**Injuries: how to treat them -or better still-how to avoid them.**

We’ve all been there. We start running. Everything goes well for a number of months or even years. We start to improve, to have some success in races, to revel in the feeling of fitness, health and well-being. And then, just as we begin to dream of running for Ireland, of competing in the Olympics, of standing on the victory podium…....... we get injured. We feel cheated: how can this super-fit body of mine let me down? It’s not fair. And then we meet the wag who inevitably cracks the old clichéd joke “ Ah, so you’re injured ? Well, you’re a real athlete now”. The joker himself is in imminent danger of injury at this point but, if we can resist the temptation to deck him and actually think about it , we might have to admit that there is truth in what he has said. Because the reality is that the stresses which we impose on our bodies by running every day ( or perhaps more than once every day) are bound to take their toll and what we are doing is not really normal. As Seb. Coe once snapped at a reporter “*Normal ?* Of course we’re not f\*\*\*ing ‘*normal’*; how could it be ‘normal’ to run 100 + miles per week?”

And then we start the seemingly never ending merry-go-round of looking for treatment and cure. We become impossible to live with. We learn that RICE is not to be eaten but instead is a process to be engaged in as soon as possible after injury. We learn arcane terms such as “medial meniscus”, “patella chondromalacia”, “ iliotibial band syndrome”, “plantar fasciitis” ,etc., etc. And we become total bores, inflicting on everybody we meet the minute details of our particular injury ( which,of course, is far more complex and interesting than anybody else’s injury.) And one other thing happens**:** we begin to appreciate just how wonderful it was to have been able to run, something that, until now, we had taken for granted.

Very few athletes will go through an entire running career without experiencing some of the following problems. A number of studies have shown that between 60% and 80% of runners get injured every year. ( I am a little sceptical about these figures ) There are FIVE main reasons why runners get injured; these are : **Overuse; ; Poor Diet; Poor Running Form; Weak Core Structure; Lack of Recovery \***  *\* A recent article in* ***The Sunday Independent*** *by Michelle Biggins, who is a chartered physiotherapist and a Ph.D. student at the University of Limerick, emphasised the importance of sleep in injury prevention . This was already referred to in an article in Coaching Corner* ***( cf. Recovery : Post Session/ Post Race ).*** *Furthermore, research by the* ***US National Sleep Foundation*** *found that adolescent athletes who slept eight or more hours each night were 68% less likely to be injured than athletes who slept less.*

 While we all know that RICE is the first response to any injury ( Rest ,Ice, Compression, Elevation), many physios now say that we should add another letter to that acronym : the letter P. So we now have PRICE\* : the P standing for “Protect” e.g. in the case of the Achilles tendons, they should be protected by wearing shoes with good arch support ,a sturdy heel counter and a heel rise ( which reduces the Achilles’ need to stretch when you land during a running or walking step ). I also believe athletes should consult a chartered physiotherapist as soon as possible after injury strikes. Now let us look at some of the most common injuries which runners experience : \* ( They go on to say *“ You must pay the PRICE of your injury to get better and avoid chronic problems in the injury-reinjury cycle”. )*

**Stitch :**  We will start with the “humble stitch”- possibly the first “injury” that most novice athletes experience. Many people would say that this is not really an injury , and perhaps it’s not . The term “stitch”( like “shin splints” ) is applied as a generic term to all exercise induced abdominal pain but sometimes it may be a muscle tear or something more serious. If it is simply a stitch, in the true sense of the word, it is due to a cramp in the diaphragm muscle. It occurs most often when the athlete is running fast and when breathing is laboured. In these circumstances the athlete tends to pant, so the diaphragm muscle contracts in a shortened position and is never fully lengthened; lengthening only occurs when the athlete exhales fully .The stitch can be broken ( like any muscle cramp ) by lengthening the muscle. To do this the athlete should **“belly breathe**” i.e. pushing the belly out forcefully while breathing IN and pulling the belly in while breathing OUT, attempting to empty the lungs of all their contained air.( Indeed we should breathe like this all the time.) So, breathing out fully at regular intervals, rather than panting, should prevent this form of stitch from developing and cure it if it happens. Many young or inexperienced athletes experience stitch simply because they did not allow sufficient time between eating their last meal and the start time of the race or hard workout. “Nerves” can also bring on stitch due to the fact that when we get very nervous we tend to take shallow, rapid breaths or we may almost “forget” to breathe. This is why people who are experiencing any sort of panic attack are encouraged simply to breathe ,slowly and deeply, preferably in the manner outlined above. Overly enthusiastic coaches or supporters can, inadvertently, exacerbate the nervous tension which all athletes ( but especially inexperienced ones) will feel immediately prior to a race. As Alberto Salazar says : ***“Learning to relax before races is very important; unlike football players headbutting helmets in the locker room, runners need to keep*** ***themselves relaxed and in a perfect zone where they are neither over-aroused or under-aroused”.*** But sometimes, the “stitch” may be something else. For a number of years I experienced crippling “stitches” in many races. I was told it was simply a stitch ; I was told I was “breathing in too much air”( seriously ! ); I was told it was “all in your head”. ( is there anything more insulting or more frustrating than to be told it’s “all in your head”? ).Eventually a scan showed that I had torn, and frequently re-torn, an oblique abdominal muscle which, with treatment and exercises ,eventually cleared up. Why hadn’t I sought professional advice earlier ? Well, remember that this was the 1970s when runners rarely bothered to go to physios and a macho attitude prevailed which told us to tough it out and “run it off ! This is why I firmly believe that injured athletes should get professional advice and treatment as soon as possible; coaches are very knowledgeable in many areas but they are not medical professionals and are not really qualified either to diagnose or treat injuries. **Shin Splints:** Perhaps the second most common affliction to affect runners, especially novice runners, is the dreaded “shin splints”.It is a generic or umbrella term which covers quite a number of different conditions relating to soreness along the vicinity of the shin bone. If you’re lucky , it is simply a case of the small muscles (along the side of the shin bone) remaining in a tight, contracted state after a hard workout. In this case , ice and a few days rest will be enough to solve the problem. The cause is usually a combination of overpronation and over striding. Toe curl exercises can be very helpful in treating this type of “shin splints” . Sit on the edge of a chair that has a small towel placed in front of it on the floor. Place a 1Kg. weight at the far end of the towel and moisten the towel for better traction. With your heel on the edge of the towel closest to you , crunch your toes and attempt to grip the towel and pull the weighted end of the towel towards to you .Perform 3 reps. to start but increase the number of reps. and the weight over time as you get stronger. Unfortunately, the phrase “shin splints” often betrays a lack of diagnostic precision. The more accurate term may be **tibial or fibular bone strain.** It is a bone injury localised to one or both of the tibia and fibula. Bone strain typically develops through four stages of injury. In the first stage, vague discomfort somewhere in the calf, is noted after exercise. As training continues, the discomfort comes on during exercise. Sometimes the pain may abate as you warm up but returns towards the end of the session. At this stage it is possible to run through the pain (though never a good idea, as pain is Nature’s way of telling us that something is wrong ) but, if not treated, the pain becomes so severe that training becomes impossible . At this stage it is a Grade 3 injury. Eventually, the injury may be so bad that even walking can be very unpleasant. A Grade 4 bone injury has become a stress fracture. At this point the athlete is looking at a six week rest period : there is no other solution. Of course, “shin splints” can sometimes be a chronic tear in the tibialis anterior or tibialis posterior muscles. So correct diagnosis is of paramount importance. Not much point in getting treatment for a fracture if you’re suffering from a muscle tear and vice-versa! It can also be confused with Compartment Syndrome which will be discussed later in this article. A genuine bone strain can usually be diagnosed by feeling the site of maximum tenderness. This tenderness is always along either the front or back borders of the tibia or along the outside edge of the fibula. Applying firm finger pressure to these areas produces pain severe enough to make the athlete cry out involuntarily and pull his leg away. Quite often, there is mild swelling over the injured bone so that, when the finger pressure is released, a small indentation is left in the tissues overlying the injured bone. Many studies have shown that **athletes who suffer stress fractures generally have reduced bone** **density due to a low calcium diet.**

Overstriding may also be a factor in in the development of anterior tibial bone strain. Overstriding is especially common during fast downhill running. Posterior tibial bone strain, which is the most common type, is associated with high levels of ankle pronation. Of course, the most obvious causes of bone strain or stress fracture are unprotective running shoes, excessive training on hard surfaces and too much speed work (too often and/or too soon ) .Running continually in one direction is also a factor. “Shin splints” are usually experienced by young or novice runners within the first six months of starting to train or returning to training after a lay-off. On the other hand , experienced runners who develop any form of bone strain have usually altered their training methods in one or more ways. (Suddenly increasing their training distances, introducing speed work or hill running, or simply pushing the pace too hard too soon ). So, prevention being the best cure, what are the ways to avoid “shin splints” in general. Well, that question has already been more or less answered during the course of the last paragraph but just to sum up : proper shoes are a must ; thank God, the “barefoot running” craze seems to have died a death; while running barefoot on grass is fine ( indeed it was a great pleasure to run barefoot on the beautiful grass tracks in College Park , Belfield and Iveagh grounds 40 years ago), running on concrete or asphalt footpaths with minimalist shoes is a recipe for disaster ; firmer shoes that are more likely to control excessive pronation may be necessary while training on grass or trails is an obvious precautionary measure. Excessive training in spikes should be avoided. Even while doing speed work athletes should wear “flats” ,unless the track is slippery due to rain or frost. Proper diet with adequate mineral intake is a must. Stretching e.g. standing calf muscle raises can be a big help. And,of course, adequate easy recovery days and some complete rest days must be built into the athlete’s training programme. If, in spite of all, the athlete does get a bone injury, 6-8 weeks rest will usually cure the problem

**DOMS:**  Delayed onset of muscle soreness is that feeling of muscle discomfort that comes on 24 to 48 hours after a race or hard workout. It is NOT due to lactate accumulation but to damage to the muscle cells, especially the connective tissue and the contractile proteins. There may be microscopic tearing or rupturing of the cells. Inflammation may also be present. Soreness may be greatest near the muscle-tendon junctions. Ice baths ,or at least letting cold water run on the affected parts, can help. But the best means of enhancing recovery would appear to be mild exercise. ( This was already referred to in one of the earlier articles entitled ***“Recovery Post-Workout/Post -Race***” ) There are four medical reasons for this : first, breaking up the connective tissue adhesions between muscle cells may decrease the stretch that stimulates pain-inducing neurons in the region. Second, the brain and spinal chord produce endorphins which, when released into the blood stream, have analgesic properties. These are released even with mild activity. Third, elevated activity of sensory neurons from working muscles and tendons seem to inhibit the activity of smaller pain-inducing neurons. Fourth , increased circulation of blood through the affected tissues increases the influx of nutrients and helps to “flush out” the products of cellular breakdown. As stated before , this is why the great Kenyan runners go for a very ,very slow jog in the evenings after their two earlier workouts. And, indeed, this is why the competitors in ultra races over a hundred years ago always did something similar. A number of trans-America races were held in the U.S.A in the early years of the twentieth century ( usually Los Angeles to New York ) where the competitors consistently ran 60+ miles per day . Invariably they went for an ultra slow jog or simply a walk in the evenings to get rid of the stiffness after their day’s exploits. The late Laro Byrne always reminded us of this; he put it in simple terms : “Going for a jog after a hard session makes the blood flow back through the chambers of the heart; it is filtered there and all the crap is flushed out” ( Laro didn’t use medical jargon but he got his point across in plain Wicklow-speak ! )

**Hamstring Injuries**: Steve Jones, former marathon world-record holder, once said ***“ Every great athlete is only a hamstring away from oblivion***”. A chilling reminder that there is a thin dividing line between super fitness and break down . Hamstring difficulties are common among runners, with strains, “pulls”, tendinitis and tears the most common problems. Why are hamstring issues so common ? Most distance runners have developed a situation known as ***“quad dominance***”, a situation that occurs when the quad muscles overpower the action of the hamstrings in the movement of the leg during a running stride. Running high mileage can place repetitive functional overload on the quads ,making them strong ,powerful and dominant. When the quads contract as you land, the opposing muscles, the hamstrings, act as brakes to stop your knee from hyper-extending at the end movement of a running stride. If the hamstrings are significantly weaker than the quads, due to constant loading of the anterior ( frontal ) chain from running , then one of two things will occur : 1. Your hamstrings will tear as a result of not being able to take the load developed by the contracting quads and momentum from hip extension; 2. You will run slower as a result of diminished power from the hip flexors and knee extensors as the hamstrings have to contract earlier to be able to brake the ensuing movement. Hamstring injuries can be slow to heal and they also tend to return again and again if the underlying cause of the problem is not addressed. A proper strengthening programme – focusing on eccentric loading – must be undertaken. The hamstrings can be strengthened by using a series of specific, isolated, eccentric exercises- those in which muscle fibres lengthen as they contract and this can eliminate the quad dominance which led to the problem in the first place. Here are three eccentric exercises which will strengthen the hamstrings : 1. ***“The Good Morning***” : Start with your legs locked ,arms holding a weight bar on your shoulders with opposing grip ,back in neutral position and core tight. Slowly bend over at the waist , gently feeling the stretch on the way down. When you have gone down as far as you can with your knees locked, start to come back up slowly. Do not jerk upwards or arch your back. 2. ***Single Leg Romanian Dead Lift*** : Stand holding a light dumbbell in front of you in your right hand, placing your weight on your right foot . Lean forward by approx.15 degrees. Keeping a slight bend in your right knee, your back flat and your chest out , lift your left leg straight out behind you as you lower your body over your right leg. Slowly slide the dumbbell down your quad to about mid-shin and, using your hamstrings and glutes, lift your body back to an upright position, keeping your weight on your right leg. Repeat for 8-12 reps. then switch legs and hands. 3***. Eccentric Hamstring Curl :*** The easiest way to do this is on a hamstring curl machine but, if you do not have access to such , you can do the equivalent with the help of a partner. Kneel on an exercise mat with your toes pulled towards your shins. Keep your hands in front of your chest. Your partner sits behind you , facing your back ,pressing down on your lower legs with his hands. Keep your core tight , chest up and hips forward so your body forms a straight line from your ears to your knees. Maintain this posture as you lower your torso toward the floor while resisting gravity with your hamstrings and calves. Control the range of motion as far as you can, catch yourself with your hands, then push off the floor to assist your hamstrings and glutes in pulling you back up to the starting position.

**Lower Limb Injuries.** Lower limb injuries are usually connective tissue problems. **The three main types are Achilles** **tendinopathy, plantar fasciitis, and iliotibial band syndrome**. Let us remember that tendons and ligaments adapt less readily than muscle or bone to long term, repeated stimulation in the form of athletic training. Ligaments are composed mainly of a connective tissue molecule called *elastin*, a stretchable fibrous protein, while tendons are essentially non-stretchable and composed of *collagen* molecules. Collagen fibrils have enormous ensile strength – even more than steel wire ! Unfortunately, however, tendons have very poor blood circulation which ,of course, can make them slow to heal if injured. Let us look at each of those three types of injury in greater detail :

**1.Achilles Tendinopathy .** Poor old Achilles : his mother, Thetis, dipped him as a baby in the river Styx thereby conferring on him immunity against all wounds and injury . But she held him by what is now medically known as “the calcaneal tendon” and the waters of the Styx did not touch that little spot . Consequently, that was the one part of his body that was vulnerable and ,of course, he was eventually killed by Paris who shot him in the heel with an arrow.

 Runners must regularly feel like Achilles at that fateful moment when he realised he was doomed : how often have runners felt let down by an Achilles injury ? Probably more athletic careers, including that of Ronnie Delaney, were cut short by Achilles tendon problems than by any other single injury.

The Achilles tendon is a tough band of fibrous tissue .It is the largest tendon in the human body. It originates about halfway down the lower leg where the superficial and deep fasciae of the gastrocnemius and soleus merge into one band of tissue to form the Achilles. Many physios will tell an athlete suffering from this condition that his problem originated in the soleus due to a lack of stretching. The theory is that the calf muscles undergo rapid eccentric shortening at heel strike, followed by rapid concentric contraction at toe-off and these rapid alterations in muscle action may cause degeneration in the Achilles tendon due to repetitive micro-tears. Over pronation is also a common cause of Achilles tendinitis- in fact it is almost always caused by overpronation. ( People with “flat feet “ i.e. low arches are particularly inclined to over-pronate ). A marked difference in leg length can cause overpronation. A sudden overload in training (in either quantity or quality ) can lead to this problem : interval training and hill sessions are particularly stressful on lower limb muscles and tendons. It is useful to introduce such exercises early into the training programme on a very gradual basis to ensure adaptive limb strengthening that will permit tolerance to more intense workouts later on. Excessive training in spikes or in very light running shoes or shoes that are inappropriate to the athlete’s biomechanical needs can all be instrumental in causing this injury. A high heel tab on the training shoes can also irritate the tendon leading to inflammation. It was way back in the 1970s that Ron Hill started at first to cut away the tab from his trainers and, later, to start developing and manufacturing training shoes with no heel tab or with a cutaway tab. There are actually **three** separate conditions of Achilles tendon dysfunction : Achilles tendonitis; Achilles paratenonitis and Achilles tendonosis but you feel similar pain from each one . ***Achilles tendonitis*** occurs when the volume and intensity of running outpaces the body’s ability to repair microdamaged fibres in the tendon. Chronic inflammation occurs and pain soon follows. Stiffness may be present in the morning and after periods of inactivity. The pain may be worse when you’re barefoot and lessened when wearing a shoe with a slight heel lift or pad. ***Achilles paratenonitis*** is caused by an inflamed tendon that irritates the sheath ( paratenon )as the slides back and forth with muscle contractions. It is very easy to recognise as the whole length of the tendon becomes swollen and is very painful even to touch***. Achilles tendonosis*** when the body’s repair mechanism fail to maintain the health of the tendon, the repair process fails and the inner substance of the tendon breaks down. Tendonosis appears as a firm, bulbous nodule about the size of a pea in the middle of the tendon. The nodule represents scar tissue surrounding the damaged area. It should not be confused with heel bursitis , a condition characterised by pain and swelling at the back of the heel bone. We all know that distance runners are obsessive and compulsive *(As the old joke says : “ you don’t have to be mad to be a runner – but it’s a big help if you are”)* and there is a huge danger that the injured runner will try to resume training before his tendinopathy is fully healed. Even easy running on an inflamed Achilles is ill advised : remember that to an individual tendon cell , easy running is a megastress. While swimming and running in a pool ( using a flotation vest ) can help to maintain cardiovascular fitness, even then caution is needed to ensure that the tendon isn’t stressed by vigorous movement in the water. A runner suffering from this condition should, of course, resort to “RICE” in the first instance. Massaging the tendon ,using horizontal friction with the finger and/or thumb, will help. Anti-inflammatory medication may be take for a limited time. A heel raise of between 7 and 15mm.should be inserted in the shoes; gentle stretching by allowing the heels hang over the step of a stairs is also recommended. If the athlete overpronates very badly ,then a professionally made orthotic may be necessary to ensure that the condition does not recur.

**2.Plantar Fasciitis :** Luckily , this injury is relatively rare. The plantar fascia is a tight band of dense connective tissue on the bottom of the foot extending from the heel to the base of the toes. It can be damaged in several ways .The least likely way is that it gets bruised and injured by a pointed rock or some other obstacle in your path as you run .It can be caused by overpronation but the most common cause is leg length discrepancy which often leads to unilateral pain i.e. pain in one foot but not in the other. The symptom of this injury is pain directly in front of the heel, usually first noticed during running but it later becomes noticeable when the athlete gets up in the morning. High foot arches, excessive pronation, rigid feet ,leg-length inequality and reduced ankle mobility are all considered to be factors in the development of this condition. Most of the measures recommended for treatment of Achilles tendinitis can be utilised for this injury. Exercises that increase the eccentric strength of the foot muscles should be beneficial e.g. rolling the foot on a bottle, ice-cold soft-drinks can or tennis ball. Dorsiflexion exercises, such as “making circles” with the foot ( “writing with your foot” ) can also help. Measures to increase shock absorption ,such as shoe pads, should be taken. Anti-inflammatory medication, such as Ibuprofen ( or Nurofen ,which is the same ) can help but athletes must be careful not to overdo such medications as they can have a very severe effect on the stomach. Uphill running and speedwork must be avoided at all costs. A condition which is very similar to plantar fasciitis is **tarsal tunnel syndrome.** The tarsal tunnel is an anatomical structure on the inside of the heel bone . TTS is a painful condition in which the tibial nerve is compressed as it travels through the tarsal tunnel. It is usually caused by high degrees of pronation . Once again, rest and ice plus anti-inflammatory medication are the first resort . Foam rolling can also help. The use of heel lifts will take a significant amount of stress off the plantar fascia. These heel lifts can be purchased in any pharmacy. Double -legged ( or single -legged ) toe raises can be of some benefit. Long term treatment consists of anti-pronation shoes and, possibly, orthotics.

**3.Iliotibial Band Syndrome :** The iliotibial band is a thickened strip of fascia that extends from the hip across the outside of the knee to insert into the large shin bone, the tibia, just below the line of the knee joint. The classic feature of iliotibial band syndrome is severe pain ,well localised, over the outside of the knee. The pain only comes on during exercise. It may occur because you are slightly bowlegged but the most common cause is overpronation of the foot. Some authorities argue that the best way to limit pronation is to increase your cadence or stride frequency i.e. more steps per minute. Of course , if the pronation is related to a functional leg-length discrepancy , then you may need an orthotic or at least a shoe lift. Strangely, with this injury the athlete may be able to walk long distances or even play other sports without discomfort . Walking downstairs is usually painful. Downhill running particularly aggravates this injury as does running on hard surfaces. Another feature of this condition is that the pain subsides immediately when the athlete stops running. Consequently, this is one of those injuries where the runner may be told “It’s all in your head”. Don’t believe it ! Go to a physio ! The latter will usually be able to make a correct diagnosis by discovering that a certain area of the knee is extremely sensitive to pressure. It is confirmed by what is known as the ***“Noble Test”*** ( named after a South African surgeon ) . In this test , pressure is applied to the side of the knee ; the knee is slowly straightened from approx. 90 degrees of flexion. At about 30 degrees of flexion the athlete feels the same pain as he did while running. Heavy training mileage, sudden increases in training and too much racing can all lead to this type of injury. Athletes with this injury must reduce their training but may not have to stop completely. It is safe to run with discomfort but not with pain. Interestingly, a very effective treatment for this injury was developed by the US Marine Corps. They discovered that immobilisation of the knee for three days ,during which the marines wore immobilisation braces on their injured knees and walked using crutches, resulted in complete recovery. They also took anti-inflammatory medication and iced their knees three times per day. Incidentally various studies have shown that the injury occurs on the side of the body corresponding to the side of the road on which the athlete most often ran so, runners who usually ran on the right hand side of the road tended to develop IT band syndrome on their right side. Specific stretching exercise for the It band will help to prevent this condition developing, as will strengthening the gluteus muscles using side-lying leg lifts.

**Other Running Induced Injuries .**

**Runner’s Knee :** This term was probably first coined by the legendary Dr. George Sheehan in the early 1970s. For a long time it was considered to be ***chondromalacia patella*** - a degeneration of the joint cartilage on the under-surface of the kneecap. In 1984, however, Dr.Stan James ( who helped Joan Benoit to recover from this condition in super-fast time to win the US trial and Olympic marathon title ) noticed that the area of most severe pain was on the inner or outer border of the kneecap at the site where the patella tendon and the medial and lateral retinacula attach. This is not the site affected by chondromalacia patella, so Dr.James coined the term ***patellofemoral pain syndrome .*** Since then improved technology ,using various type of scans, has proved Dr.James correct. These show that the ligaments and bone in this condition are abnormal, showing degenerative changes that explain the pain caused by this injury. Runners who suffer from PFPS do not require surgery and certainly not all develop osteoarthritis. It is cured by the prescription of anti-pronation shoes and corrective orthotics. In the acute stage ,icing twice a day and taking anti-inflammatory medication ( sparingly) help to relieve the pain. Strengthening the quad muscles on the affected side also helps recovery and prevents recurrence. The causes of this injury are the usual litany of training too far ,too hard, too soon. Excessive interval training, always running on the same side of a cambered road and racing too often ,all contribute to developing PFPS.

**Osgood-Schlatter Syndrome** : This is a condition limited to growing children but is quite common. The pain is localised over ***the tibial tubercle***, into which the patella tendon inserts. In growing children, the tibial tubercle is an area of bone growth and repeated contractions by the powerful quadriceps muscle which inserts into the tibial tubercle, can cause minor separation of the cartilage from the underlying bone. The condition resolves itself when the cartilage is replaced by bone, usually around the age of 15. ( It is sometimes called Osgood-Schlatter ***Disease*** which is a rather alarming title ! Parents should be reassured that their child will grow out of it ).

**Heel Bruise** : In this condition , pain is felt in the heel pad directly under the calcaneus. The heel pad comprises specialised tissue designed both for shock absorption and energy return. As we get older, the thickness of the heel pad decreases and loses some of its shock absorbing qualities which predisposes the runner to injury. The best treatment is the use of a special heel cup ( a “Tuli cup” ) designed to maintain the mobile tissues of the heel pad underneath the heel at heel strike.

**Stress Fractures in general.**

A runner’s bone may fracture as a result of repeated minor trauma accumulating over many weeks or months. It was first recognised by a German army doctor who noted that these fractures most commonly occurred in new recruits who were just introduced to marching. ( Indeed stress fractures are still sometimes called “march fractures”. It is also interesting that only three animals ,all athletes, humans, racehorses and greyhounds, develop these injuries.) A study conducted in Finland in 1978 found that 55% of stress fractures occurred in the tibia, 23% in the metatarsals, 14% in the fibula, 6% in the femur ,1% in the ankle bone and 1% in the groin ( pubic arch bone ). The pain is usually bearable when the athlete is at rest or walking but becomes unbearable when running is attempted.

The onset of a stress fracture is usually quite sudden ,warning symptoms are generally mild – runners get very little notice of the trauma which is about to hit them .Then ,suddenly, they are no longer able to run. The “ Hop Test” is often used to diagnose a stress fracture : hopping on the injured leg is painful. Even standing on the affected limb ( especially if the fracture is to the pelvis ) may be impossible. Diagnosis is confirmed if tenderness is felt, localised to the bone. Even gentle pressure to the injured pain can cause excruciating pain. A hair-line fracture may require an MRI scan ( Magnetic Resonance Imaging ) or a CT scan ( Computerised Tomography ) to be diagnosed as, generally, it will not show up on a conventional X ray. Both of these type of scans are very costly – unless your health insurance policy covers them ! The runner should also be aware that a CT scan exposes him to radiation while the MRI does not. Therapeutic Ultrasound ( TUS ) is a cost-effective and non-invasive tool for diagnosis of stress fractures. Fractures of the foot bones usually heal within six weeks; the tibia and femur may require 8 to 12 weeks while the pelvis may require 3 to 4 months or even longer. The exact reasons for stress fractures is unknown . We do know that, first, there must be an unusual concentration of stress at one particular site in the bone and ,second, the bone must be insufficiently strong too resist these forces.

**There are seven important factors associated with stress fractures:** **1. Genetic Factors : (a) the high arched foot** which fails to absorb shock adequately and is associated with fractures of the femur and metatarsals. **(b) the pronating low-arched foot** which causes abnormal biomechanical function in the lower limb . **(c) leg length inequalities** : a number of studies have found that 73% of fractures of the femur ,tibia and metatarsals occurred on the side of the long leg whereas a minority of fibular stress fractures occurred on the side of the short leg.

**2. Low Dietary Calcium Intake :** Myburgh et al. ( in 1999) found that stress fractures were 12 times more frequent in people with low calcium intakes. In these studies ,a low calcium intake was by far the best predictor of risk of stress fracture. Similarly, Bennell et al. ( in 1995) found that female athletes were more likely to diet and restrict their food intakes. Furthermore, women with a history of oligomenorrhea were six times more likely to develop a stress fracture**. 3. Low Bone Density :** Again , Myburgh et al. in 1990) found that stress fractures are more likely to occur in athletes who have low bone density , most likely as a result of inadequate calcium intake (in men) and of menstrual dysfunction (in women), both of which are probably related to an eating disorder. **4. Training Errors :** Stress fractures typically occur in novice runners or in competitive athletes who **increase their** **training load too suddenly or return too quickly to heavy training**. Excessive training on hard surfaces also increases the risk of stress fracture . **5. Shoes** : As stated before, running shoes have become very specific. Thirty or forty years ago we all wore neutral shoes. The Adidas Gazelle was the state of the art shoe back then . Thousands of runners ran millions of miles in those shoes with very few injuries. ( It has reappeared in a new existence as a retro fashion leisure shoe ! ) Sometime in the 1980s, the Nike Pegasus arrived on the scene . It was quickly hailed as a superb shoe , and, despite a number of modifications and updates, it has remained one of the best on the market. ( I understand it now rejoices in the name “Nike Zoom Pegasus” ). But most shoes are now specifically geared towards pronators, supinators and neutral. These are sometimes referred to as “over-pronators”, “under-pronators” and “ neutral pronators” respectively. Good sports shops, especially specific running stores, will test your feet and advise you on which is appropriate for you. You can also use the **Wet Feet Test** which is very simple to do and to understand : the basis of this test is that the wet footsteps you leave on the floor while walking is a good indicator of how your foot absorbs the shock of the impact with the floor. If you are over-pronating the image will look like the entire foot; if the image looks like the foot with a moderate “slice” take out of it, you are a neutral pronator while if the image looks as if it has a huge “bite” taken out of it you are an under-pronator or ,in other words , a supinator. Pronation is determined by the height of the arch of the foot : people with low arches are more likely to overpronate. Insufficiently expressed arches are called low or fallen arches ; the term **flat feet** applies to the arch which is sitting on the ground completely. Athletes with low arches are more susceptible to injury and may require orthotics. A flat footed runner needs a shoe with lots of support. “Stability” is the standard term which shoe companies use to denote shoes which are aimed at helping to correct over-pronation. The Mizuno Wave ,the Asics Gel Foundation 10 ,the Brooks Trance 11 and the New Balance 1260 have all been endorsed by competitive runners as excellent shoes for over-pronators. **E**xcessively hard running shoes, especially spikes, are a factor . Spikes should ,in general, be kept for races as they offer very little protection. They may be necessary for short spells of intense speed work during the sharpening phase of training . Otherwise distance athletes are well advised to wear flats when training on the track. Distance runners should make sure to purchase spiked shoes which have a heel ; years ago, spiked shoes had no heel at all and were probably responsible for countless injuries.

**6. Race :** People of Caucasian descent seem to be more prone to stress fractures than those of African descent. ( result of a study by Blickenstaff and Morris in 1966 ; also Bennell et al. in 1983 )

**7 . Female gender :** Women are more prone to stress fractures than are men. As outlined above , women with amenorrhea and women who are very weight conscious and indulge in frequent dieting are most susceptible to stress fractures. Wearing high heels at work during the day promotes calf-muscle shortening and, perhaps, eccentric weakness of the calf muscles. The only time that it may be a good idea to wear high-heeled shoes is during the early treatment phase of Achilles tendonitis. It is essential for women to ensure that they are obtaining adequate calcium in their diet; a deficiency in this important mineral can lead to low bone density making the bones more susceptible to fracture. *( cf. the article on Diet and Nutrition )*

**Treatment :** Runners hate being told to rest ! And the good news is that with most stress fractures the continuation of exercise is not only possible but actually advisable. You can run in a pool using a flotation device or you can run in shallow water without a flotation device. This activity appeared to increase the rate of healing of fractures of the lower limb. ( Both Alberto Salazar and Mary Decker would attest to this ). United States marathon runner , Ed Eyestone ( two time Olympian with a PB of 2:10:59 ) found, in a 1993 study, that six weeks of running in water using a flotation aid maintained the VO2 max. and 3K racing performance of trained athletes just as effectively as did an equivalent training programme of the same intensity and frequency as running on dry land.

 **N.B**. There are two exceptions to the general rule that rest is not necessary for the healing of a stress fracture. A stress fracture of the neck of **the femur** requires the urgent attention of an orthopaedic surgeon as it is an extremely serious injury . It will almost certainly require immobilisation. Similarly a fracture of **the navicular bone** will heal more rapidly if immobilised and may, indeed, fail to unite properly if not treated in a plaster cast as soon as possible.

**Compartment Syndrome .** Obstruction to either the arterial blood flowing into the muscles or the venous blood returning to the heart can produce incapacitating symptoms that make running impossible and even dangerous. These symptoms are known as either **acute or chronic compartment syndromes**. In the past they were often confused with bone strain. In the compartment syndromes , exercise causes an abnormal rise in pressure in one or more of the muscle compartments of the lower leg. It is likely that the pressure rise occurs because fluid accumulates in the muscles during exercise. Normally there is sufficient space in these compartments for the muscles to swell without there being any increase in pressure. In people who develop this injury , however, the muscle compartments are tight and do not allow sufficient room for such swelling. So the pressure rises abnormally in those compartments during exercise , and the resulting pressure may be so great that it interferes with the blood flow to the muscles , causing them to become painful, especially when they are stretched eccentrically . As of now, the only factors known to be associated with this injury are hereditary : muscle compartments that are too small to accommodate the normal swelling of their contained muscles during exercise or muscles that are simply too big for their compartments. The pain usually occurs in one or more of the large muscle groups – usually the anterior calf muscles but, occasionally, the posterior and lateral calf muscles. The athlete may also notice that the affected muscles lose their normal suppleness and become very hard to the touch. While most athletes who suffer from this injury develop the chronic form over a gradual period of time, some runners may be hit by the acute form. This gives no previous warning : the muscles suddenly become painful after exercise and, instead of abating after rest, the pain gets worse and worse. There may be a loss of sensation in the skin over the muscle and eventually there may be paralysis of those muscles which become rock hard. Severe muscle cramping may also occur. What has happened is that there has been a complete blockage of the blood supply to the affected muscles . And, as these muscles now have an inadequate blood supply , they begin to die. The only solution to both acute and chronic compartment syndrome is a surgical procedure ( in the acute form , the surgery must be performed as an absolute emergency ) in which the lining of the tight compartment is split ,allowing the muscle to expand freely inside its compartment. After the surgical wound heals, the athlete is able to run again without pain. Incidentally, there are no stretching or strengthening exercises that are of any value in preventing this condition.

 **How to Avoid Injuries** : ***( easier said than done ! )***

 George Rhoden, who won two Olympic Gold medals in the 1952 Olympics ( 400m. and 4X 400m. ) and who set a world record for the 400m. of 45.8 in 1950, once said “ Unless the feet function at maximum efficiency ,nothing can be accomplished. ” He should know : he is now a podiatrist and is alive and well at the age of 91. It is now generally accepted that feet with inherent structural problems are responsible for a large percentage of leg, foot and muscular disorders in both athletes and in the general populace. Weak feet cause 95% of foot ,leg and knee injuries including heel spurs, shin splints , Achilles tendinitis ,stress fractures of the metatarsals, chondromalacia and tendinitis of the knee.The foot is an engineering marvel . Its 26 bones, three arches and innumerable ligaments and tendons create a complex mechanism capable, as George Rhoden says, “ of supporting hundreds of pounds”. He goes on to say “ It must be realised that the foot is the start of a linear projection involving the whole body. An imbalance in the feet will be compensated for somewhere else in the body. So structural imbalance of even minor degrees can result in incapacitating injuries and persistent disability”. The average distance runner travels at a rate of approx.5000 steps per hour on each foot. Out of this training an overuse syndrome can be born – and these problems can be measured in millimetres. Some athletes have weak feet whose neutral position is slightly slanted, with the weight on the outside of the foot. With this type of foot a number of difficulties can arise : the arch may fall and cause such problems as heel spur and metatarsal problems or the stress may cause twisting of the foot on the ankle or twisting of the leg on the knee ,leading to repeated stress fractures of the fibula and various knee ailments. When an athlete gets injured he faces two challenges : first ,to keep physically active and ,second, to find out why the injury happened and how to prevent recurring in the future. This article has already partly addressed the first one : aqua running, cycling ( spinning) on a stationery bicycle, cross-training , AlterG ( anti-gravity treadmill ) ,etc. are all methods to maintain the athlete’s cardiovascular fitness. But better still if we can avoid injuries altogether. The standard preventative measures are well known by now but let’s summarise them in conclusion:

**Biomechanics** : a bio-mechanical profile conducted by a physio is a worthwhile exercise . Common innate problems which predispose the runner to injury would include unequal leg length; inflexible calf muscles; hypermobile flat feet; high arched feet; high degree of ankle pronation . If these problems are identified early and corrected the athlete may be spared a lot of frustration . Robert Forster ,co-author with Roy M.Wallack of ***Healthy Running Step by Step*** ( a very fine book ) believes that you can’t just fix an injury in isolation. “ Performance, injury prevention and injury rehab. are all linked; you can’t separate them. You have to figure out the cause of the problem: fix the cause and you get fewer injuries”. Forster works with a team of running-biomechanics experts in Centinela Hospital Medical Centre in Los Angeles and he firmly believes that good form and gradual adaptation make for a fitter, faster and less-injured athlete. He goes on to say that a huge number of running related injuries comes down to leg-length discrepancies. There are two types : a structural discrepancy ,in which a leg is truly longer than the other and a more common functional discrepancy caused by an asymmetry in the ilium, one of the two large bones that make up the pelvis. Dr. George Sheehan used to say ,half humorously and half seriously, “ An injured runner would almost be better off in the hands of an engineer than in the hands of a doctor; the real issue is the biomechanical problem which has caused the injury in the first place. The whole thing is about **structural balance”.** *(The whole area of biomechanics is so vast and so important that a future article will be devoted entirely to this topic. )*

**Nutrition :** Training is only half the battle when it comes to achieving great results **. Food is the other**. The key concept that you should remember about healthy nutrition is that you should **eat foods that are close to the ground--** meaning unadulterated and unprocessed **.** Most foods in the store have been processed to such a degree by the giant food corporations that they have little nutritional resemblance to their root food sources. The food industries try to get us hooked with appearance and addictive combinations of salt, sugar and fat. The best foods are natural and whole: lots of fish and white meat, a little red meat, lots of fruit ,vegetables, nuts, legumes and minimally processed whole grains and other carbs.and sugars. *( And, of course, Jerry Kiernan would never speak to me again if I didn’t recommend liver ! And, certainly, a helping of medium rare liver, twice a week , can help to keep your haemoglobin levels topped up ).*

The best diet plan can be boiled down to one sentence : ***Control insulin levels during the day and train your metabolism to be efficient at burning fat , not storing it.*** An earlier article for **Coaching Corner** dealt with the whole area of nutrition , so I’m not going to repeat all of that ! *(* ***cf. Nutrition and Hydration ) .***The value of good daily nutrition is analogous to good sleep habits. If you regularly get adequate sleep you can get away with the odd late night ; but if you do it too often you will become chronically fatigued and run-down. Similarly, if you eat well every day but miss the odd meal here or there ,your energy levels and quality of sessions won’t suffer . But if you have a chronically inadequate diet, you are almost certain to break down because your body is not receiving the protein and other nutrients necessary to repair the micro tears which your muscles incur as a result of hard training. There is an old adage which says “ Eat like a king in the morning, eat like a prince at mid-day but eat like a pauper in the evening”. That might make a lot of sense for people who work in sedentary jobs (eating a large dinner late in the evening is a modern development in this country and it is not a healthy one: people go to bed shortly afterwards and, consequently ,have no opportunity to burn off all those calories ) but it is not a good idea for an athlete in hard training. To keep energy levels stable and ready , eat often ! If you don’t, your insulin levels wane and your “metabolic motor” slows down. A good breakfast is essential ; it is often called the most important meal of the day. It should be comprised of porridge or muesli , some fruit ,some protein ( e.g. eggs ) and some carbohydrate ( e.g. wholemeal bread ). Keep nutrients coming at regular intervals so that your metabolism keeps burning brightly throughout the day. So, have a healthy snack at mid-morning : fruit again is ideal as it is a complex carbohydrate and releases its energy slowly . Keep away from the chocolate snacks which give an instant, but short-lived, blood sugar boost . Lunch should be a type of salad, again with protein ( chicken or fish ) and carbohydrate. If you are going to do a tough workout in the evening , then you need a light snack in the afternoon ( about 4 p.m. ). We know that it is essential to ingest some carbo and protein within 90 minutes of concluding hard training ,so a banana or protein bar is ideal. A more substantial meal**\*** is necessary afterwards and, because you are training hard, you don’t need to worry about not burning off the calories. Because you have kept your metabolism activated throughout the day, it will continue to work overtime even while you sleep. It’s like a brightly burning fire : the more fuel you pile on it , the more quickly and brightly it will burn and consume the extra fuel. A person who doesn’t exercise has a metabolism like a dull, smouldering fire which is unable to burn up the material piled on it. A hard training athlete, on the other hand, can eat up to six times per day and , provided none of it is junk food, will actually be stimulating his metabolism to keep revving faster . Remember again that every hard workout creates “micro-trauma” to the soft tissues and bones that make up the musculoskeletal system . Composed of structures primarily made up of collagen, the body’s soft-tissue system includes tendons, fascia and ligaments. Collagen is the main structural protein in the various connective tissues and makes up from 25% to 35% of the whole-body protein content. The bones that make up the skeletal system are made mostly of calcium. So it is quite obvious why good nutrition is vital in repairing the body and protecting it against injury. \*( cf. ***“Nutrition and Hydration***” in an earlier article )

**Shoes** : If you know your biomechanical profile you will know which type of shoe is suitable for you. Wearing the wrong type of shoe can cause dreadful damage to your feet and legs. Remember the old running adage : “ Most injuries originate in the feet”. Don’t skimp on shoes ; as the late Noel Carroll used to say “ Even the most expensive shoes are cheaper than orthopaedic surgeons”. It must also be pointed out ,however, that some podiatrists believe that ultimately it does not matter what type of running shoes you wear as long as you run using proper technique. I imagine that this position is rather controversial and I would be very reluctant to agree completely with it.

**Training Surfaces:** Training on grass or dirt trails is much kinder on the legs than hard roads or tracks. Downhill running ,while it may develop leg speed, carries a number of risks. It accentuates the impact shock of landing and pulls the pelvis backward thereby extending the back. It also causes the muscles to contract eccentrically ,thereby increasing muscle damage. Overstriding, more common in downhill running, increases the loading on the anterior calf muscles.

**Training Errors** : Doing too much too soon; increasing the quantity and/or quality of training too quickly ;too much track running; too much downhill running; too much racing; too much running on the toes; too many speed sessions, etc. ( too much…too much…too much ….! All progress should be gradual )

**Stretching exercises** : Stretching should be done every day, not just before and after running. As stated in an earlier article , stretching **afte**r a run is probably more important than stretching beforehand. **Dynamic stretching before** a session or race is the more effective while **static stretching is more appropriate afterwards**. Athletes should stretch after showering **and in a warm** **environment** – not immediately after their workout while getting cold with sweat drying on their bodies . Stretching should be gentle: jerky movements should be avoided .

 **Strength and Conditioning**: Vitally important especially “around the middle” as Ron Clarke used to say. This topic was dealt with in some detail in the article entitled ***“Complementary and Supplementary Forms of Training***and we will return to it in the article on biomechanics. Many coaches now believe that weight training is a “magic bullet” for injury prevention ,robust bones and muscles. Biomechanical deviations cause pain and injury ; very often the deviation is an imbalance between the strength of one set of muscles and its opposing set e.g. quads and hamstrings, adductors and abductors. By strengthening the set that is weaker, the problem can be eliminated.

*Finally, it must be said that if you are a serious ,competitive runner ,then injury is an ever present risk. As Roy Keane said recently “ If you want to play a game that has no injury risk, you should take up chess” . ( And ,inevitably ,he got into trouble with the PC brigade for saying it ! ). There is a thin dividing line between super-fitness and breakdown . All that any athlete can do is to take common-sense precautions as outlined above . The good news is that most injuries are curable and surgery is required in only very exceptional cases. While runners with very severe biomechanical abnormalities are predisposed to injury , very few have such monumental abnormalities that they cannot be corrected with modern physio methods and orthotics.*

***The next article will focus on biomechanics and running style.***