercises using Weights.
Some of the exercises I have found good are:
Step-Ups. There is a distinctive way to perform Step-ups that is a good test of stabilization ability. They are performed on alternate legs with the lower leg kept close to vertical throughout the movement. Executed this way they target the glutes more than when the knee is allowed to move forward and are a good specific hip extension exercise. Often when Athletes start training with this exercise they have great difficulty in staying tall and maintaining level hips. There is a great tendency to 'wobble' or 'twist' on the way up. This indicates that they have weak stabilizers. Athlete progress is clearly limited by their ability to stabilize the weight. So this is a good way to measure improvements in stabilization strength. Athletes usually display the gains from other training methods that impact upon stabilization by improving in the perfect execution of this exercise more rapidly.

Young kids can start step ups on a low box without a weight progressing to a box that is not so high that it causes their upper leg to be lifted above parallel. Then add a barbell weight and progress within the obvious limits of the athletes stability. Do 3 sets of 8 each leg.

Standing Vertical Dumbell Presses - The athletes stand tall with good posture and have to focus on maintaining this position throughout each set. If they cannot stand tall they are lifting too heavy. Do 3 sets of 6 -10.

Chin-ups - Athletes develop the ability to do 3 sets of chinups for as many as they can do. If they can't do any then they can do standing lateral pulldowns on a machine that uses a cable.(3 sets of 6-10)

Standing Upright Rows - The Athletes stand tall with good posture and hold a barbell near the middle and lift it to the height of the base of their neck. If they cannot maintain their ability to stand tall they are lifting to heavy. Do 3 sets of 6-10

Exercise choice - There are many other exercises that can be used that are good. I have read some research that recommends against using isolation exercises like hamstring curls, knee extension or leg press. The argument is that these exercises are training muscles in a way that is not the way the muscles function when moving. Some even consider that these exercises may increase the risk of injury. I consider them appropriate for rehabilitation or at best for basic general conditioning. My squad rarely ever do these exercises.

(See the Strength Training Section for some more advanced ideas)

Theraband exercises

Therabands are thick flat rubber bands that can be purchased in a roll. They exist in a number of resistance grades. Many stabilizer muscle groups can be specifically strengthened using them.

A few examples are:
1. Cut a 90cm length, and tie the ends. Get the athlete to step into the theraband circle (band around ankles) and get them to do a series of sumo type walks (squat position with wide legs). Get them to

walk sideways, forwards and backwards lifting each leg up (like sumo wrestlers do) and not allowing the theraband to pull their legs together. It is recommended to do one set of 15-25 steps.
2. The athlete lays face down with the theraband around their ankles. They then get into a hyperextended position and abduct their legs. It is recommended to do 1-2 sets of 20.
3. Hip Rotators can be strengthened by having the athlete lay face down, knees together with the lower legs held vertically and placing the Theraband around their ankles. The athlete should then maintain the knees together and rotate their hips so that their ankles move outward. A similar exercise can be devised to strengthen rotation in the opposite direction.

Often there are big differences in the strength of outward movement and the inward movement. Strengthening and equalizing hip rotator strength should improve stability and improve running form especially when fatigued.

Hill Training

Hills can be used in a variety of ways. They are good for developing strength in the running action. Athletes can do starts running up slight hills, they could bound 20m or they could do longer runs up hill for endurance. The most pleasant type of hill is to use a hill that varies in slope and winds slightly as it climbs in a natural setting.

Hill Training Acceleration Activity A
4-8 x 20m starts - full recovery

Hill Training Power Activity B
4-8 x 20m alternate leg bounding - full recovery

Hill Training Endurance Activity C
4-10 x 80m rest between 2min

Hill Training Endurance Activity D
2-3 x 800m hill on slight slope gradually going faster - walk down recovery

Hill Training Strength Endurance Activity E (Advanced)
2-4 sets of 3 x (20m bound + 20m run + 20m bound) recovery 90s and 8min between sets.

Downhill Training

Running down very slight slopes is also a good way to practise good technique. When running downhill it is very obvious to the athlete when they are overstriding. The goal should be to run with a smooth action and to do this the athlete has to practise maintaining dorsiflexion and making ground contact well underneath the body.

Downhill Training
4-6 x 60m relaxed with smooth impacts on a very slight smooth grassy slope. recover between 3min

Combined Hill Training

3-5 laps of (hill run up gentle slope - 30-50m bound up a steeper hill - 100m slow jog - walk down steep hill - fast smooth running on gentle downhill - jog across to bottom of hill)
Do these continuously at a manageable intensity. Aim for quality bounding on each lap.

Sprinting Technique Development

Sprint Drills
Drills aim to specifically strengthen the muscles in postures and actions that are similar to those that occur during the sprint action. They are posture drills, specific strength drills and functional flexibility drills all at the same time (Gambetta et al.). It is very important that correct execution of the drill be trained carefully with coach feedback essential. This is because drills performed incorrectly can ingrain bad habits that will result in the opposite of the intended effect. Bad drills are much worst than not doing drills at all. Athletes should never perform them as relaxed warm-up activities unless they are done perfectly. They are as serious a business as a concert pianist practising piano.

I have the athletes in my squad simply concentrate on two drills:
1. Ankling - circular movements of the lower leg maintaining dorsiflexion, striking with a backward moving (active) foot. They do 6-8 of these over 6-8s every time they warm-up.
2. Quick Recovery High Knee Running - they catch their leg early bring it rapidly up underneath stepping over the height of the other knee. They keep their pelvis stable lift their knees as high as they can without 'sitting'. They do these aiming to perform them with perfect form. This means maintaining constant lumbar curve, avoiding 'sitting' or losing dorsiflexion before impact. The positive cues are to stay high, step over opposite knee and land flat footed. They do about 6-8 of these over 6-8s at varying tempos and transition out of them into the normal sprint action for about 15m.

Sprinting - Maximum Speed Development

Athletes perform all runs in these sessions one by one. This is so that they can practise thinking about their movement by themselves without distraction. It is too easy for athletes when they have someone else near them in another lane to compete and not think about how they are moving.

Just choose one kind of session to perform on a given maximum speed training day from something similar to the following.

Max Speed Activity A
30 - 40m sprints from a 3 point start. Aim to do up to 6 with 3-8min rests in between. Only do as many as the athlete can perform with absolute best times. (We time them starting the watch from their first movement). As soon as they have become significantly slower this part of the entire training session should end. It is possible to do 2 sets of 3 with 3-8min rest between sprints and a longer but active break between sets.

Max Speed Activity B
Flying start sprints the athletes should accelerate gently for about 25m then sprints maximally across a 15-30m zone. The goal is to create the highest speeds possible over what will be about a 2-3s duration. Aim to do 2 sets of 3 with 3-5min rest in between and an active recovery in between sets.

Max Speed Activity C
in's and out's the athletes should accelerate gently for about 25m then sprint maximally across a 15m zone this is called the "in" then they should freewheel maintaining stride frequency for 15m this is the "out" before performing another 15m "in". Aim to do 4 with a 5min rest in between.

More advanced athletes can do in & outs over longer distances e.g. 40m max acceleration zone then 20m "out" , 20m "in", 20m "out" and finishing with 20m "in".

Max Speed Activity D
Sprint Conditioning
40m sprints at 95% effort - practising good form and relaxation. Do 2-3 sets of 4-5 with a recovery of 90s between reps and a longer active recovery between sets. Important to do no running at maximum effort. This type of session is thought to increase the storage of CP.

Ideas and possible variations are to:

- always have the athletes do maximum speed sprints with the wind. Running against the wind is a strength activity.
- have the athletes do some sprinting on a bend where they focus on keeping their left hip high.
- occasionally do a small amount of plyometrics between each sprint.

Advanced Techniques
Overspeed Training
Overspeed Training is very effective in some athletes at increasing maximum speed. However it is a dangerous activity and must be conducted very carefully. Athletes should not do overspeed training unless they have a high level of postural control and are not athletes with a pronounced anterior tilt (butt out postition). Overspeed towing will pull the athlete into a position of even more lumbar curve and will very likely result in hamstring or back injury.

There are a number of forms of overspeed training:

Surgical Tubing
We used to use surgical tubing and have one athlete tow walk foward to pre-stretch the tubing and then run at a pace that provided the right amount of resistance. We found that the athlete had a large amount of assistance early but the overspeed effect was difficult to control.

Using a Pulley Mechanism - Ultra Speed Pacer
We have been using this method of overspeed training with good effects. The athlete is assisted by a partner towing them using the multiplying effect of the pulley. The assisting athlete only need to run about half as fast as the athlete being assisted and the force delivery can be smooth. To use the ultra speed pacer requires at least 2 people as well as the athlete. One athlete to wear a harness which has the pulley mechanism immediately behind them. One coach to hold the handle at the end of the cable

(or a pole to fix it to) and someone to time the performance of each run and monitor the athletes form.

A typical overspeed session we have performed is detailed below:

Warmup (Mixed)
Speed Drills
40m sprint from 3 point start
4 x 40m assisted tows using speed pacer
1-2 x flying 80m rest 3min at 100%
Warmdown

This session is a combination of overspeed and speed endurance straight afterward. An example of the data collected for a sub12.00 100m Female is the 40m from 3pt in 5.00s from first movement and the assisted runs are in 4.34-4.54 , the fastest flying 80m recorded has been 8.68

I would not recommend doing assisted sprinting with surgical tubing or an ultra speed pacer on a grass track. It is difficult enough turning muscles on & off faster with overspeed let alone adding the difficulty of stabilizing on an unreliable surface. Overspeed can often make the athletes sore from the increased forces experienced. I would recommend starting with just 2-3 assisted runs and repeating once a week on a fresh day and at least 4 days before any competitions. Never do this form of training when the athlete is sore. Also I would only do this form of training with an athlete who has done regular maximum speed sprinting and is close to a speed plateau. It is best done during the late power phase and conversion/maintenance phase of training.

I have read that it is also valuable to do overspeed while wearing a lightly weighted belt e.g. 2kg. This increases vertical forces and trains the athlete to stay up higher. I have not yet used this method of training with my squad.

It is also possible to do slight overspeed sessions using downhill running or with talwind. Both of these methods may help but are not near as effective as overspeed towing.

Acceleration/Complex Training
There are special low resistance disk sleds available that have a mechanism that causes the sled to drop off the back of an accelerating athlete after a set distance. We have used this equipment to cause a recruitment overspeed effect. The contrast effect of having the athlete sprint maximally while resisted causes recruitment of a greater amount of muscle and then when the resistance is released the athlete experiences a surge of speed. This is a great way to train the nervous system to allow the athlete to run faster. It is just like when someone throws a medicine ball repeatedly and then picks up and throws a basketball.

There are many other ways to use complex training:

- Lifting weight and then bounding or bouncing e.g. quarter squats then bounce over hurdles.
- Lifting weights and then sprinting eg squats fast then a block start.
- Running arms with weight then unresisted running arms
- Uphill Training then sprint on the flat
- Resisted starts then unresisted starts
- Weighted belt sprints then unweighted
- plyo bounces with a light weight then without weight

All of these methods function by impacting on the nervous system in a different way than conventional training. A big part of sprint training when an athlete is already strong and has reached a plateau is to work on more conversion of strength to power and power into the specifics of

sprinting.

The book Explosive Power & Strength by Donald Chu covers complex training in detail.

Starts & Acceleration

Many young or older developing athletes are not strong enough to start properly but it is still important for their performance to be able to react to the gun and accelerate with as good a technique as possible.

Acceleration Activity A
Block starts
Perform 4-6 x block starts over 15m. rest between 3min
Focus on keeping eyes looking down at track head down, using a big arm action and pushing. The goal is to have an entire body that is leaning forward significantly and being held up by the strong forces being exerted from the legs as a pushing action. These are best done with competition. It is important for the starter to vary the pause and deter athletes from guessing the gun. Athletes can prevent "popping up" vertical too early by keeping their eyes looking at the track more closely - this will keep their head from leading the body up.

Acceleration Activity B
Resisted acceleration.
The coach or an able assistant faces the athlete and resists them as they try to accelerate by pushing against their shoulders. It is important to have the athlete leaning forward through their whole body as they do this. It is also fun and effective to have the resisting partner release tension on the athlete which allows them to display a subsequent brief burst of speed.

Another way to resist is to use a harness and resist using a long length of stretchable rubber tubing and some rope. This is what my squad uses and the athlete is able to accelerate maximally for 20m. We would plan to do this 3 times then 1 unresisted for a contrast effect and may do two sets of this.

Acceleration Activity C
Gun Reaction Drill
The athletes should get down on all fours and practise moving their arms like they will when the gun is fired. e.g. If an athletes has their left foot forward in the blocks then their left arm should swing forward and their right arm backwards. Athletes should practise this so that it becomes automatic that they react to the gun without having to think about it as much.

Acceleration Activity D
Plyo then accelerate
Athletes do 4 alternate bounds then sprint 20m. Repeat maybe 4 times with 3-8min in between.

Speed Endurance Training

Tempo Sessions
These are opportunities to practise good technical form and relaxation. They develop a sense of rhythm in the athlete. They can be done over any distance but the main rule is to avoid producing form that would effect running form. Tempo sessions are great way to practise running and are very important for the long term development of the athlete. The athlete should run relaxed at a speed that is well within their ability and emphasize staying in as good a sprint position as possible. Athletes should not perform tempo runs in a lazy position. They should stay tall, have a full arm action and

maintain a perfect postural position.

Tempo Activity A - Athlete should maintain relaxation throughout all runs. "Speed that comes Easy".
4 x flying start 60m rest between 3min
active recovery 10min e.g. Med Ball
4 x flying start 100m rest between 5min
active recovery 10min e.g. jog
4 x flying start 60m rest between 3min

Tempo Activity B - Athlete should maintain relaxation throughout all runs. "Speed that comes Easy".
4 x flying start 150m rest between 3min

Tempo Activity C - Athlete should maintain relaxation throughout all runs. "Speed that comes Easy and is variable"
6 x 100m changing speed slightly every 20m rest between 3min

Tempo Activity D
2-3 x flying start 300m at 4-6s below max effort with 10min between. The athlete should make sure that each 100m is slightly faster.

Speed Endurance
To develop the endurance of speed at race speeds it is best with kids to develop this in races but there are some sessions that are also good. It is important not to do these types of sessions very often in young kids or early stage developing athletes because the priority should be to develop absolute maximum speed and improve running technique. Always the athlete should be striving to run with as good a form as possible.

Speed Endurance for 100m Activity
2 x 2 x flying start 60m rest between sprints 2min and 10-15min active between sets.

Speed Endurance for 200m Activity
2 x 2 x flying start 100m rest between sprints 3min and 10-15min active between sets.

Speed Endurance for 400m Activity
2 x flying start 200m with 3min rest between sets. Have a 15min recovery and then the athlete could do 3 x flying 60m relaxed at 400m pace with 3min rests.

Endurance Drills
Once athletes are capable of performing sprint drills technically well they can then perform them over longer durations as a way of improving the endurance of holding good body position. The athletes in my squad do our version of the high knees drill in segments totalling up to 200m. They only go as far as they can hold good technique in each segment. I have seen great gains in the ability of the athletes to hold good form come from this area of training. The caution is never to have an athlete use drills in this way until they technically proficient at them or they will be practising bad habits. I have heard of athletes doing up to 400m of certain drills in a single effort. If done properly this would be a superb way to develop maintenance of a good body position.

Novelty Training

Carrying balls
Athletes run carrying a 2-3kg med ball in front of their chest at a relaxed speed. Aiming to minimize the wobbling that occurs when no arm action is happening to aid in balance. This teaches them that

the function of arm action is also to balance. It may help eliminate the bad habit that many athletes have of swinging their arms in a way that increases trunk lateral rotation. Athletes could also practise running with no arm swing and also with very minimal arm swing.

Foam rollers
Athletes can use foam rollers to train the core in a way that aids balance. These can also be used to stand on while throwing and catching medicine balls as an extra challenge to balance. Kids find this to be a lot of fun.

Skateboard Riding/Scootering
These activities are both similar to the active foot action used in running and they are great for developing the strength of the stabilizer muscles. Athletes will find that they fatigue quicker in the leg on the scooter or skateboard and not the one hitting the ground. It would be good if athletes that ride scooters or skateboards develop the ability to ride using either leg and do them in equal amounts. Then riding scooters and skateboards will likely have a positive effect on their running. This is as long as they avoid injury from crashes ofcourse!

Rollerblades, Ice Skating and Rollerskating.
Most skaters have great postures this is because skating develops the strength of the upper glutes (glute medius) and also the adductors. These are very important muscles for stabilization. Skating is great way to develop better balance, stabilization and strength in the important glute muscles. If you think that the top 100m sprinters have big glutes check out the posteriors on the speed skaters!

Rope Skipping
Almost any sort of skipping rope type games are good. Maybe best done in short segments with more difficult to master activities preferred. Once again like with all plyometrics avoid trying to jump in a way that prevents the heels from touching the ground.

Play running
Skipping, backwards running and combinations of various ways to move are also great for adding another different physical and neural stimulus.

Some ideas would be to expand the use of movement play in the warm-up period. This can truly be what is called a mixed warm-up by having athletes use and develop a great range of different movement skills. Skipping, Karioka, Side-steps, backward running, lunge walking etc.

Technical Practise

Baton changes - It is fun for athletes to work in pairs to improve their confidence and effectiveness in relay baton changes. Many athletes first taste of success is in relays so it is worth practising.

Hurdle Drills - Hurdle Drills are very good for improving hip mobility and stabilization of the trunk. Young athletes find it fun to learn how to do them and practise. Short hurdle races are also fun for athletes to do in training.

Hurdle Walking
The athlete walks over six or eight low hurdles setup at about one metre spacings. Stand just before the first hurdle, lift the lead knee up very high and place the lead leg vertically down on the other side of the hurdle. The lower part of the leg should not reach out in front of the body. Bring the knee of the trail leg out to the side to above hip height with the foot pointed outward to clear the hurdle. Bring the trail knee across the hurdle and as the trail knee clears the hurdle bring the knee up and to the front centre of the body. Move the trail leg vertically down on the other side of the hurdle. The lower part of the leg should not reach out in front of the body. It is important to maintain high hips

throughout the action and use a good range of arm movement. These drills can also be done with the extra challenge of holding a ball with straight arms above the head.

Mobility Drills

Leg swing drills
1. Leg Swings. Stand holding onto a wall for balance with one hand. Swing a leg forward and backward 10-15 times. Repeat with the other leg.
2. Inward and Outward - Place both hands on a wall for support. Swing a leg out away from the body and back across the body 10-15 times. Repeat with the other leg.

Hurdle drills
Lateral Leg Lifts. Stand at the end of a hurdle, with our body slightly to the left of the hurdle. Keeping your right leg straight, lift it up and over the hurdle. When your right foot hits the ground, lift your left leg and circle it over the top of the hurdle. Pause and step back across the hurdle with your left foot first. Start with 3 sets of 5 reps in each direction and build to 3-5 sets of 10. There is a variation of this drill where the athletes does the same action with legs that are bent. This creates a situation where there is a higher knee lift.

A more advanced activity is to set up 5 hurdles.
Then start by moving laterally over one hurdle and then back one,then over two and back two,over three and back three,over four and back four,over five and back five, over four and back four, over three and back three, over two and back two, over one and back one.
This a total of

Lower leg conditioning

Many athletes have trouble with lower leg inujuries as they mature and especially if they are training really hard at any stage in the future. It is a good investment of time to perform as much pre-habilitation exercises as possible. The muscles of the shin, foot, ankle and calf can all be conditioned in a variety of ways to make them more resilient.

One simple way to condition the lower legs is to do heel/toe walking at the end of most training sessions. For all but the most important competition part of the year. My squad twice weekly do 2 sets of:
30m walk on toes as high as possible
30m walk on heels with toes pulled upward toward shin as high as possible.
30m walk on toes as high as possible with toes pointed outward.
30m walk on heels with toes pulled upward toward shin as high as possible with toes pointed outward.
30m walk on toes as high as possible with toes pointed inward.
30m walk on heels with toes pulled upward toward shin as high as possible with toes pointed inward
30m on the outside of the feet.

These are best done barefoot where possible. Barefoot walking & play is a good way to condition the feet. Staying in shoes all the time allows condition of the feet to deteriorate and will likely eventually in foot/lower leg injury such as plantar fasciitis.

Stretching

I believe it is best for all athletes at any age to follow a personalized stretching program designed by a physiotherapist but teaching some important stretches is also valuable in training. It is important that athletes know how to do it properly. Combinations of some dynamic stretches and static stretches are appropriate. Muscle Physiology researchers now believe that static stretching does not decrease the risk of injury pre-competition or pre-training. Some research has shown a slight increase in injuries among athletes that stretch statically pre-event. My squad do loosening up activities involving the use of accupressure and then a mixed movement warm-up. They do static stretching mostly at home that is designed for them personally and a small amount after training.

Planning a Training Week

The spacing of certain types of training activities needs to be carefully thought through so that maximum quality can be produced in the athletes training. Physiological and Nervous system freshness is essential if athletes are going to develop good technical habits. Also young athletes should be fresh for most competitions that they plan to perform in. The following are guidelines to help with the planning of athlete training for an early stage developing athlete.

In the Off-season:

- No more than three in total of maximum speed sessions OR plyometric activities per week that are spaced 72hrs apart.
- At least one day a week where there is no running.

E.g.

Mon - Track Session - Max Speed + Med Ball
Tue - Pilates or Swiss Ball
Wed - Track Session - Plyometrics + Starts+ Tempo
Thu - Gym
Fri - rest
Sat - Hills + Tempo
Sun - Jog + Pilates or Swiss Ball

If racing in low key meets:

- One maximum speed session per week that is at least 72hrs before competition.
- No more than one plyometric activity per week that is at least 48hrs before competition.
- At least two days a week where there is no running.

E.g.

Mon - Track Session - Max Speed + Med Ball
Tue - Pilates or Swiss Ball
Wed - Track Session - Plyometrics + Starts+ Tempo
Thu - Gym
Fri - rest
Sat - Competition
Sun - Jog + Pilates or Swiss Ball

In the 5 days before major competitions:

- No maximum speed sessions.
- No plyometric activities.
- At least 2 days of no running.
- Small numbers only of starts. eg 3-4 starts
- No Gym training

e.g.

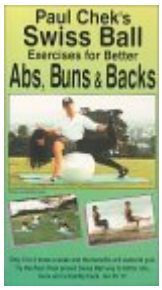
Mon - Track Session - 3-4 Starts to 20m + Med Ball
Tue - Pilates or Swiss Ball
Wed - Tempo - small volume eg 4 x fly100 relaxed at 80%
Thu - Warm-up and Drills only
Fri - rest
Sat - Major Competition
Sun - Pilates or Swiss Ball

Planning for more advanced athletes
The challenge for the more advanced athlete is to be able to create a program that maximizes quality in all training as much as possible. The more advanced athlete will generally do at least 3 sessions in the gym with weights where at least 2 are major sessions. Some athletes do their weight training after sprinting and a few do theirs a few hours before they run. The key in planning is to maximize nervous system recovery and make certain that fast days are fast.

Recommended Resources

Training Kids for Speed companion Video

Paul Cheks Swiss Ball Video 'Better abs,buns & backs"

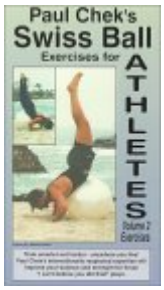


My squad do this Swiss ball workout 2-3 times a week for most of the year.

Paul Check's Swiss Ball Exercises for Athletes Vol 1 - VHS

Excellent Training Video Series that shows how to train using a Swiss Ball for best effects.

Paul Check's Swiss Ball Exercises for Athletes Vol 2 - VHS



Excellent Training Video Series that shows a full Swiss Ball workout that is performed using the right methods.

Denise Austin - Mat Workout Based on J.H. Pilates (2000)

This video contains 2 x 20 minute workouts - They are great to incorporate with other workouts or use alone when time is limited. Workout 1 is all pilates. Workout 2 combines yoga and pilates. My squad does this 2-3 times a week.

How to strengthen the lower parts of your legs, and prevent (or repair) shin-splint problems.
by O. Anderson and W. Reynolds
http://www.pponline.co.uk/encyc/0161.htm

Back to Basics
by Vern Gambetta
To do with development of children and physical activity
http://www.gambetta.com/a97001p.html

Functional Balance
by Gary Gray and Vern Gambetta
Ideas to do with balance training
http://www.gambetta.com/a97002p.html

Explosive Power & Strength : Complex Training for Maximum Results
Donald A. Chu / Paperback / Published 1996
http://www.amazon.com/exec/obidos/ASIN/0873226437/sydney2000trac00/

Too Loose Too Much
by Vern Gambetta
The truth about stretching
http://www.gambetta.com/a97003p.html

Following the Functional Path
by Vern Gambetta and Gary Gray, PT
Functional training explained
http://www.gambetta.com/a97004p.html

Leg Strength for Sport Performance
by Vern Gambetta
The functional way to strength train legs
http://www.gambetta.com/a97006p.html

Learning to Move
by Vern Gambetta
http://www.gambetta.com/a97007p.html

Plyometrics: Myths and Misconceptions
by Vern Gambetta
http://www.gambetta.com/a97008p.html

Neuromuscular adaptations following prepubescent strength training.
Ozmun, J. C., Mikesky, A. E., & Surburg, P. R. (1994).
http://www-rohan.sdsu.edu/dept/coachsci/vol66/ozmun.htm

Strength Training for Children
by J. Graham

http://www.faccioni.com/Reviews/childstrength.htm

The Use of Medicine Balls for Speed & Power Development
by A. Faccioni
http://www.faccioni.com/Reviews/medballtraining.htm

The Role of the Mid-Torso in Speed Development
by A. Faccioni
http://www.faccioni.com/Reviews/midtorsospeed.htm

Plyometrics
by A. Faccioni
http://www.faccioni.com/Reviews/plyometrics.htm

Dynamic Warmup Routines for Sports
by A. Faccioni
http://www.faccioni.com/Reviews/Warmup.htm

Speed Training for Team Sport Athletes
by A. Faccioni
A range of good ideas
http://www.faccioni.com/Reviews/teamspeed.htm

Pilates ReTraining of Lumbar Stabilisation Muscles
Some explanation of value of Pilates exercises
http://www.faccioni.com/Reviews/pilates.htm

USA Sprint Tech Info.
by Adrian Faccioni
(Power Point Presentation)
486Kb zip file
Brilliant description and analysis of modern sprint biomechanics and training.
http://www.faccioni.com/articles/USA%20Speed%20Presentation%202000.zip

The Inner Unit - A new frontier in Abdominal Training
by Paul Chek
Great article
http://www.coachr.org/innerunit.htm

The Outer Unit
by Paul Chek
Great article outlining importance of specialized core conditioning
http://www.coachr.org/outer.htm

The Use Of Swiss Balls In Athletic Training-
An Effective Combination Of Load And Fun
By Klaus Bartonietz, Germany, and Debbie Strange, New Zealand
Some explanation of value of Swiss Balls
http://www.coachr.org/sb.htm

Young Athlete Conditioning
by Adrian Faccioni and Di Barnes
Excellent article
http://www.faccioni.com/lectures/juniorcondition.PDF

'Run-Play' Training
Some Creative training ideas
http://www.pponline.co.uk/encyc/0272.htm

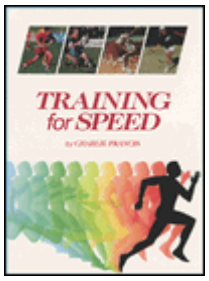
Proceedings of the Conference on Strength Training & the Prepubescent
Information about safety of strength training for kids
http://www.sportsmed.org/Publications/..%5Cpdf%5Cstrength_training_prepubescent.pdf

Why sprinters should cock their ankles
Explanation of Dorsiflexion
http://www.pedigest.com/sample/biomechanics.html

The Simple Secrets of Developing Great High School Sprinters
by Bryan E. Hoddle
Some useful ideas and explanation
http://www.watfxc.com/TF/TF%20Education/Hoddle1.htm

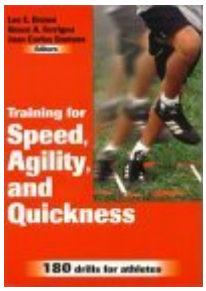
The Pros And Cons Of Using Resisted And Assisted Training Methods With High School Sprinters
Parachutes, Tubing, And Towing
By Ken Jakalski
http://www.coachr.org/vests.htm

Training for Speed by Charlie Francis



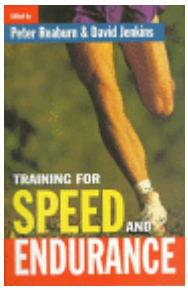
A recommended book on Sprinting. Contains plenty of great sprint training ideas. Written by the coach of Ben Johnson who ran 9.79 for 100m in the Seoul Olympics. For more information

Speed Agility and Quickness
by Brown, Ferrigno and Santana



Heaps of ideas for activities that develop Speed, Agility and quickness.

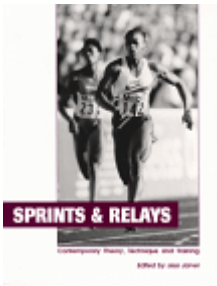
Training for Speed and Endurance
by Peter Reaburn (Editor), David Jenkins (Contributor)



The contributors to Training for Speed and Endurance are sports specialists keen to bridge the gap between

laboratory findings and athlete preparation. They are all involved in the training and preparation of elite athletes, and their aim in writing this book has been to provide practical guidelines for developing and maintaining speed and endurance fitness for both individuals and team players. Training for Speed and Endurance will make sense of all the new techniques and the latest research. It will be of interest to anyone wishing to gain up-to-date information on training principles and will be of particular value to those individuals or team players who need to focus on speed and endurance. The book is an excellent resource for coaches, individual athletes, health and physical educators of senior students, and tertiary students of sports science.

Sprints & Relays : Contemporary Theory, Technique and Training
by Jess Jarver



Great compilation of recent research to do with Sprints & Relays.

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