Speed Training: Improving Acceleration for Optimal Performance

By maximum-maximorum.com

Introduction

The ability to accelerate is an important quality to possess in sports such as Track athletics, Rugby, American Football, Soccer and Basketball.
The worlds fastest men (Usain Bolt, Asafa Powell, Tyson Gay), and women spend a large amount of their time training to hone this most important of skills. The ability to accelerate allows Rugby players like Brain Habana, Jason Robinson and Jos Lewsey to evade the opposition. In this post, we will analyse the mechanics and major muscles (also known as prime movers) fundamental to high performance acceleration. We will then suggest training methods to develop this most important quality for speedsters of all running sports.

Description of acceleration mechanics

At the start of a run or sprint, athletes have to assume a favourable position to accelerate their body. This position is characterised by a lean forward with the support or drive leg behind the body. An example is the start and acceleration position of the 100m in Track and Field. The acceleration mechanics can be characterised by a long stance phase and a floating phase that is short.
This position allows the athlete to apply more force and recruit muscle mass to overcome gravity.
Starting and acceleration differ enormously from constant speed or maximal speed. The foot spends a longer time (circa 180-250ms) on the ground and because of the lack of pre-stretch of the achilles tendon (relative to the constant speed phase) muscular strength is a significant factor for success. This type of strength is classified as explosive muscular strength. The foot is in a flatter position when making contact with the ground with very little rebound. Constant speed is characterised by a reactive action relying on the stretch-shortening of tendons, ligaments and muscles. The difference between the two phases of sprinting are the reasons why a sprinter can be world class at 60m yet an also run at 100m. Obviously the 100m requires a longer constant speed phase encompassing phases of maximal speed.

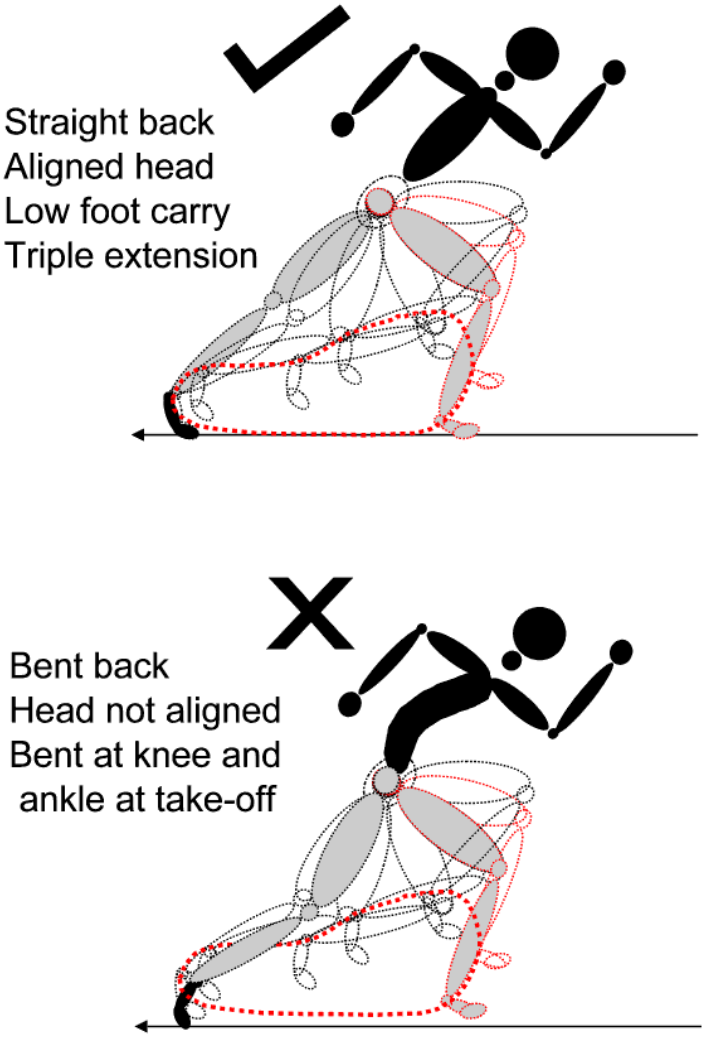


Fig 1:The correct body form and position for optimal acceleration

Biomechanics

At the start, when the body is hanging forward, the back must be kept stiff and straight without any rounding, this is true for all acceleration patterns regardless of the sport in question. The lean can be achieved by bending the spine with a slight pelvic tilt (bending at the waist). Rounding of the back will weaken the role of the back muscles responsible for keeping the body and spine straight. The muscles responsible for this role are the erector spinae. A slight bend in the back at the waist allows the ES to participate in acceleration yet a rounding of the back diminishes the response. The ES is capable of rotating the pelvis and so can transfer energy through the pelvis, using the pelvis to aid the legs to apply force to the ground. The strength of the ES and latissmus dorsi is crucial in aiding an athlete to maintain the lean during acceleration. The stronger the dorsal and erector

muscles the longer the athlete can hold the position and so prolong the acceleration phase. An often ignored but crucial area for success in acceleration is the development of upper body strength. Arm action can contribute to the force applied by a sprinter to the track. Fast explosive arm drive allows a stabilisation of the body but also takes advantage of the global workings of the central nervous system. As you move your arms explosively, the signals sent to the prime-movers also spill-over to the legs. The more forceful and explosive the arm drive, the more forceful and explosive will be the leg drive. Muscles of the shoulder complex and the upper back along with arm muscles contribute to stability and propulsion. The latissmus dorsi, trapezius, and deltoids are the prime movers in the arm drive, helping to mobilise the shoulder joint. Strong biceps and triceps will aid acceleration of the arms also. Quick mention should also be given to the neck. The neck has to be in line with the back, without bracing of the neck, the head alignment will cause acceleration to be less efficient. A neck brace used by boxers could come in useful for developing neck strength, this in particular will favour Rugby players in particular when they are tackled by the opposition, the neck will be able to react faster on impact to protect the spine.

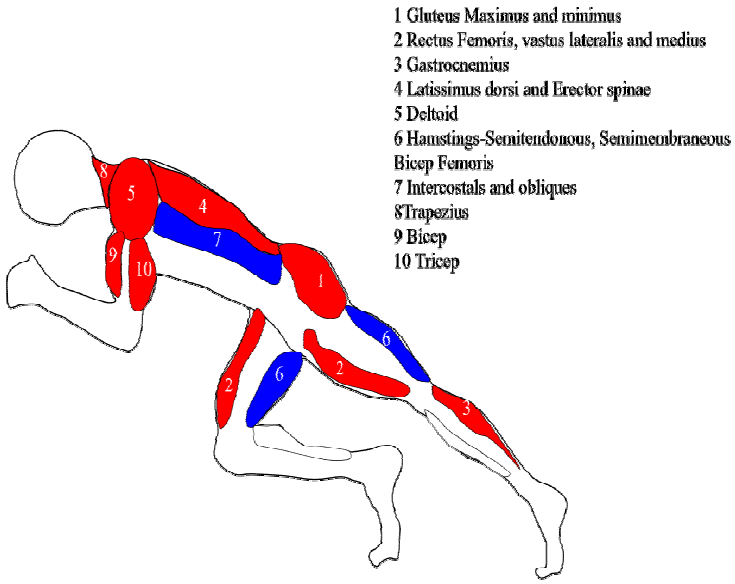
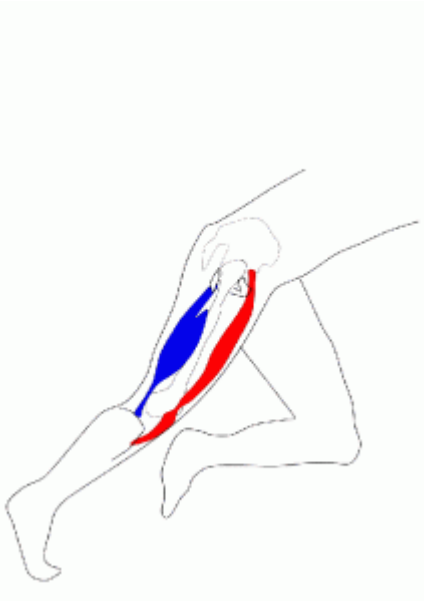


Fig 2:The major muscles involved in acceleration

Push-off can be strengthened by extending the ankle, knee and hip joint simultaneously; this is also known as **triple extension**. Hip and knee extension are compatible at stance phase and so the role of the rectus femoris is decisive in the acceleration phase. In short, the RM acts as a transmitter of energy between the two joints. The gluteaus maximus and quadriceps are the engines that generate force during the acceleration phase. The gluteaus maximus transmits its force to the knee through the ilio-tibial band and through the rectus femoris. The gastrocnemius transmits force from the knee to the ankle joint. The gastrocnemius acts very differently from the constant speed mechanics of sprinting, it has no rebound and so the muscle fibers in the gastro have to be able to provide the necessary forces.
During the acceleration the generation of force is the most important factor. A runner has to maintain stretch forcefully because a fast stretch wouldn't allow enough time for application of muscular explosive strength. Thrust forces are more horizontally directed than running at constant speed. Inter-muscular co-ordination is very important. During acceleration, there is no pre-loading of hamstrings and outer pendulum swing of the leg. What takes place on the ground is decisive during acceleration and what takes place in the air is decisive at max speed. There is little landing energy to process during the stance phase of the acceleration and so greater force can be generated

The optimal angle for acceleration is 45 degrees but stronger athletes can manage more acute angles for the initial strides. Whether a sprinter, rugby player, soccer player or, the optimal angle of 45 degrees is the ideal but as the athlete becomes stronger, a more acute angle can be utilised.



Arm action should be vigorous and purposeful, with an emphasis on the shoulder joint. The head should be in line with the back, but in team sports, players need to see the opposition and team members and so it is not a hard and fast rule.

Exercises to develop the qualities of acceleration.

As mentioned earlier in this post, the acceleration is determined by the strength qualities of the prime movers and the angle of the body in relation to the ground.
To develop explosive muscular strength, there are many methods that can be utilised. Each can replace or compliment the other, but the most important quality to possess is high levels of maximal strength. There is no conflict between the possession of maximal strength and the acquisition of explosive strength. A higher level of muscular strength allows an athlete to readily obtain explosive strength. Below, you will find a range of possible methods for developing acceleration mechanics and strength.

Resistance training

Resistance training is the most popular means of obtaining strength and power in modern sports training. Resistance training can be used to develop maximal strength efficiently. A Load of 80-100% is sufficient to develop maximal strength. Loads can be set serially with optimum recovery of 2-5 min's. The longer recoveries are needed for heavier loads. Most experts espouse this percentage range as ideal for developing max strength but, the key to developing maximal strength is to use a LIMITED range of reps. Regardless of the percentage, 2-3 repetitions are more effective than 5-6 repetitions. This is not an uncommon practice amongst power lifters and Olympic weight lifters. Resistance training should be undertaken for both upper and lower body. In particular, the shoulder complex should be targeted. A sequence of body building>max strength>power>strength/power endurance should be followed with each phase lasting approximately 2-3 weeks.

10-60m sprints
Sprint runs done over 10 to 30m will improve acceleration over time. Technique must underpin these runs over the set distance. A technical model for acceleration must be emphasised. An example of a session might be

2×3x30m sprints with 2 min's between rep's and 5 min's between sets. 60m sessions can consist of 3×3x60m with 3 min's between runs and 6 min's between sets.

Resistance training

Speed squats
Speed squats are deceptively taxing, but also fun as well. The aim is to complete a set amount of reps in the shortest time possible. This brings an element of direct feedback into play for the athlete. A bench that allows the lifter to assume a position where the top of the thighs are parallel with the ground is utilised to standardise the exercise. A set amount of rep's for example 5 repetitions, could be chosen for the session. Consequently; every weight used onwards is completed with five repetitions. The time taken to complete each set is recorded. This allows the coach and trainees to monitor their progress session by session. As progress is made, a noticeable pattern will reveal itself. The time taken to complete a lighter load in say session 1 will be the time taken to complete a much heavier weight in session 10 for example.

Depth jumps
Depth jumps with or without a rebound can also be used to develop maximal strength. The tension experienced by the extensors of the legs can exceed 3x bodyweight. The optimal height for developing maximal strength is 0.75-1m. A rebound is not necessary for the higher boxes, here the athlete can jump and hold the landing position for approximately 3-4 sec's. Sets of 6-8 rep's, done continuously, with a set recovery of 5-7 min's are ideal. Lower boxes should be used until the athlete feels ready to increase the height. All depth jumps should be done with a double foot take off and landing.

Box jump ups
Box jump ups are an expression of explosive concentric strength. They are the opposite of depth jumps, where the emphasis is on developing muscular eccentric strength upon landing. Box jumps positively influence concentric actions and recruitment of muscle. The aim of the exercise is to jump two-footed onto as high a box as possible. The world's most explosive athletes, weight lifters are capable of jumping on 2m+ boxes.
Box jump-ups should be done in sets of 3-4 with 8-10 rep's and a recovery of 5 min's recovery.

Vibration training
Vibration training is a very new method of training. This type of training can be used to develop maximal, explosive and reactive strength. Gains are most noticeable when developing maximal strength. If done properly, vibration training can add 20-40kg onto a squat in a short space of time. An optimum frequency needs to be chosen for each athlete. An EMG machine is inbuilt into the best vibration platforms. Duration on a vibration platform can be anything from 30 sec's-2 min's.

Jump squats with barbell
Jump squats with a barbell of 30-50% of maximum can also be used to develop the explosive strength needed for quality acceleration in athletes. The athlete positions the barbell on their backs and completes a set of very intense and challenging jumps. Squat jumps should be done on a mat that absorbs the landing shock, protecting the spine from unnecessary trauma. No other exercise targets the quadriceps and gluteals so intensely in preparation for acceleration.

Sleigh and hill work.
Towing a sleigh is an effective method for developing strength and acceleration mechanics. The sleigh should be towed for 30m on a flat surface. To control the exercise, the maximum decrement in time should be 0.8 sec's. For example if you are capable of running 3.8 sec's for the 30m then when using a sleigh the time should be 4.6 sec's. This will solve the problem of selecting the appropriate weight for the sleigh.

Hill work
Hill work is an excellent natural means of developing acceleration mechanics and strength. The steepness of a

hill will help an athlete to get into the right position for acceleration. Hill work can be done incorrectly if the right instructions are not conveyed to the athlete. The aim of the exercise is to improve the extension of the ankle knee and hip simultaneously. The extension of all three joints is known as triple extension. In order to achieve this desired effect the athlete has to resist the urge to scurry up the hill. The correct technique is like a bound up the hill with a knee drive forward and a forward rotation of the hip concentrating on fully extending all joints on contact with the ground. The optimum gradient is no greater than 6%.

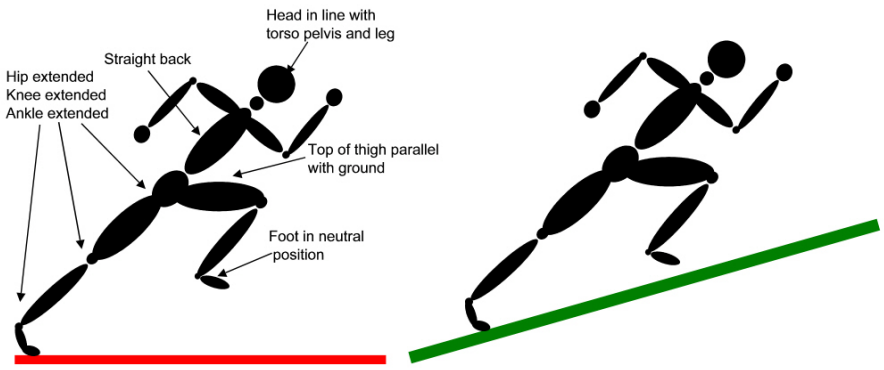


Fig 4:Training on an incline will aid transfer of the correct mechanics on a flat surface

Conclusion:

Acceleration involves the use of many muscle groups to work synergistically. Concentric and explosive muscular strength is the determining factor. Technique is essential for utilising any gains made from increases in power.
A range of training methods can be used to develop the qualities needed for a better acceleration pattern.