# AFF Runners Handbook

By Nick Jones April 8th, 2009

## Introduction

The purpose of these notes are to provide an overview of the basic running principles, including the components of running performance, training principles and the different types of training zones used, in order to enable coaches & runners to enhance their understanding and thus provide a more knowledgeable base for the development of you as runners within the club.

Also included are overviews of supplemental training activities, race preparation and the biomechanics of running, with details of drills and exercises used to help improve running economy and technique.

Hopefully this guide will act as a tool to provide a useful reference guide for improving your running performance, and enabling you a more concise understanding regarding training etc.

# B: TRAINING PRINCIPLES

### 1: How a training programme improves performance

When you train, you put your body under stress. Afterwards, when you are resting, your body then adapts to that stress. It rebuilds muscle fibres, creates more of the different types of cells you need (eg. red blood cells, mitochondria etc.), increases the size of energy stores, and so on. This makes sure it is better able to cope with the stress next time it occurs. The benefit of training comes from this process of physical adaptation. It is important to realise that the benefits occur after you train, not while you are actually exercising. This is why it is so important to ensure proper rest while training.

**OPTIMAL STRESS + OPTIMAL REST = OPTIMAL PERFORMANCE**

# C: Improving Each Component of Running Performance

When a runner is at a low level of fitness, easy running produces benefits to most of the components of running performance. To optimize the contribution of the components a coach needs to understand how the components function and how they affect their role and capacity.

### 1 Developing the Cardiovascular (CV) System

The cardiovascular system refers to the heart muscle and the network of vessels carrying blood to and from the parts of the body. For runners the muscular system required for running needs a large blood supply.
The function of the CV system is to provide an adequate supply of oxygen to the running muscles and to meet the increasing demands for oxygen as the runner

becomes fitter. The delivery of oxygen depends on how powerful the pump (heart)is, and how efficiently the blood is diverted from less crucial areas of the body to the exercising muscles.

### i) The Heart As a Pump

A typical nontrained adult's heart pumps 70ml of blood at a rate of 70 bpm in order to accommodate the resting metabolism. (c. 4.9/min). After a runner has trained for a few months, his/her heart's stroke volume may increase to over 80ml because training strengthens the heart and allows it to squeeze more blood with each beat. So now the same 4.9l of blood needed for the resting metabolism can be met with a heart rate of 61 beats per minute. The heart rate would slow further after further time training.

Easy steady exercise is the best type of training for desirable CV adaptations with the least discomfort. Thus the heart rate associated with any sub maximal exercise, such as a easy distance run, decreases following training, just like the resting heart rate is decreased. Stronger heart muscle is the desired result of regular exercise.

### ii) Oxygen – Carrying Capacity of the Blood

Oxygen is transported by haemoglobin and thus it is important for the optimum amount of haemoglobin in the blood. At sea level the blood is around 97% saturated with oxygen. Significant deterioration in performance will occur if the haemoglobin concentration is reduced as this means a drop in maximum oxygen consumption (VO2max) This can be often due to a lack of iron in the diet.

### iii) Blood Flow

Blood flow is determined by the diameter of the vessel through which the blood moves, the pressure difference between the heart and the destination of the blood, and the thickness of the blood.

When exercise starts the required situation is for the vessels feeding the exercising muscles to relax and open up, increasing the blood flow to those muscles. Obviously the clearer the vessels the more blood can flow through and this can be facilitated by a careful diet free from the artery clogging trans fats etc.

Also, blood flow to the exercising muscles increases as a result of a diversion of blood from areas of lesser need.

The blood does thicken in conditions of dehydration due the loss of plasma (water) from the blood. Maintaining optimal blood volume is very beneficial for races and training and in doing so depends on maintaining good nutritional & hydration habits.

## 2 Building the Running Muscles

The cells/fibres of the running muscles benefit from the labours of the CV system. These removed the carbon dioxide and lactic acid from the exercising muscles.

General easy running produces many adaptations in and around the running muscles.

a) Increase in the number, size, and distribution of the mitochondria, the sites of aerobic metabolism within the muscle fibres.
b) Increase in oxidative enzyme activity, which improves the rate that the delivered oxygen can be processed
c) More capillaries become active and distribute blood to the muscle cells. ie. more oxygen to more parts of the muscle.

These adaptations to training improve the muscles capacity for receiving & processing oxygen. The muscles also can become better at conserving stores of glycogen (stored carbohydrate fuel), metabolizing fat for energy & dealing with lactic acid.

Easy running creates these adaptations. The runs should be between 59 – 74% of aerobic capacity (65-79% of max. heart rate). For most runners this is 45-60 secs/mile slower than marathon pace or 1.5 – 2 mins slower than 5k pace.

# 3 Increasing Lactate Threshold

Runners must be able to work increasingly close to their maximum oxygen consumption without suffering from high accumulations of lactic acid in the blood. This accumulation is a function of how much lactic acid is being produced by the exercising muscles and the rate at which it is being cleared by the muscles, heart & liver. Excess lactic acid build up caused the running muscles to stop.

Being able to hold down this accumulation and minimise effects for longer at faster running speeds really benefits distance runners. This is acquired by "Threshold Training" in which you run just at the point whereby the muscles are clearing the lactic acid build up. This is normally at a constant value so with this type of training the body can react & adapt to working at faster speeds at the lactic acid clearance rate. The constant blood-lactate value is produced during a 20-30min run at a pace that can be maintained for about an hour in a race situation. For trained runners this is at about 88% of VO2max or 92% of maximum heart rate.

# 4 Improving Aerobic Capacity (VO2max)

Improvements in the CV system and the peripheral components enhance the body's capacity for consuming oxygen. The amount of oxygen someone consumes when running, depends directly on how much oxygen can be delivered to the exercising muscles, how well those muscles process the delivered oxygen, and how easily the muscles can deal with the carbon dioxide & lactic acid produced.

The maximum level of oxygen consumption, beyond which increases in exercise intensity don't lead to further increases in oxygen consumption. This level of oxygem consumption is called VO2 max. ( The initials stand for volume of oxygen )

To optimize VO2max, a runner must stress the oxygen delivery & processing system to its limit while running. To accomplish this "Interval Training" is required. This involves repeated runs of up to 5 minutes each, at about 3k to 5k race pace, with relatively brief recoveries between each effort.

**vVO2 max** – This term represents the speed (velocity)at which a runner can run when consuming oxygen at their VO2 max

## 5 Developing Speed

The ability at the end of a race to throw in an effective finishing kick can often mean the difference in achieving a PB or beating a close competitor. Some people have an overabundance of slow twitch muscles which are best suited to endurance running, others have more fast twitch muscles which are geared for shorter, faster distances.

But it is possible for an endurance athlete to promote the muscle fibres by specifically gearing your training to faster running and paying close attention to your running technique.

## 6 Improving Running Economy

Running economy involves the amount of oxygen being consumed relative to the runner's body weight and the speed of running. If one runner uses 50ml of oxygen per kg of body weight per minute to run at 7:00min/mile pace and another uses 55ml then the first runner is more economical. If the first runner can improve the oxygen consumption, through training, to 48ml then the economy has been improved to an even greater level. This is the goal of training because the runner can now race at a faster speed than before without using more energy to do so.

"Repetition Training" improves economy by helping the runner eliminate unnecessary arm & leg motion, recruit the most needed motor units while running at or near race pace, and feel comfortable at faster running speeds.

## Summary:

Basically a runner's ability is determined by the following:

| | | | | | | |
|---|---|---|---|---|---|---|
| Efficiency of lungs, heart & blood in delivering oxygen round the body | x | Efficiency of muscles translating oxygen & fuel into energy | x | Efficiency of body in translating movement into speed across the ground | = | **RUNNING PERFORMANCE** |
| **( VO2 Max )** | | **(Lactate Threshold)** | | **( Running Economy )** | | |

# D Achieving the Goals of Training

Based on these components the goals that a runner is trying to accomplish through training are as follows:

- Improve the body's ability to transport blood & oxygen
- Increase the ability of the running muscles to effectively use their available oxygen (to convert carbohydrate & fat fuel into useful energy)
- Shift lactate threshold to correspond to a faster running speed
- Increase aerobic capacity (VO2 max)
- Improve Speed
- Lower the energy demand of running (improve economy)

## Determining a Runners' Training Intensities

There are numerous tests to determine a runners' VO2max but the easiest way is to base workouts on an estimate of the VO2max using a formula devised by the world class running coach Jack Daniels. This takes a runners' recent race performance and from that determines an estimate of the training paces (vVO2max) required for each type of workout. There is a lot of science behind this and the figures are just a guide but have been proven to provide the required stimulus and improvements.

A copy of this table can be obtained from any of the club coaches but it will be posted on the website with an explanation on how to use it.

The other method to determine training intensities is to base these on a proportion of a runners' maximum heart rate. Again there are numerous tests to determine this accurately but for a simple calculation many people use the following formula:

- Men: 220 – age = estimated MHR
- Women: 226 – age = estimated MHR

# Training Zones

This table summarises the key workouts:

| | **VO2max** | **Lactate threshold** | **Running economy** |
|---|---|---|---|
| **Efficiency** | Interval training (3k & 5k) | Threshold runs<br>Fartleks<br>Cruise Intervals | Track speedwork (200m – 800m) |
| **Endurance** | Long,slow distance runs | Hill sessions<br>Leg strength exercises<br>Long,slow distance runs | Marathon pace<br>Easy Runs |

## 1 Easy Pace Running

**Intensity: 59-74% VO2max 65-79% HRmax**

This covers warm-ups, cool downs and long runs and should be free from trouble or pain. These elicit desirable physiological benefits that build a solid base from which higher intensities can be performed. The heart muscle is strengthened, muscles receive increased blood supplies, and the working muscle cells increase their ability to to process the oxygen through the cardiovascular system. East pace runs should make up the vast majority of a week's training schedule.

The benefits of easy pace runs are more of a result of time spent exercising rather than the intensity.

## 2 Marathon –pace Running

**Intensity: 75-84% VO2max 80-90% HRmax**

Naturally marathon pace running is particularly useful in training for a marathon as it simulates race pace conditions and gets the body used to this during the long runs. But this faster pace may benefit runners during easy runs if there's adequate time to recover for a subsequent quality session. Marathon pace varies from about 10-15 seconds per mile slower than threshold pace for top runners and circa. 30 seconds slower for slower marathon runners.

## 3 Threshold training

**Intensity: 83-88% VO2max 88-92% HRmax**

This type of training falls in the Threshold zone of intensity and comes in two varieties (steady, prolonged runs, also called tempo runs and intermittent runs, also called cruise intervals) both of which are run at the same relative intensity.

Threshold pace is great for improving endurance. Being at the same intensity doesn't always mean being at the same speed, due to headwinds & hills etc. which all effect the speed without changing intensity.

Threshold intensity is comfortably hard, or circa.24-30 seconds slower than 5K race pace.

## 4 Interval Training

**Intensity: 95-100% VO2max 98-100% HRmax**

The purpose of interval pace training is to stress the runner's VO2max (aerobic capacity), through a single session of intermittent running rather than one hard continuous run. The time between repeated efforts is important, especially if the efforts are relatively short (under 3 minutes). It takes around 2 minutes for a runner's

system to gear up  to functioning at VO2max, so the ideal duration of each effort should be about 3 and 5 minutes.each. The reason for not going over 5 minutes is to prevent too great an anaerobic involvement, which can result in a stressful blood lactate buildup in the muscles.
One thing to note is that the intensity should not always be at 100% MHR. If a runner is doing the efforts at 6min/mile pace at 100% MHR then running at 5:50 pace will also result in 100% MHR but will be too fast for the training session, which the purpose of, is to obtain the optimal result with the least possible stress. Race pace interval training would be performed at race pace for a runner's particular event.

### 5 Repetition Training

Repetition training involves repeating a particular effort with the purpose of becoming comfortable running fairly fast, feeling light on the feet and efficiently running at race pace or faster. Basically this type of training is to improve economy and speed.

The intensity of running reps usually puts considerable stress on the body to provide energy anaerobically (without oxygen) which in turn produces beneficial changes in anaerobic pathways, where fuel is converted to energy in the absence of adequate oxygen.

In repetition training, you recruit the exact muscle fibres you need for economical running. These are the muscle cells that allow you to run fast with minimal effort, minimal wasted movement, and minimal energy spent. Proper technique and adequate recovery is essential.

It is the goal to ensure that the recovery is long enough to enable the runner to perform the next effort as well as you did the previous one. If the technique and mechanics suffer the the purpose of the session is lost.

## E Biomechanics

**The three key main mechanical requirements to running faster are as follows:**

**i) Increase stride frequency (leg turnover)**
**ii) Increase stride length**
**iii) Improve running economy (ie. using the least amount of oxygen & energyto run at a certain speed)**

If all things are equal such as weight,VO2max then it is usually the most efficient running style that invariably prevails.
Elite runners are:

i) More relaxed –waste little effort in non-essential tension & movements.
ii) Recruit other energy sources to supplement muscular effort
iii) Breathe more efficiently

**Running Stride Phases**

**Footstrike:** The intitial contact between the ground and the foot

**Midstance: Composed of two subcomponents:**

**Foot-Flat:** Body completely over the stable foot contacting the ground
**Heel-Rise:** Beginning of the propulsion forward as the heel begins to leave the ground

**Toe-off:** Final propulsion & last contact between the foot and the ground

**Swing-through phase:** The leg swinging under the body getting into position for te next foot strike.

## 1. The Five Characteristics of Good Running Technique

**Stiffness**

Looking at elite runners they seem to run smooth & fluid and certainly not stiff. However a certain type of stiffness is actually the hallmark of the best runners' strides.
The legs are like a spring, and a runner who exhibits sufficient muscular stiffness when the foot strikes the ground will run more efficiently than a runner whose muscles are too loose on impact. The energy that is created is returned to the ground faster, therefore sending the body upward & forward. A looser stride allows more energy to dissipate as heat or friction and will mean that the foot keeps on the ground longer, therefore wasting energy.

**Compactness**

The two variables determining running speed are stride length & stride rate. The best runners tend to make shorter strides (and hence a higher stride rate) at any given speed than average runners. This is commonly referred to as a compact stride.

The compactness of a stride is determined mainly by where the foot lands. If the foot is directly underneath the hips then the stride is compact. If the foot is in front of the hips then the runner is overstriding.

When the foot lands in front of the body there is a lack of stability. Due to the difficulty of balancing in this position, runners' who overstride put a lot of energy into stabilising the body against impact forces and gravity before they can begin to generate thrust. The foot remains in contact with the ground longer and therefore produces a braking effect that kills forward momentum.

When your foot touches down beneath the body forward thrust can be generated immediately. It is important aswell for the shoulders to be in front of the hips to complement the forward motion.

**Ballistic Action**

Ballistic muscle actions are short & fast rather than sustained & gentle. Better runners invariably contract their muscles more forcefully upon touch down & push off. Ballistic runners use more energy this way but use less energy overall, because they get more free elastic energy and they spend more time floating & relaxing.

**Stability**

Running subject the joints to extreme downward-pulling forces and half the energy goes toward preventing the body from collapsing upon contact with the ground. Average runners tend to bend their support the knee of the support leg more on impact, the hip of the unsupported leg dips to the ground and the pelvis tips forward. These excessive joint movements waste a lot of energy and put extra strain on the joints that can lead to injury. Joint collapse is a type of stride flaw that tends to result from other stride flaws, such as overstriding.

**Symmetry**

No runner runs with perfect left-right symmetry, but the best runners tend to run more symmetrically than others.

Different asymmetries may crop up in a runners' stride:

- One foot lands harder than the other
- One foot pronates more than the other
- Angles of hip & knee on impact are different in the right leg than in the left
- Twisting of the spine which creates wasted energy with sideways momentum

Economical runners typically run with their hips & shoulders more square to their direction of travel and keep their pelvis fairly neutral by generating thrust early, when the foot is still underneath the body.

## 2. Stride Length & Frequency – Improving Speed

**NB: Turnover rate is dictated not by leg turnover, but by arm swing.**

A trial with 40 runners showed that they all had similar stride rates from beginning to end.

Three significant differences between faster & slower runners:

i) Slower group had shorter strides
ii) Faster group speant less time on the ground
iii) Slower group touched ground more in front of body

**Conclusion of trial :**
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- Faster runners were able to maintain their turnover rates, stride lengths with shorter ground contact and more air time.

- Slower runners, as they tired:

i) Straightened up
ii) Increased their overstrides by reaching forward
iii) Which shortened their strides and increased ground contact time.

Study supports importance of pushing off well behind centre of gravity. Important to have a forward posture rather than upright so that you are pushing through and not pulling. Tight hamstrings are one of the biggest thieves of speed and are nearly always associated with overstriding.

A runner must focus on letting their forward momentum carry over the flat foot on the ground so that it is behind when push off occurs.

To increase speed, increase turnover rate or stride more either or both in combination.

**IMPORTANT**

**Never try to lengthen stride by reaching more in front of the body, but by pushing off more forcefully.**

The strength of the ankles and calves are critical to achieving an improved and more dynamic push off.

## 3. Arm Action

The arms & shoulders work with the opposite legs and hips to maintain balance. The upper part of the arm moves relatively straight backward & forward while the lower part of the arm may move slightly across the body during the forward swing. The hands should be carried in a relaxed, cupped position and held fairly close to the chest, at heart height, to reduce the blood pumping effort to the arms.

Since arm & leg movements tend to mimic each other a runner can help control the tempo by focusing on the arm swing.

Quick little arm movements tend to produce the most economical running. And by driving the elbows back more forcefully helps the drive off, thus maintaining stride length.

The symmetry of the arm swing is also important as this can prevent injuries to one or the other leg.

## 4. Foot Plant

A runner should make foot contact with a relatively flat foot and the roll forward over the ball of the foot toward toe-off. The foot should strike the ground after it has completed its forward swing and is swinging rearward. It should make contact directly under the slightly bent knee.
A heel-first contact requires a straightened leg and sends the shock upward through the body, so that any structural weakness in the major joints or back absorbs the shock.

## 5. Assessing a Runners' Technique

**Common Inefficiencies to look for :**

- Movement is stiff & mechanical rather than coordinated, rhythmic and fluid
- Hands/feet swing too far in front of the body, forcing the posture to be too erect and rigid rather than balanced & relaxed
- Foot contact is heel first , with a straight leg in front of the centre of gravity, instead of nearly flat footed, beneath a slightly bent knee nearly under the body
- Elbows stick out to the sides or are locked at a 90 degree angle, so tha the shoulders swing the arms rather tha letting the bending elbow assist the arm swing
- Hands/feet swing too low, with limited elbow bend and heel kick up
- Upper arm/upper leg doesn't swing back far enough to cock the the upper body for flight, thrust the chest forward to extend momentum, and position the straightening leg to release maximum energy from the toe-off
- Movement is powered by "reaching & pulling" instead of "loading & firing"

**Effective Focus Objectives:**

Also focus on positive actions which will enhance technique:

- Refine positions of arms, hands, elbows & posture and a runner's foot placement & leg drive will automatically improve as well.
- You should not be able to see your hands on the forward swing
- Keeping the forearm at heart height, reaching back with the upper arm, to cock the shoulder and thrust the chest forward, properly aligning the body to release energy more effectively during leg drive.
- Keeping hands within chest-touching distance as they swing from heart height to just above the waistline, with the elbows unbending slightly, and the back up to heart height.

# F. Methods for Improving Running Form

Apart from cross training & strength training there are specific ways to enhance the key characteristics of good running form.

## Proprioceptive Cues

Proprioceptive cues are used to improve technique through particular thoughts and sensations that athletes focus on while performing a sports movement to help them control that movement in a desired way. These cues enable a runner to modify their stride for the better as you think about them while running. It does require concentration and discipline but if a runner just concentrates on one cue during a run they stand a good chance that over time it will become "habit"

### i) Falling Forward

Tilt the whole body slightly forward as you run, and don't bend at the waist ; tilt the whole body from the ankles. When you first get a feel for this cue you can exaggerate your lean to the point where you feel you're about to fall flat on your face. Then ease back to a point that feels comfortable and controllable, but where gravity still seems to be pulling you forward.

**Purpose:** This cue will help correct overstriding, because when you're running with a slight forward tilt in your body, your feet will naturally land close to your centre of gravity.

### ii) Navel to Spine

Concentrate on pulling your belly button inward toward your spine while running. This takes a bit of focus but this cue will activate the deep abdominal muscles that serve as important stabilisers of the pelvis & lower spine during running.

**Purpose:** When the deep abs are kept tight, most of the force generated by the buttocks & hamstrings is transferred to the ground & hence into forward movement.

### iii) Running on Water

Imagine you're running on water, and your goal is to not fall through the surface. To do this you must overcome the squishiness of your running surface by applying maximum force to the water in minimum contact time, like a skimming stone. Try to make your feet skip across the running surface in a similar way: quickly, lightly, yet forcefully.

**Purpose:** This cue will teach you to stiffen your stride, minimize ground contact time, and begin the thrust phase earlier

### iv) Pulling the Road

Imagine your running route is like a giant nonmotorised treadmill where you are only able to run in place by pulling the treadmill belt backward with your feet. Envison yourself doing the the same thing with the road as you run outdoors.You're not actually moving forward – you're simulating forward movement by pulling the road behind you with each foot.

**Purpose:** This propioceptive cue will teach you to begin generating thrust earlier, stiffen your stride, and minimise ground contact time.

### v) Scooting

Run in a scooting manner by actively minimising vertical movement. Do not exaggerate too much to the point of reducing stride rate or increasing ground contact time. Just think about about thrusting your body forward instead of upward while running.

**Purpose:** This cue will enable you to run with greater stability by reducing vertical impact forces.

### vi) Pounding the Ground

Most runners are taught to run as softly as possible. In fact, running speed is almost entirely a function of how forcefully you hit the ground with your feet. An overstriding runner allows the foot to fall passively to the ground with each stride. Practice actively driving your foot into the ground and give a backward pull to this driving movement rather than a completely vertical movement.

If you are a heel striker (overstrider) work on shortening your stride and landing flat-footed before using this cue.

**Purpose:** Teaches you to stiffen stride, thrust earlier, and minimise ground contact time.

### vii) Driving the Thigh

Concentrate on driving the thigh of your swing leg forward a little more forcefully than you normally do. A more forceful forward-upward movement of this leg will create a counterbalancing downward-backward action in your opposite leg as it comes into contact with the ground.

**Purpose:** This cue will enhance your stride symmetry and stiffness

### viii) Buttock Squeeze

In the instant before your foot makes contact with the ground, contract the muscles in the hip and buttock on that side of your body and keep them angaged throughout the ground contact phase of the stride.

**Purpose:** This cue will enable you to maintain greater stability in the hips, pelvis, lower spine and will minimise wasteful(asymmetrical) long axis rotations.

### ix) Feeling Symmetry

Focus your attention on a specific part of your body, or stride, on both left & right hand side. Concentrate on the feel of your arm swing, the forward movement of your swing leg, the moment of footstrike, push-off, or something else. Compare the feeling on one side with the other. If you feel there is a discrepancy, adjust your stride in a way that eliminates it, or at least reduces it. Specifically, alter your stride on the side that feels less comfortable, natural, or "right", to make it feel more like the side that feels better.

**Purpose:** Obviously, this cue helps you reduce asymmetries in your stride.

### x) Axle Between the Knees

Imagine there is an axle, dowel or something else positioned between your knees and pushes them half an inch farther apart than they normally would be while running.

**Purpose:** This cue helps you engage the hip flexors and hip external rotators & prevents internal rotation of the thigh – a common cause of injuries.

## Technique Drills

Technique drills enable you to work on improving a particular facet of your stride outside the normal running. By using exaggerated controlled movements your body should eventually adapt these into your normal running motion over time thus making you more economical etc.

### i) Running No Arms

Lace your fingers of your hands together and make a big circle with your arms at shoulder level. Run 50- 100m at a moderately fast tempo with your arms in this position. Jog back & repeat.

**Purpose:** This drill will force you to activate your deep abdominal muscles to maintain an upright posture and thereby teach you how to activate these muscles while running. It will also help eliminate rotational asymmetries by taking away your ability to compensate for these rotations with shoulder movements.

### ii) Steep Hill Sprints

Find the steepest hill that's available and sprint up it for 20 seconds. Jog back & repeat.

**Purpose:** This drill will develop your ability to run ballistically, applying great force to the ground on footstrike and driving your leg forward to assist in this effort.

### iii) One-Leg Hop

Hop as fast as you can (controlled) on one leg for 20 seconds. Jog back & repeat.

**Purpose:** In addition to increasing your push off power, this drill enhances the stability of the hips, pelvis, lower spine, and knees on impact by challenging the muscles that stabilise these joints with extreme impact forces for a short period of time.

### iv) High Knees

Run with a fast cadence & highly exaggerated knee lift, bringing your thighs up parallel to the ground with each stride. Do this for 30 secs, jog back & repeat.

**Purpose:** This drill teaches you to drive your swing leg and couple the movement of your thighs to strike the ground with greater force.

### v) Bounding

Run with long, leaping strides ( like the first two strides in the triple jump ). Continue for 30 seconds.

**Purpose:** This enhances push-off power and stability on impact. It also helps teach you to begin retracting your leading leg before impact, because the braking effect of overstriding is greatly exaggerated when you're bounding.

### vi) Stiff-Legged Running

Run briskly for 20 seconds with your knees locked as much as possible. This drill greatly increases reliance on the buttock muscles and decreases use of the hamstrings for forward propulsion.

**Purpose:** This drill will help you increase the stiffness of your stride and also boost its compactness by teaching you to begin thrusting earlier.

### vii) Heel Flicks

Run for 20-30 seconds flicking heels up towards the buttocks. Concentrate on pushing feet forcefully back.

**Purpose:** This drills encourages a high follow through and therefore the trailing leg is in a better position to come through to the drive phase with minimal energy.

## G. Common Running Injuries

The following table provides information to help you identify and overcome six of the most common running injuries.

| **Name of Injury** | **Where the Pain is** | **Most Common Causes** | **Commonly Effective Corrective Measures** |
|---|---|---|---|
| Iliotibial (IT) Band Friction Syndrome | Just below hip bone or just above knee on outside of leg | Weak hip abductors,tight iliotibial band | Strengthening hip abductors.<br>Stretching IT band.<br>Deep tissue massage. |
| Hip flexor tendonitis | The front of the hip or groin | Weak deep abdominals, tight hip flexors | Strengthening deep abdominals.<br>Stretching hip flexors.<br>Gait retraining |
| Patellofemoral pain syndrome ( ie. runner's knee) | Just below the kneecap | Weak hip abductors, weak quads, weak deep abdominals, overstriding | Strengthening hip abductors, quads & deep abdominals.<br>Gait retraining.<br>Changing shoes. |
| Bone Strain (shin splints) | The shin, usually on the side facing the other leg | Increasing running mileage too quickly, overstriding | Reducing running mileage, then ramping up more slowly.<br>Gait retraining.<br>Changing shoes. |
| Achilles tendinosis | Achilles tendon | Adding fast running too quickly.<br>Age | Eccentric strengthening exercises for calf muscles.<br>Deep tissue massage (particularly active release therapy) |
| Plantar fasciitis | The heel | Increasing running mileage too quickly, overstriding & poor shoe selection. | Ceasing running until injury heals.<br>Wearing night splint.<br>Changing shoes.<br>Gait retraining. |

**Nick Jones**
**April 8th, 2009**