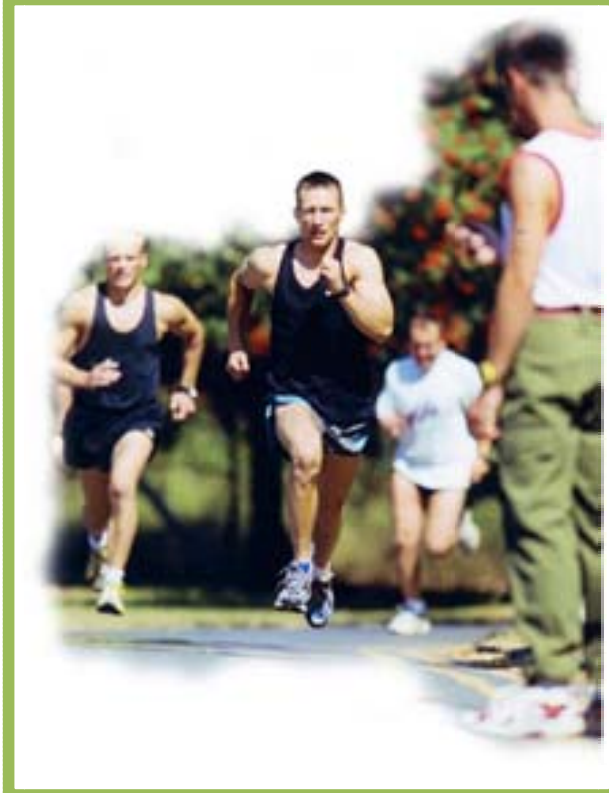
2013

Running: Injuries & Illness



Boot Camp & Military Fitness Institute

6/5/2013

RUNNING: INJURIES AND ILLNESS

CONTENTS

		Page
01	Introduction	2
02	History and Examination	2
03	Patellofemoral Pain Syndrome	3
04	Patellar Tendinopathy	4
05	Illiotibial Band Friction Syndrome	5
06	Shin Pain	6
07	Plantar Fasciitis	8
08	Running Illness	9
09	Sport and Exercise Medicine	11
10	Key Points	12
11	Further Information and Reading	12

The information provided within this article is not intended to act as a replacement to professional advice but merely to provide the reader with an overview of common issues associated with running injuries and illness.

(c) 2013

01: Introduction

Running has become a popular pastime in the UK over the last 30 years with the evolution of large city marathons, as well as charity and fun runs making endurance exercise a realistic and achievable target for all; regardless of fitness level. This has led to the phenomenon whereby inexperienced runners may undertake physical activity that they are not fully prepared for, resulting in increased morbidity. Musculoskeletal problems form up to 15-20% of all general practice consultations with a significant proportion attributable to running. The scope of this article is to focus on the lower limb musculoskeletal injuries and running-related illnesses experienced by runners (and others engaged in similar physical activities), highlighting basic diagnostic and management strategies that can be utilised.

The following eight sections will focus upon one particular aspect of running injuries and illness, and include:

1. History and Examination
2. Patellofemoral Pain Syndrome
3. Patellar Tendinopathy
4. Illiotibial Band Friction Syndrome
5. Shin Pain
6. Plantar Fasciitis
7. Running Illness
8. Sport and Exercise Medicine

02: History and Examination

In order to establish a diagnosis for any musculoskeletal injury, it is vital to understand the exact mechanism and circumstances of the injury process. By knowing the direction of forces acting upon a particular body part, it is possible to focus further history and examination towards developing a diagnosis (*from an exerciser's viewpoint, developing an understanding of how and why the injury occurred*).

Running-related injury often results from adjustments in training and it is therefore important to elicit this in any consultation. The parties (clinicians, physiotherapist, exercisers etc) should attempt to define changes in the volume of training including weekly running distances, frequency, intensity and type of training, i.e. hill, interval, sprint or endurance. New equipment such as training shoes or running kit may also result in an altered running pattern leading to injury. Certain injury patterns may develop when an individual switches from running on a soft surface, i.e. sand or grass, to concrete.

Diet and nutrition may also have an important role in injury development and prevention (*see Female Athlete Triad within Running Illness*) and should also be considered in the history. It is important to ask about the level of competition and importance of running for an individual. An elderly patient who runs for independence and fitness may be equally affected by an injury as a young 'elite' athlete. It is always worth considering the

(c) 2013

possibility that pain or disability may be resulting from a non-musculoskeletal cause and 'red flag' symptoms should be elicited early in any consultation.

Examination of any musculoskeletal injury requires observation, palpation, movement assessment and further specialist testing. When examining an exerciser it is important observe for deformity, swelling, bruising and scars. Observation should include a focused assessment of the injured area as well as a more generalised evaluation of the exerciser during walking and standing.

Palpation attempts to elicit tenderness, crepitus and temperature differences. The range of motion (ROM) of a joint should be assessed actively, passively and against resistance, looking for restriction of range, stiffness or pain during movement in all directions. There are numerous special tests that can be used to assess each musculoskeletal structure. For qualified professionals it may be useful to incorporate a few well rehearsed tests into an examination routine in order to elicit subtle pathology and to build upon this as clinical experience develops.

03: Patellofemoral Pain Syndrome

40% of running related injuries affect the knee joint. Patellofemoral pain syndrome (PFPS) describes the group of symptoms that result from the anterior knee and the patellofemoral joint. PFPS arise as a result of 'mal-tracking' of the patella in the femoral groove during knee movement. A normal patella runs smoothly in the femoral groove. However, an imbalance in the forces acting on the patella, with relative weakness of the medial structures, may result in lateral drift and subsequent knee pain on movement.

Individuals suffer from diffuse knee pain, which is exacerbated by incline running, as well as walking on stairs and squatting. It is the most common overuse injury sustained by runners, with females affected twice as commonly as males.

Numerous factors contribute to PFPS including biomechanical abnormalities, such as valgus knee deformity (knock knees) and excessive foot pronation (roll onto the medial aspect) during gait. The vastus medialis obliquus (VMO) is one of the important structures that limit lateral tracking of the patella during knee movement. It is important to assess the function of the VMO by observing for obvious wasting and by asking individuals to contract their quadriceps muscles by pushing down into the couch to observe the patella tracking. This should be smooth and without gross side-to-side movement. Diagnosis is thus made on a clinical basis.

Treatment of PFPS is multi-faceted and includes pain control as well as managing any underlying biomechanical abnormalities. An initial period of reduced activity with regular ice and non-steroidal anti-inflammatory drugs (NSAIDs) aims to improve pain and localised inflammation.

The next stage of management addresses the contributing factors. Foot orthoses can be used to prevent excessive foot pronation, reducing valgus load at the knee and correcting

(c) 2013

lateral patellar movement. It is also important to ensure that the individual has appropriate training footwear, preventing excessive foot pronation during running.

Patella taping is often performed by a physiotherapist and aims to correct the imbalance of forces on the patella during knee movement. The patella can be taped from a lateral to medial direction ensuring that it glides more centrally and therefore more effectively in the femoral groove. This immediately reduces anterior knee pain and allows the individual to perform rehabilitation exercises, helping to optimise the function of the VMO. Physiotherapy interventions may include VMO and general quadriceps strengthening as well as stretching of the tight lateral patellar structures.

'Lateral release' surgery for PFPS describes the technique whereby the lateral retinaculum of the knee is incised with the intention of reducing some of the tightness. Onward referral may be required for intractable cases but there is little evidence to suggest that surgery improves PFPS and poor outcomes are not uncommon.

04: Patellar Tendinopathy

Patellar tendinopathy (PT) is classically seen in jumping athletes. However, it is also a relatively common injury in runners due to the repetitive nature of the discipline. Recurrent overload within the tendon results in micro-trauma and continued activity leads to degeneration and failed healing. This may start as an inflammatory process and progress to chronic degeneration. PT often results in prolonged absences from sporting activity due to the functional importance of the patellar tendon.

Anterior knee pain is commonly felt at the lower border of the patellar, although pathology can occur anywhere along the tendon. Pain is worse during and after activity and after prolonged periods of sitting or knee flexion. On examination, the tendon may feel slightly thickened with tenderness commonly located in the proximal patellar tendon. Tenderness is classically exacerbated when performing a decline squat, where the individual is asked to carry out a single-legged squat on a slight down slope.

PT is usually diagnosed clinically. However, lateral x-ray may demonstrate calcification within the tendon. Ultrasound is the imaging modality of choice, enabling dynamic assessment of the tendon, and may demonstrate thickened irregular areas of degeneration.

Initial management aims to halt the progress of an acute 'inflammatory' tendinopathy so reduced activity should be advocated. Ice and NSAIDs may be useful in the early inflammatory stage but their benefit beyond this time has not been demonstrated. Correction of any biomechanical abnormalities such as pes cavus (high arch) or pes planus (flat foot), as well as improving flexibility of the claves, hamstrings and quadriceps through stretching will reduce the risk of relapse.

The role of corticosteroid tendon injections remains debatable. However, newer therapies such as sclerotherapy injections aim to obliterate 'new vessel' formation within the tendon, thus relieving pain.

(c) 2013

Eccentric tendon exercises have become the mainstay of tendinopathy treatment. For PT, this involves performing squats on a decline slope, on a daily basis for at least three months. The exercises may be painful and this should not prevent completion. However, pain on the following day is a sign of excessive rehabilitation and the individual should reduce the activity.

Surgery for PT may involve excision of degenerative tendon tissue with few advantages over conservative management. Surgical success rates are reasonable (approximately 80%), although return to activity may take 6 to 12 months.

05: Illiotibial Band Friction Syndrome

The Illiotibial band (ITB) runs along the lateral aspect of the thigh, formed by the tensor fascia lata and the gluteus maximus. It originates at the iliac crest and inserts into the lateral tibial condyle, crossing the hip and knee joints.

Illiotibial band friction syndrome (ITBFS) describes the phenomenon common to runners whereby the deep part of the ITB rubs against the lateral femoral epicondyle during knee movement. The 'friction' of the ITB against the bony femoral prominence causes pain that classically occurs during foot strike as this is the angle at which contact between the two structures occurs. It is the second most common injury sustained by runners, accounting for approximately 8% of presentations to sports medicine clinics and is more commonly seen in males.

The classic presentation of ITBFS is that of generalised ache over the lateral aspect of the knee, which is exacerbated by running, especially on downhill slopes. It commonly begins after a recent change in training intensity, with the onset of the pain typically occurring after a set duration or distance into a run.

On examination, the individual often has marked tenderness over the lateral epicondyle of the femur, found just above the lateral joint line of the knee. However, proximal discomfort may also be a feature. This discomfort is particularly obvious on examination after passive repeated flexion and extension of the knee at an angle of around 30° when the patient may describe a burning sensation.

Treatment relies on reducing the stimulus, which may involve adjusting frequency, intensity and type of training. Early management with ice and NSAIDs reduces local inflammation and a corticosteroid injection into the area between the ITB and the lateral femoral epicondyle may improve acute pain.

Biomechanical factors must be considered and corrected as many abnormalities can predispose to ITBFS. A genu varus deformity increases the tension of the ITB across the lateral femoral epicondyle and can be targeted during rehabilitation. Tightness of the ITB will also increase the tension at the knee, predisposing to ITBFS. Stretching of the ITB forms an integral part of the treatment, as well as self-massage, which can be performed on a foam roll.

(c) 2013

There are several surgical procedures that may be used in unresponsive cases of ITBFS, aiming to excise the small area of the ITB that is abrading the lateral femoral epicondyle or removing the bony prominence itself. The surgical outcomes are usually favourable and commonly enable return to sport.

06: Shin Pain

'Shin splints' describes the mid-shin discomfort experienced by runners during or after activity and represents several diagnoses, including chronic exertional compartment syndrome (CECS), tibial stress fracture and medial tibial periostitis (MTP), as well as vascular and nerve entrapment disorders. These conditions often co-exist and require a detailed management approach (Table 1).

Table 1: Common features of shin pain in athletes

Diagnosis	Pain	Associated Features	Investigation
Chronic exertional compartment syndrome (CECS)	None at rest, aching and tightness builds on exertion after specific duration	May develop parathesia secondary to nerve compression with raised compartment pressures	Invasive exertional compartment pressure testing
Tibial stress fracture	Localised sharp pain with subcutaneous tenderness	Pain exacerbation with tuning fork	X-ray, MRI, CT or bone scan
Medial tibial periostitis (MTP)	Diffuse ache, medial tibial border	Worse in morning or after exercise	MRI, bone scan, diffuse uptake; clinical diagnosis

Biomechanical abnormalities such as pes planus/cavus may predispose an individual to shin pain (Box 1). A cavus deformity results in reduced force dissipation on foot strike with greater force transferred to the shin. Pes planus causes excessive foot pronation, increasing the distance across which the shin muscles must act to drive the body forwards during the propulsive phase of gait. Tightness of the calves and hamstrings also place additional strain on surrounding structure such as the shin, resulting in injury. A formal gait assessment in a running shop or with a physiotherapist or podiatrist may reduce the risk of developing certain injuries.

Box 1: Lower limb biomechanical considerations

- Pes planus (flat foot);
- Pes cavus (high arch);
- Genu valgus (knock knee);

(c) 2013

- Genu varus (bow legged);
- Tight hamstrings;
- Tight calves;
- Squinting patellae; and/or
- Leg length discrepancy.

Chronic Exertional Compartment Syndrome

In CECS, the pressure within the fascial compartment becomes elevated during exercise resulting in tissue hypoperfusion and pain with a typical pattern of onset after a certain time or distance. The individual often complains of 'tightness' that worsens with continued activity and eases rapidly on cessation, leaving an aching sensation. The anterior and lateral compartments are most commonly affected.
Examination at rest may be normal, but after exercise the affected compartment may feel tense and tender. The diagnosis may be confirmed via invasive monitoring by demonstrating increasing compartment pressures during exercise, which may require referral to specialist centres equipped with such facilities.

Management initially involves reduction of aggravating activity; however this is usually not curative. Soft tissue therapies such as massage and vacuum cupping, as well as stretching of the affected muscles and fascial compartment may provide some relief. However, surgical treatment is often required. Fasciotomy is the most common technique, but removal of a portion of the fascia (fasciectomy) may also be necessary. Surgery for CECS has good outcomes with the majority (80%) of individuals making a successful return to sport.

Tibial Stress Fracture

Tibial stress fractures are a relatively common cause of anterior shin pain in distance runners. The majority (90%) occurs in the posteromedial tibia and are considered amenable to management. However, a small proportion occur in the anterior tibia. These fractures develop under tension as a result of the anterior bowing shape of the tibia and thus are notoriously resistant to treatment with a high risk of complications.

Stress fractures often occur after an increase in training intensity or duration, presenting with shin pain of gradual onset that is exacerbated by exercise and may be present at rest or at night. On examination, there is usually localised tenderness of the tibia with occasional soft tissue swelling. Any individual with an injury that is suspicious of a stress fracture should be referred to the emergency department or fracture clinic for further assessment and management. X-ray may demonstrate a 'dreaded black line', although further investigation with computed tomography (CT), magnetic resonance imaging (MRI) or a bone scan is often warranted to confirm diagnosis.

Initial management involves resting the affected area and may require partial or non-weight bearing with crutches and/or a pneumatic brace. The return to activity is governed

(c) 2013

by the clinical response to treatment with an absence of localised bony tenderness and pain-free mobilising indicating successful healing. The individual is advised to undertake low impact activity initially, i.e. swimming, and progress gradually to weight bearing activities. Intrinsic factors such as bone mineral density must also be considered with stress fractures, especially in women (see Femlae Athlete Triad). Surgery in the form of bone grafts or intramedullary nailing may be required for anterior tibial stress fractures.

Medial Tibial Periostitis

Medial Tibial Periostitis (MTP) has a female preponderance and occurs when excessive traction forces are exerted upon the origin of tibialis posterior, soleus and flexor digitorum longus, commonly as a result of the repeated ankle movements during running. Individuals describe pain along the posto-medial border of the shin that 'warms up' with exertion and worsens after exercise, noted as an aching after prolonged rest or sleep.

Biomechanical factors (Box 1) may predispose an individual to MTP, as may a recent increase in training, incorrect footwear and reduced lower limb muscle flexibility. On examination, there may be a diffuse area of tenderness, with pain on hopping or on percussion and as such it is important to exclude tibial stress fracture and consider CECS as a differential diagnosis. X-ray is usually normal and the diagnosis is established on clinical grounds, although MRI or bone scan may demonstrate diffuse non-specific changes along the border of the tibia.

Initial management with ice, reduced activity and NSAIDs controls pain and localised inflammation. Correction of abnormal biomechanics is essential and may take the form of orthotics to provide medial arch support, using shock absorbing footwear and encouraging stretching of tight calf muscles. Soft tissue therapy through massage and vacuum cupping may also provide some symptomatic relief. Surgical release of the muscle from the postero-medial tibia has reasonable success rates but is usually only considered for intractable cases.

07: Plantar Fasciitis

Plantar fasciitis (PF) is a common injury sustained by runners, with 10% lifetime prevalence for the general population. The plantar fascia is a thick aponeurotic band extending from the medial aspect of the calcaneus (plantar surface) that splits to enclose the digital tendons at the proximal phalanges and helps support the arch of the foot.

PF describes a degenerative non-inflammatory process that occurs with repetitive foot strike. Biomechanical abnormalities such as pes planus (flat foot) may predispose to PF as the lack of medial arch support leads to over-pronation, requiring the plantar facia to work harder during the gait cycle. A pes cavus (high arch) deformity may lead to PF too as the rigid foot has less ability to cushion landing forces. Tight calves and hamstrings may also predispose an individual to PF, as can increased activity, obesity and incorrect footwear.

Medial heel pain is most commonly observed on initial walking in the morning or after a period of immobility and tends to gradually improve during exercise. On examination,

(c) 2013

there is usually diffuse tenderness over the medial aspect of the plantar calcaneus, extending towards the base of the toes. X-ray may demonstrate a bony calcaneal spur. However, such abnormalities have not been causally related to PF and the diagnosis is usually made on a clinical basis.

Treatment initially consists of analgesic measures including reduction precipitating activity, ice and NSAIDs. The mainstay of management involves stretching of the calves, hamstrings and the plantar fascia itself, which can be achieved by placing the toes against a wall with the heel on the floor and pressing the arch downwards. Massage may also provide some relief from the discomfort of PF and can be achieved by rolling a golf ball underneath the arch of the foot against a firm floor. Heel and arch supports as well as cushioned footwear aim to raise the heel and reduce impact forces.

Corticosteroid injection into the plantar fascia may provide significant relief but can be painful and carries a significant risk of fascia rupture. Newer treatments such as extra-corporeal shock wave therapy have also demonstrated some promising early results. Surgery for recalcitrant cases involves resection of the middle third of the plantar fascia with evidence no longer supporting removal of any bony heel spur.

08: Running Illness

Hyponatraemia and Fluid Replacement

Individuals who attempt long distance events such as marathons will recognise the need to maintain adequate hydration. Over-hydration can, however, lead to severe illness in the form of exercise-associated hyponatraemia (EAH), which is defined as serum sodium of less than 135 mmol/l during or up to 24 hours after prolonged physical activity.

It occurs as a dilutional effect of excess fluid consumption beyond that of body fluid losses during prolonged exertion. Low plasma sodium levels reduce plasma osmolality leading to a fluid shift from extracellular to intracellular compartments. This can lead to peripheral oedema, nausea, vomiting and headache, with confusion, seizures and death occurring with unchecked illness progression as a result of cerebral oedema.

Risk factors for developing EAH include excessive fluid consumption during endurance events, renal dysfunction, hot environmental conditions, female sex and slow running with prolonged event duration. Treatment consists of resuscitative measures as well as initial restriction. Intravenous hypertonic saline (3|% NaCl) is required if neurological symptoms predominate.

Recent fluid replacement guidelines suggest cautious rehydration for individuals involved in endurance events. The guidelines advocate ‘drinking according to thirst’ and encouraging individuals to weigh themselves before and after training events to calculate fluid losses with the aim of ‘avoiding weight gain during exercise’. Medical and fitness professionals should be advised to offer such guidance to individuals who are concerned about hydration during endurance events.

(c) 2013

Exertional Heat Illness

Exertional heat illness (EHI) encompasses a spectrum of disorders ranging from heat cramps to life-threatening heatstroke (which carries a 7% morality). It occurs in the sporting environment due to an individual's inability to adequately dissipate the heat generated through muscular exercise and is commonly seen during endurance events. Heatstroke describes the clinical syndrome of neurological disturbance associated with a core body temperature of greater than 40°C (rectal temperature). Individuals may become dizzy, confused and agitated with a change in personality and collapse with a reduced Glasgow Coma Score (GCS) is not uncommon.

Risk factors associated with heatstroke include dehydration, obesity, high environmental temperature, febrile illness, alcohol ingestion and poor fitness. Rapid cooling at the roadside ensures restoration of core body temperature to normal. In the sporting environment, this is usually achieved through ice-water body immersion, evaporative spray cooling or ice packs to the axillae, neck and groin. Outcomes are greatly improved by cooling the individual as rapidly as possible with survival rates improving when core temperature is restored to below 38.9°C within 60 minutes.

Individuals should be advised to ensure that they remain hydrated, avoid excessive alcohol consumption prior to endurance activity and avoid running when unwell. Other causes of exercise-associated collapse must be considered including hypotension (low blood pressure), which rapidly responds to leg elevation and hypoglycaemia (low blood sugar), which should be measured in the initial assessment.

Female Athlete Triad

Primary care practitioners are commonly the first medical professional to encounter an individual with the female athlete triad (FAT). FAT describes the syndrome of disordered eating, low bone mineral density and amenorrhoea or menstrual dysfunction. It occurs in females who have a negative energy balance due to excessive physical activity and/or insufficient calorific intake. A significant proportion of females may only suffer from components of the triad, which exists as a continuum between health and disease.

Excessive exercise in combination with a restricted diet can result in suppression of reproductive function and bone formation, which occurs when the body enters 'starvation mode'. This results in hypothalamic amenorrhoea with subsequent menstrual abnormalities. This process is reversible when energy balance is restored through increased calorific intake.

Reduced energy intake also results in lower bone mineral density and strength due to decreased bone formation and increased resorption. As a result of these bone changes, individuals have a higher incidence of stress fractures.

Screening for FAT relies on the medical professional elucidating a detailed history regarding exercise volume, dietary intake and menstrual irregularities. If amenorrhoea

(c) 2013

exists, then it is important to exclude other treatable causes before presuming that reduced energy availability is the cause.

Management relies on improving availability through incremental increases in dietary intake or a reduction in output as exercise (or both). The aim is to restore a normal menstrual pattern and reverse low bone density. A dietician and psychiatrist may offer optimal outcomes in individuals who are resistant to therapy. Individuals with a diagnosis of osteoporosis on Dual Energy X-ray Absorptiometry (DEXA) scanning may benefit from calcium and vitamin D replacement as well as bisphosphonates. However, there is little evidence supporting their use in the younger population.

Exercise Dependency

Exercise dependency (ED) develops when an individual becomes addicted to physical activity, resulting in withdrawal symptoms when exercise is withheld, as well as feelings of guilt and low mood. It may lead to interference with relationships and continued participation in physical activity despite medical contraindications.

There appears to be a close relationship between ED and eating disorders, with obsessions regarding weight and body shape commonly described. ED may result in illness due to reduced immune function and musculoskeletal injury when the individual fails to heed warning signs and continues to exercise despite them.

Tolerance may occur whereby increasing levels of physical activity are required to achieve similar psychological benefits. Participation in exercise and obsessive thoughts regarding physical activity may dominate and interfere with social functioning.

It is important for medical and fitness professionals to educate individuals about the dangers of ED as the individual may be able to recognise early signs of the condition and about further progression. Regular rest forms a vital part of the training and recovery process and may practically involve the individual swapping an intense cardiovascular workout for a gentle stretching session. A multidisciplinary approach, including input from psychiatrists and psychologists, may optimise an individual's outcomes.

09: Sport and Exercise Medicine

Sport and exercise medicine (SEM) is a relatively new National Health Service (NHS) specialty that was set up in 2005 in response to the growing need to manage musculoskeletal and exercise-related injury and illness. SEM consultants are trained in musculoskeletal medicine, exercise prescription and promotion and public health and as such provide a crucial solution to the medical problems associated with exercise-related and musculoskeletal injury, as well as physical activity.

SEM consultants aim to reduce NHS costs and improve musculoskeletal management by offering a service to individuals who do not require referral to orthopaedic care for surgery. Through primary care referral, this enables increased orthopaedic operating time and reduces waiting lists. SEM doctors also provide exercise prescription advice, assessing the

(c) 2013

cumulative risk for individuals with multiple pathologies and advising individuals to undertake safe levels of physical activity.

10: Key Points

- Running-related injuries are commonly seen in general practice;
- It is important to consider underlying biomechanical abnormalities when assessing individuals with musculoskeletal injury;
- A sudden change in training may precipitate musculoskeletal injury and must be addressed during management of such cases;
- Cautious fluid intake during endurance exercise will help prevent severe dilutional hyponatraemia; and
- Extreme volumes of exercise may result in adverse physical and psychological outcomes.

11: Further Information and Reading

Further information for individuals can be found at www.patient.c.uk, which offers user-friendly advice regarding each of the specific running-related conditions mentioned in this article. Another website, www.physioadvisor.com, provides a description of each running injury listed in this article, as well as a comprehensive list of rehabilitation exercises.

Bamber, D. Cockerill, I.M., Rodgers, S. & Carroll, D. (2000) "It's Exercise or Nothing": A Qualitative Analysis of Exercise Dependence. *British Journal of Sports Medicine*. 34(6), pp.423-430.

Bruckner, P. & Khan, K. (2007) *Clinical Sports Medicine*. 3rd ed. London: McGraw-Hill.

Cowan, S.M., Bennett, K.L. & Hodges, P.W. (2002) Therapeutic Patella taping Changes in People with Patellofemoral Pain Syndrome. *Clinical Journal of Sport Medicine*. 12(6), pp.339-347.

Department of Health (2009) *Let's Get Moving. Commissioning Guidance. A New Physical Activity Care Pathway for the NHS*. Available from World Wide Web: <http://www.dh.gov.uk/prod_consumdh/groups/dh_digitalassets/documents/digitalasset/dh_105944.pdf> [Accessed: 26 April, 2013].

Fagan, V. & Delahunt, E. (2008) Patellofemoral Pain Syndrome: A Review of the Associated Neuromuscular Deficits and Current Treatment Options. *British Journal of Sports Medicine*. 42(10), pp.789-795.

Gill, C.S., Halstead, M.E. & Matava, M.J. (2010) Chronic Exertional Compartment Syndrome of the Leg in Athletes: Evaluation and Management. *The Physician and Sports Medicine*. 38(2), pp.126-132.

(c) 2013

Gunter, P. & Schwellnus, M.P. (2004) Local Corticosteroid Injection in Illiotibial Band Friction Syndrome in Runners: A Randomized Controlled Trial. *British Journal of Sports Medicine*. 38, pp.269-272.

Harrast, M.A. & Colonno, D. (2010) Stress Fractures in Runners. *Clinical Journal of Sports Medicine*. 29, pp.399-416.

Kipps, C., Sharma, S. & Pedoe, D.T. (2011) The Incidence of Exercise-associated Hyponatraemia in the London Marathon. *British Journal of Sports Medicine*. 45, pp.14-19.

Macintyre, J.G., Taunton, J.E., Clement, D.B., Lloyd-Smith, D.R., McKenzie, D.C. & Morrell, R.W. (1991) Running Injuries: A Clinical Study of 4,137 Cases. *Clinical Journal of Sport Medicine*. 1(2), pp.81-87.

Manore, M.M., Kam, L.C. & Loucks, A.B. (2007) The Female Athlete triad: Components, Nutrition Issues and Health Consequences. *Journal of Sports Sciences*. 25(Suppl 1), pp.S61-S71.

Moen, M.H., Tol, J.A., Weir, A., Steunebrink, M. & De Winter, T.C. (2009) Medial Tibial Stress Syndrome. *Sports Medicine*. 39(7), pp.523-546.

Peers, K.H. & Lysens, R.J. (2005) Patellar Tendinopathy in Athletes. *Sports Medicine*. 35(1), pp.71-87.

Taunton, J.E., Ryan, M.B., Clement, D.B., McKenzie, D.C., Lloyd-Smith, D.R. & Zumbo, B.D. (2002) A Retrospective Case-control Analysis of 2002 Running Injuries. *British Journal of Sports Medicine*. 36, pp.95-101.

(c) 2013