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Shin pain in athletes

Assessment and management

Background
Shin pain is a common complaint among running athletes and can be caused by bony, muscular, vascular or neural pathology.

Objective
This article discusses the likely causes, assessment and management of shin pain in athletes presenting in the general practice setting.

Discussion
Accurate diagnosis is important as treatment differs depending on the cause. The characteristics of the pain and examination findings after exercise give strong clues to the diagnosis; further investigation may be unnecessary. Bony stress reactions and fractures are the most common cause of shin pain; patients describe a 'jarring' sensation along the bone margin with heel strike. Other causes include recurrent exertional compartment syndrome (RECS), tenosynovitis, neurological entrapment and rarely, vascular entrapment. Symptoms of vascular entrapment may be similar to RECS and this may cause diagnostic confusion. Increased bone stress in athletes is largely due to inappropriate training program design and can usually be alleviated by reducing impact loading until pain resolves.

Keywords: musculoskeletal diseases; leg; tenosynovitis; stress factures

CPD

Shin pain is a common complaint among running athletes. Patients often say they are suffering from 'shin splints', however these words simply describe the pain and do not represent a specific diagnosis. The characteristics of the pain and examination findings after exercise generally give strong clues to the diagnosis without the need for further investigation. *Table 1* shows the common, less common, and rare causes of shin splints in athletes.

Shin pain can be divided into four broad pathological categories:

- bony
- muscular
- vascular, and
- neural.

Stress reactions/fractures and recurrent exertional compartment syndrome (RECS) may occur in the same patient, which may cause diagnostic confusion.

Bony stress reactions and fractures

When thinking about bony stress reactions and fractures, it is useful to consider these as diagnoses on a 'continuum of bone stress'. *Figure 1* illustrates how an increase in running load can shift a runner from a normal state of bone turnover to one of stress reaction and, at the extreme, a stress fracture. The converse is also true: reducing load tends to return the runner to a normal level of bone turnover. This concept can be very useful when explaining to patients how to resolve their stress reactions or fractures.

Increased bone stress is largely due to inappropriate training program design which results in levels of running load that are too high for the individual. When designing a training program it is important to consider training volume, intensity and frequency. Appropriate 'periodisation', whereby the volume and/or the intensity of training varies over time, is an important component of modern training regimens. Other factors such as biomechanical inefficiencies, poor technique, inappropriate footwear, menstrual irregularities, and low bone mineral density may contribute to the risk of stress fracture. However, in most cases, these factors are less important than inappropriate training program design.

Bony stress reactions and fractures typically occur over the medial tibial borders and can also occur in the fibula. Rarely, they

Table 1. Causes of shin pain in athletes		
Common	**Less common**	**Rare**
Stress reactions	Recurrent exertional compartment syndrome (RECS)	Vascular entrapment
Stress fractures	Tenosynovitis	Central nervous system disorders
	Neurological entrapment	Primary muscle disorders
		Tumours

may occur in the anterior tibia. Unlike medial tibial stress fractures, anterior tibial stress fractures have a potential for catastrophic fracture if the athlete jumps and lands in a certain way. For this reason, they should be managed far more conservatively with prolonged periods of nonimpact loading lasting for at least several months.

Assessment

Patients describe pain from bony stress reactions and fractures as a 'jarring sensation' along the bone margin strongly related to heel strike. In the early stages (stress reaction), the pain typically occurs on commencing activity and disappears as the athlete warms up into their running, only to reappear on cool down after exercise cessation. If training continues and the injury progresses, pain becomes more constant throughout a running session and the athlete may need to stop because of the severity of the pain. At extreme levels, nocturnal aching or constant daily pain can occur (stress fracture). On examination, pain is felt on hopping or jumping and there is linear (stress reaction) or focal (stress fracture) tenderness over the medial tibial border.

In the majority of cases the diagnosis is clear from the clinical presentation and investigation is not required. However, triple phase bone scan will clearly demonstrate areas of focal/linear uptake over the tibial border corresponding to the site of maximum tenderness (*Figure 2*). If there is a suspicion of an anterior tibial stress fracture, plain X-ray should be performed looking for a horizontal cortical fracture – the 'dreaded black line' (*Figure 3*).

Management

Management of bony stress reactions and fractures involves reducing impact loading (running/jumping) until pain resolves. During this period, the athlete may cross train through nonimpact type activity such as cycling, swimming and gym work. Once they are pain free, they may return to running using a 6–8 week 'walk-run' program; this prevents recurrence of pain and allows the patient to self govern their recovery. Attention to biomechanical inefficiencies, appropriate footwear, and occasionally, orthotic prescription, may be useful. Anterior tibial stress fractures in high demand athletes often require avoidance of impact loading for periods of many months for bony union.[1] This, combined with the much greater risk of complete fracture, will occasionally necessitate internal fixation with a tibial nail.

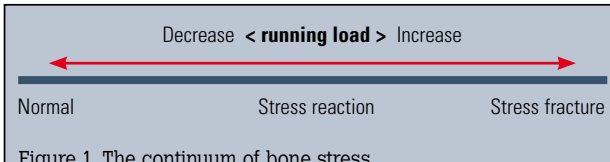


Figure 1. The continuum of bone stress

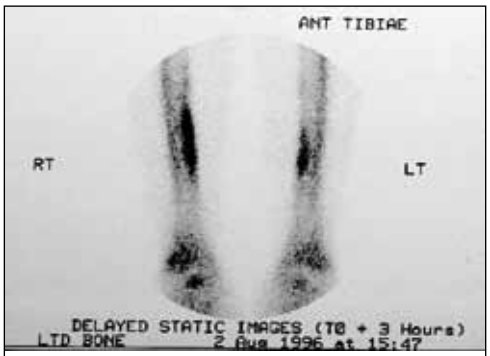


Figure 2. Triple phase bone scan showing medial tibial stress fractures

Recurrent exertional compartment syndrome

Recurrent exertional compartment syndrome occurs when the pressure in a muscular compartment is intermittently elevated during high levels of activity in that group of muscles. In the lower leg, the deep posterior compartment is the most commonly affected and this may cause medial tibial pain.

Assessment

In contrast to bone stress, the pain of RECS comes on at a relatively predictable point after commencing running and builds as exercise continues. The pain is often described as a 'tightness/pressure/cramping/swelling' feeling immediately overlying the relevant compartment and may be severe enough to stop the patient running. Occasionally, patients may describe paraesthetic symptoms related to neurovascular structures traversing that compartment. The symptoms usually settle within 30 minutes of rest and the patient is pain free the following day. Athletes will often describe a long history of this predictable exercise induced pain over years, and despite lengthy symptom free periods while resting, it usually recurs soon after commencing running again.

Figure 3. X-ray showing anterior tibial stress fractures

Figure 4. Fascial hernias in the setting of recurrent exertional compartment syndrome

Postexercise examination in the case of anterolateral pain reveals a palpably tense and tender compartment, often with fascial hernias (*Figure 4*). Altered sensation may occur if neurovascular structures are affected. Compartment pressure monitoring is an invasive procedure and is only warranted if conservative treatment fails and surgery is a consideration (*Table 2, Figure 5*).

Management

Deep tissue massage is usually the only effective conservative treatment and massage sessions often need to be continued indefinitely to maintain benefit.[3] If massage fails, referral for fasciectomy may be indicated. Fasciectomy is curative in a relatively high proportion of cases[4] with a return to full function after 2–3 months through a progressive return to running program.

Neurological entrapments

Neurological entrapments are significantly less common than the bony and muscular pathology described here. The superficial and deep peroneal and the saphenous nerve are more commonly involved.

Assessment

Neurological entrapment usually causes pain described as 'burning' or 'aching'. In addition, transient paraesthesiae, dysasthesiae and weakness may occur during exercise according to the nerve involved. The pain is variable in onset during exercise but characteristically persists for days after activity, including at night, and there is often a constant background level of symptoms in between bouts of running. Examination during/after exercise may reveal sensorimotor changes related to the involved nerve; diagnostic local anaesthetic blocks of sensory nerves during exercise may aid in confirming the diagnosis.

Table 2. Compartment pressure monitoring

Description of procedure	A slit catheter system is inserted into the relevant compartment and the pressure is measured using a handheld digital manometer (*Figure 5*). For a test to be valid, the patient must be able to reproduce their typical symptoms by running during the test
Measurements	Can be recorded before during and after exercise. Postexercise pressures over a 5 minute period are the most predictive of RECS. These are compared to established normative data[2]
Normative compartment pressures per unit time postexercise (Pedowitz criteria[2])	• Pre-exercise <15 mmHg • 1 minute postexercise <30 mmHg • 5 minutes postexercise <20 mmHg

Figure 5. Stryker™ compartment pressure unit and slit catheter

Nerve conduction studies and electromyogram (EMG) are helpful in some cases to localise a lesion.

Management

The mainstay of treatment is corticosteroid injection around entrapment sites such as the peroneal tunnel, perforation point of the superficial peroneal nerve, or saphenous nerve. Neuromodulating medications such as pregabalin (Lyrica) and amitriptyline (Tryptanol) can be considered if a complex region pain syndrome situation exists and localised entrapment is excluded. Surgical exploration is occasionally necessary when a localised entrapment can be identified and nonsurgical treatment is unsuccessful, particularly in the case of the common peroneal nerve at the peroneal tunnel.

Tenosynovitis

Tenosynovitis occurs mainly in the tibialis anterior and posterior, and the peroneal tendons.

Assessment

Pain directly over the involved tendons occurs during exercise with a 'warm up' and 'cool down' pattern similar to bony pathology. Pain can last for days after heavy bouts of exercise. Tenderness and swelling over the tendon segment is common with crepitus on active movement in the acute stage. Diagnostic ultrasound is often useful if confirmation is required and may be useful to help guide corticosteroid injection.

Management

Management involves reducing running intensity, icing, biomechanical modification with change in footwear or orthoses where necessary, nonsteroidal anti-inflammatory drugs (NSAIDs) and corticosteroid injection (or iontophoresis) if pain is recalcitrant or severe.

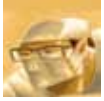
Vascular entrapments

Vascular entrapments are rare. However they are important to mention as the presentation may be similar to RECS. In running athletes, the popliteal artery tends to be involved. Occasionally the external iliac artery can cause lower leg pain in cyclists.[5]

Assessment

Pain from vascular entrapment is classically claudicant in nature with predictable timing of onset during exercise and RAPID resolution with rest within 1–2 minutes. Athletes describe a 'cramping, aching, locking up' feeling in the calf, and occasionally the arch of the foot, and may describe paraesthesiae in these areas. Occasionally, curling/clawing of the toes into flexion occurs with higher intensity exercise. Examination reveals reduced pedal pulses immediately postexercise which return to normal soon after. Pulses may be completely lost in plantarflexion. Rarely a popliteal bruit may be heard on auscultation postexercise. Duplex ultrasound of the popliteal artery will reveal high grade stenosis or complete occlusion with contraction of gastrocnemius. Correlation with ankle-brachial blood pressure indices postexercise

Figure 6. Magnetic resonance angiography showing popliteal artery entrapment



show a drop (<0.5) indicating limitation of flow to the lower leg.[6] Angiographic confirmation is usually undertaken as a pre-operative test to localise the site of entrapment (*Figure 6*).

Management

Surgical release is required if symptoms are severe enough, and some authors suggest distal thromboembolic complications may occur if the condition is left untreated.[6] Usually a medial approach at the knee is used and recovery generally takes up to 4 months before return to most running activities is possible.

Summary of important points

- There is considerable overlap in clinical presentation of different causes of shin pain, particularly with RECS and vascular entrapment.
- The majority of cases of shin pain can be diagnosed with careful separation of the historical elements, and critically, with examination of the patient after a bout of exercise that reproduces their pain.
- Investigation may be required in specific cases including X-ray to confirm anterior tibial stress fracture, compartment pressure monitoring to confirm RECS before surgery, ultrasound to confirm tenosynovitis, nerve blocks, nerve conduction studies and/or EMG to confirm nerve entrapment and vascular imaging for suspected vascular entrapment.
- Increased bone stress can usually be alleviated by reducing impact loading until the pain resolves.
- For RECS massage may be tried, but patients may require fasciectomy.

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