Dealing with shin pain in athletes

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It is important to elucidate the exact cause of exercise-related shin pain because treatment and prognosis differ widely for the various pathologies.

'Shin splints' is a term that is frequently misused to describe any exercise-related leg pain, especially pain of the medial tibia. Exercise-related shin pain most commonly originates from the bone, periosteum and muscle compartments. A range of pathologies, from bone stress to stress fractures, may affect the tibia and, less commonly, the fibula. Medial tibial stress syndrome (also known as traction periostitis) is due to inflammation of the periosteum as a result of stress to the soleus muscle attachment and the fascia, which attach to the medial tibial border. Exertional compartment syndrome occurs when the deep posterior calf, anterior or lateral muscles, which are each encased in an inflexible fascia, become swollen and painful under exercise. There is often overlap between the conditions, and they can coexist.

GPs should also be aware that other conditions may present as activity-related leg pain – for example, lumbar spine disc and facet joint inflammation, central and lateral canal stenosis, and peripheral vascular disease. These should be specifically excluded in the history and examination.

Diagnosis

The clues to differentiating the various pathologies lie in the nature and timing of the pain with exercise and the location of the pain (Table). It is also important to look for potential precipitants of periostitis and stress fractures – these are listed in the box on page 64.

Presentations

Consider the following:

Case 1: A 35-year-old male decides to contest the City-to-Surf for the first time. He begins training three months prior to the event, starting his road running at 5 km every third day and quickly increasing this to 10 km every second day. He uses his 5-year-old canvas tennis shoes as his running shoes. During his third week of training he develops generalised right medial tibia soreness, which eases after the first five minutes of running but returns on cooling down after his run.

Case 2: A 17-year-old female basketball player presents with anterior shin pain associated with exercise. She was recently accepted into an elite level scholarship program and is now training up to 25 hours and playing two games per week. This is three times her previous training load. The pain, which used to resolve with rest and icing, has recently worsened and become more localised to the anterior mid-tibia. She experiences impact pain when landing after jumping and while running or walking, and she also has night and rest pain. The patient has a history of large weight fluctuations, bulimia and menstrual irregularity with long periods of amenorrhoea. She now weighs 70 kg and is 1.92 metres tall (BMI 19 kg/m^2).

What is the cause of the pain in these patients?

Medial tibial stress syndrome

Medial tibial stress syndrome usually presents with the type of history presented in Case 1. Athletes who are involved in running or jumping sports and dancers are more likely to develop this condition.

The pain is inflammatory in nature – that is, it tends to decrease as patients warm up and return as they cool down. Initially the pain settles after a few minutes of rest but it may become persistent if continually aggravated with exercise.

Examination

Examination reveals diffuse tenderness along the medial border of the tibia (i.e. the middle two-thirds. Excessively pronating or supinating feet can best be analysed with video gait analysis (a functional rather than a static assessment), in a multidisciplinary sports medicine clinic – this is discussed further in the box on page 64.

Table. The common causes of exercise-induced shin pain

Condition	Pain characteristics
Medial tibial stress syndrome	Diffuse leg pain that improves as exercise continues but returns late in exercise or on cooling down
Stress fracture	Localised bone pain with each impact that worsens with running and may persist at rest and at night
Exertional compartment syndrome	Activity-related leg pain occurring at certain intensities of training that worsens to force running or jumping cessation and resolves completely with rest

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Potential precipitants of periostitis and stress fractures

Extrinsic factors

- Sudden increases in training intensity, duration and/or distance
- Unsuitable running surface – hard surfaces increase ground reaction forces on the lower limb and uneven or cambered surfaces increase rotational stress
- Inappropriate footwear, which can lead to inadequate shock absorption and/or rearfoot control

Intrinsic factors

- Previous similar injury or recent injury elsewhere in the lower limb (may alter biomechanics by causing joint stiffness or muscle weakness)
- Poor foot biomechanics – a rigid cavus (high arch)/supinating foot decreases shock absorption, and a planus (low arch)/pronating foot requires the medial calf muscles and peroneals to work excessively to stabilise the arch and increases rotational stress (as excessive rolling in of the foot causes increased internal rotation of the tibia)
- Calf muscle inflexibility, which reduces ankle dorsiflexion and increases the tendency to pronate while running
- Female athlete triad (disordered eating, amenorrhoea and osteopenia), a specific concern in females with stress fractures who may develop reduced bone density or more difficult to quantify microarchitectural weakness (decreased bone quality) due to disruption of the hypothalamic–pituitary–ovarian axis

Investigation

Investigation is usually not necessary. Plain radiographs are typically normal. However, if the diagnosis is in doubt, a triple-phase bone scan may show linear patchy uptake along the medial tibial border (Figure 1).

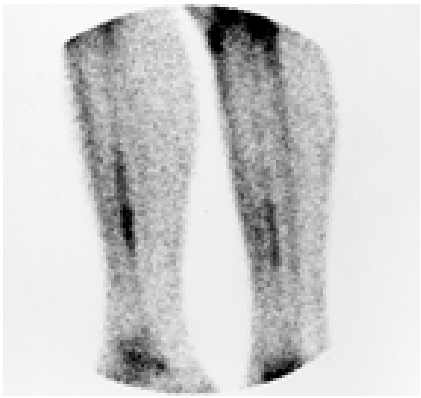

Figure 1. Delayed image of triple-phase technetium bone scan showing patchy, linear increased uptake of the posteromedial border of the tibia consistent with medial tibial stress syndrome or periostitis.

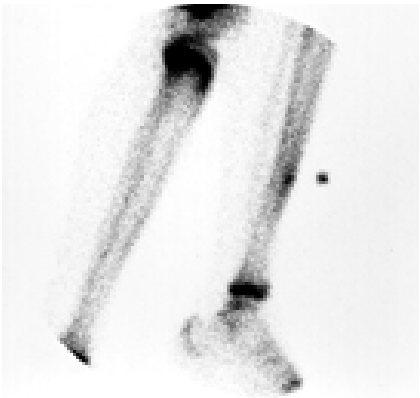

Figure 2. Delayed phase bone scan showing focal increased uptake at the area of local tenderness on the anterior mid-third tibial cortex. This indicates a potentially unstable stress fracture requiring urgent treatment.

Management

Temporary modification of the patient's exercise routine is part of the management of medial tibial stress syndrome. This involves a period of relative rest, in which the athlete is allowed to cross train using activities that require less weight-bearing, such as swimming, deep water running (without contacting the pool bottom) and cycling. Inflammation can be reduced using topical or oral NSAIDs, ice, and electrotherapeutic modalities such as low dose ultrasound and magnetic fields.

Intrinsic factors that may be causing or contributing to medial tibial stress syndrome may be corrected using deep friction massage therapy to the deep calf muscles, together with measures for improving soleus calf muscle flexibility and mode-specific strength work for synergist muscle (long toe flexors, peroneals, tibialis posterior). These should initially be performed under exercise medicine or physiotherapy supervision. Podiatry review for orthotics and advice about appropriate running shoes may be required.

When the pain and tenderness have resolved and intrinsic factors have been addressed, patients may return to their chosen activity (usually within two to four weeks). The training intensity, duration and distance should be increased gradually. Athletes should begin running on level surfaces (grassed or paved) before using cambered, hilly or uneven surfaces.

Stress fractures

Patients with tibial stress fractures, as illustrated by Case 2, typically present with localised bone pain that not only occurs on impact with weight bearing exercise but can also occur at rest or during the night. In Case 2, a mid-third anterior cortex fracture must be suspected – this is a high risk stress fracture prone to delayed union or nonunion. It should be attended to urgently because it can be complicated by a complete fracture that may displace if symptoms are ignored and running is not ceased.

Examination

Examination reveals point tenderness at the site of pain on the anterior tibial cortex and a 'hop test' (pain when hopping on the affected limb) will be positive. Patients may have percussion or vibration tenderness over the fracture site.

Investigation

A triple-phase bone scan will show intense focal increased uptake in the tibia (Figure 2). Bone scans are normally positive within 48 hours of symptom onset and

are extremely sensitive (if the bone scan is negative then a stress fracture is unlikely). However, these scans are nonspecific and tumours and infection may produce similar findings. Plain radiographs or fine-cut CT scans are useful for excluding other bone pathologies. Benign and malignant bone tumours may cause pathological stress fractures at much lower training loads. Anterior mid-third tibial cortex stress fractures may exhibit the 'dreaded black line' on radiograph – evidence of nonunion with a late presentation (Figure 3).

MRI may be used as a first line investigative tool. This technology has a high sensitivity and specificity for stress fractures, showing an increased signal of bone marrow oedema on T2-weighted imaging and/or a fracture line. However, MRI is sometimes less diagnostic early on. A CT scan may show the fracture line but is not usually necessary, depending on the clinical picture and in the presence of a positive bone scan or MRI.

Management

Although a small proportion of anterior cortex stress fractures may heal with conservative management, most do not. Orthopaedic intervention may be required in the form of intramedullary nail fixation with debridement of the nonunion. Bone grafting may also be necessary.

For medial and posterior cortex stress fractures on the other hand, the prognosis is much better. Management is similar to that of medial tibial stress syndrome, with intrinsic and extrinsic factors being identified and treated. The period of relative rest may be up to four to eight weeks, with a fortnightly assessment of tenderness. Patients can cross train with non-weight bearing activities and use NSAIDs or paracetamol for pain relief. Use of long leg air casts has been shown to reduce the time taken to return to the chosen sport. Biomechanical and training errors should be corrected in consultation with the athlete's coach.

Specific attention should be paid to female athletes, especially those competing in sports where aesthetics or weight control is important, such as gymnastics or lightweight rowing. Recurrent stress fractures may point to the female athlete triad (an energy deficit disorder), and attention should be paid to the menstrual history and eating habits. If the female athlete triad is suspected, consultation with a dietitian and sports psychologist is recommended. Bone protection involves improving carbohydrate intake to correct energy imbalance and ensuring an adequate calcium intake, either by adequate dietary intake or supplementation with calcium citrate 1500 mg/day.

Exertional compartment syndrome

Exertional compartment syndrome is a common cause of shin pain in runners thought to be caused by exercising muscles expanding within an inflexible fascia. Patients may complain of activity-related pain that begins at a specific time, distance or intensity during their activity, becomes worse with continuation of the activity, and resolves completely with rest. They may also report leg paraesthesia or foot weakness, which is caused by nerve compression within the swelling compartment.

Exertional compartment syndrome more commonly affects either the deep posterior compartment (containing the tibialis posterior, flexor hallucis and flexor digitorum longus muscles) or the anterior compartment (containing the tibialis anterior, extensor digitorum longus, extensor hallucis longus and peroneus tertius muscles). The lateral compartment (containing the peroneus longus and brevis muscles) is more rarely involved.

Examination

Examination at rest is usually normal, so it is important to have patients exercise to produce their symptoms. This may reveal a swollen, tight calf or anterolateral leg with reduced foot arterial pulses and/or neurological deficits, such as foot drop or reduced sensation.

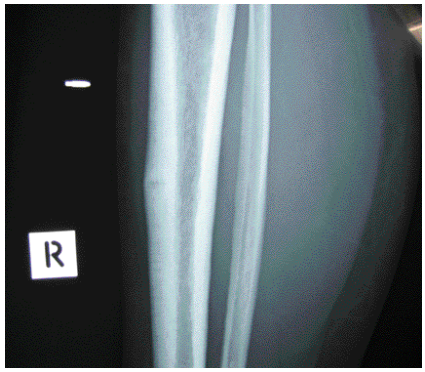

Figure 3. Lateral radiograph of an anterior mid-third cortical stress fracture of the right tibia. Note the 'dreaded black line' within the thickened cortex – this denotes an established nonunion that increases risk of fracture displacement if weight bearing sport is continued.

Investigation

Compartment pressure testing may show resting pressures greater than 10 mmHg and exercising pressures of at least 35 mmHg. A bone scan may be required to exclude other causes (e.g. stress fractures).

Management

Chronic exertional compartment syndrome requires a conservative management strategy of rest and reduced activity together with deep massage therapy to release tight fascial bands. Intrinsic and extrinsic factors should also be addressed. If this fails, referral for fasciotomy or fasciectomy is required.

Acute exertional compartment syndrome is a surgical emergency and patients should be referred immediately for fasciotomy.

Final comments

Exercise-related shin pain most commonly originates from the bone, periosteum and muscle compartments. Other conditions (related or unrelated to exercise) may cause local or referred leg pain. It is important to elucidate the exact cause of the pain because treatment and prognosis differ widely for the varying pathologies. MT

DECLARATION OF INTEREST: None.