Shin pain in athletes

CPD

Kieran Fallon

Background
Both serious athletes and patients attempting to maintain or improve their health through exercise are at risk of a number of conditions that are not frequently mentioned during medical training. Most of these are related to overuse.

Objective
The aim of this article is to improve general practitioners' knowledge of a specific group of exercise-related conditions that occur in the anterior aspect of the lower limb below the knee, commonly referred to as the shin region.

Discussion
Many having been previously grouped under the relatively meaningless term 'shin splints', these conditions include, among others, bone stress reactions and fractures and chronic exertional compartment syndromes. Some resolve with rest and a gradual return to activity, whereas others are difficult to treat conservatively and might benefit from early referral.

TABER'S MEDICAL DICTIONARY defines the shin as 'the anterior edge of the tibia, the portion of the leg between the ankle and the knee'.[1] In order to include the most relevant local pathologies, herein the 'shin' will be defined as the region below the knee but above the ankle joint and from the region of the medial tibial border, including adjacent soft tissues, to, but not including, the fibula or the lateral compartment. The athlete is generally considered to be one who is especially competent in physical activities. This can range from world-class athletes to recreational athletes who are interested in improving or maintaining their physical performance and health.

Shin pain is relatively common in athletes, particularly those whose primary activity is running. Pain in this region was previously described as 'shin splints', a term that is essentially meaningless and should no longer be used. Research has allowed for delineation of specific pathologies that are discussed in this paper. Estimates of the epidemiology of specific conditions vary, but those discussed below are those most commonly seen in sports medicine practice.

Aim

The aim of this paper is to increase general practitioners' (GPs) awareness of the clinical features, investigation and management of these conditions, which are relatively uncommon presentations in primary care practice.

Medial tibial stress syndrome

Medial tibial stress syndrome (MTSS) is defined as exercise-induced pain along the middle to distal posteromedial aspect of the tibia.[2] Previously thought to be related to tibial periostitis caused by traction, current thinking indicates that although the exact aetiology is unclear, the most common causes are likely to be tibial stress reactions or stress fractures and chronic exertional compartment syndrome (CECS) involving the deep posterior compartment of the lower leg.[3] The natural history of this condition is unknown. The incidence is 4–17% across athletic populations.[2]

Athletes involved in activities that involve running are most frequently affected. A meta-analysis revealed that female gender, a previous history of MTSS, fewer years of running experience, the use of orthotics, increased body mass index, pronated foot posture, increased ankle plantar flexion and increased hip external rotation were risk factors for the development of MTSS.[4]

Using a standardised history and physical examination, the diagnosis can be made with high reliability.[5]

Stress reactions and stress fractures

In cases of medial tibial stress reaction, pain at the medial tibial border typically comes on at the onset of activity and is relieved quickly with rest. Atypically, it might decrease as the athlete warms up, only to appear later during activity.

In cases of medial tibial stress fracture, the stress reaction has progressed and is associated with more constant pain during exercise, usually leading to premature cessation of activity. In both cases pain might be specifically related to heel strike.

On examination, observation is unremarkable. Palpation reveals tenderness at the distal two-thirds of the medial border of the tibia. The length of the area of tenderness has been thought to allow discrimination between stress reaction and stress fracture with shorter, more focal distances (<5 cm) more indicative of stress fracture.[6] Pain might be induced by hopping or jumping on the affected leg.

Investigations might include X-ray, bone scan, computed tomography (CT) and magnetic resonance imaging (MRI). Tibial stress reactions are usually not visible on X-ray, but might be seen on bone scans and MRI. Stress fractures might be detected on X-ray and CT scans, as can subtle cortical thickening and periosteal changes associated with bone stress.

Management of MTSS caused by stress reactions and fractures is conservative. Patient education is important particularly because MTSS can take up to 12 months to heal. Monitoring of the patient's mental health during the healing period is important. Active intervention involves a reduction in training load, substitution of alternative activities and a graduated return to previous training levels.

Although the return to activity is highly specific to the individual, once the patient is pain free, a six- to eight-week 'walk to run' program is reasonable advice.[7] Attention to modifiable risk factors, such as increased body mass index and pronated foot posture, and training errors, such as too rapid progression of training, might assist in prevention of recurrence.

Despite a large number of more interventional therapies having been being trialled, none has shown significant levels of efficacy.[2,8] In severe cases, analgesia might be required and, in these situations, paracetamol or a non-steroidal anti-inflammatory drug (NSAID) is appropriate.

Chronic exertional compartment syndrome

Shin pain can be caused by exertional compartment syndrome of the deep posterior compartment and the anterior compartment of the lower leg.

Deep posterior compartment

CECS of the deep posterior compartment of the leg can present in a similar fashion to the medial tibial bone stress lesions described above. It lies within the differential diagnosis of MTSS. The deep posterior compartment has strong and relatively inelastic fascial boundaries and contains the flexor hallucis longus, flexor digitorum longus, tibialis posterior and popliteus muscles.

During exercise, compartment contents can swell due to increased blood flow, leading to increased pressure within the compartment that compromises blood inflow once capillary perfusion pressure is exceeded. Recent evidence indicates that venous outflow can also be compromised.[9]

Pain occurs at or near the medial tibial border and is described as a tightness or pressure that tends to come on at an approximately reproducible running or, in military situations, marching distance. It can also occur during other repetitive activities that involve the lower limbs. If activity continues, the pain worsens, eventually leading to cessation of exercise. The pain, typically lasting for approximately 15 min after exercise, resolves with rest and perhaps elevation of the limb. Cramping, weakness and paraesthesia might also be reported.

Clinical examination after a period of rest is normal. The deep posterior compartment is not amenable to palpation, but sometimes tenderness might be felt at the medial tibial border if the area is palpated just after cessation of exercise, but this does not allow differentiation from bone stress injury. Tenderness and the sometimes described muscle herniation are not essential for the diagnosis.[10]

Clinical diagnosis of CECS can be confirmed by measurement of intracompartmental pressure. This investigation is generally performed by a physician in sport and exercise medicine or an orthopaedic surgeon.

A large number of conservative therapeutic options have been trialled but, perhaps with the exception of gait retraining (generally involving forefoot running) in military situations, none has sufficient evidence to be recommended. Cessation of the provoking activity is effective, but if this option is not acceptable, as is often the case, the patient should be referred to an orthopaedic surgeon for consideration of fasciotomy. Based on the stringent GRADE criteria, the level of evidence for efficacy of fasciotomy is very low,[11] but an approximately 60% success rate is reported for this compartment.[12]

Anterior compartment

The anterior compartment of the lower leg contains the tibialis anterior, extensor hallucis longus, extensor digitorum longus and fibularis tertius muscles. The anterior compartment is the compartment most frequently affected by CECS. The pathophysiology is as described for deep posterior CECS. Pain is felt over muscle at the anterior aspect of the lower leg between the tibia and fibula and is as described above. Because this compartment is superficial, palpation just after cessation of exercise will reveal firmness, and tenderness might be present. Tenderness and the sometimes described muscle herniation are not essential for the diagnosis.[10]

Management is generally as described above, with the gait retraining program for running and marching in the military allowing 65% of those affected to return to active duty at one year and 57% at two years.[13] Replication of this in other populations is required before this form of management can be recommended. An 85% success rate for fasciotomy has been reported for this compartment.[12]

Anterior tibial stress fracture

Stress fractures of the mid-anterior tibia comprise between 5% and 15% of all tibial stress fractures.[14] These fractures occur on the anterior aspect or 'tension' side of

the tibia and frequently fail to resolve with conservative management. Diagnosis of these fractures is often delayed.

The clinical history is one of gradual onset of localised pain at the anterior aspect of the tibia, exacerbated by activity. This progresses with continued activity and might result in pain at night. A change in training regime often precedes presentation. Examination reveals localised tenderness. Hopping on the affected leg usually brings on the pain, as does stressing the anterior aspect of the tibia using the 'fulcrum' test. This test is performed by pressing down on the ankle region with the distal section of the tibia over the edge of the examination table. This test can cause marked pain and should be performed with care.

X-rays have poor sensitivity for stress fractures but might identify advanced anterior tibial stress fractures (ATSF), the so-called 'dreaded black line'. Often an MRI scan, which has high sensitivity and specificity for stress fractures, will be required.

These are high-risk stress fractures and specialist opinion is appropriate. Initially, conservative management is undertaken but the appropriate duration of this is unclear. These fractures commonly fail to resolve with conservative management.[15] Cessation of running and similar activities and substitution of alternative activities that do not overload the tibia are appropriate. Initially, partial weight bearing and the use of a pneumatic brace might be appropriate. Bisphosphonates, low-dose pulsed ultrasound and shock wave therapy have been suggested,[16] but there is little evidence to support these interventions.

Up to 70% of cases of ATSF require surgical intervention.[15] This generally involves intramedullary nailing. Surgical management leads to symptom resolution in 88% of cases, with an overall complication rate of 28%.[14]

Tibial stress fractures also occur at the posterior cortex (the most common site), with these healing with conservative treatment, often within six to eight weeks. Stress fractures might also occur at the medial tibial plateau and the medial malleolus.

Pes anserinus tendonopathy/ bursitis

The pes anserinus is formed by the tendinous insertions of the sartorius, gracilis and semitendinosus muscles at the upper medial aspect of the tibia. The pes anserine bursa sits beneath the tendons and small bursae can be present between the tendons. In the past, most of the pathology in this region was attributed to inflammation within the bursa, but recent evidence indicates that the most frequent pathology lies within the tendons.[17] The two pathologies can co-exist and this has led to the term 'pes anserine syndrome'.

Within the context of sport, the most frequent extrinsic initiating factors are overuse and trauma. Intrinsic factors can include valgus alignment at the knee, pes planus and pelvic malalignments.[17] These contribute to excessive friction near the common tendon insertion[18] and tendinopathic changes. Female gender is also a risk factor.

In athletes, this condition presents most frequently in long-distance runners, but can also occur in those involved in sports requiring lateral movements and 'cutting', such as basketball and racquet sports. Pain, and sometimes a burning sensation, is felt at the site of the pes anserinus. The onset is gradual and occurs during exercise. There might be a recent history of increased training load. Pain might be aggravated by going up and down stairs, crossing the affected leg over the other or rising after prolonged sitting. Should only tendons be involved, pain might resolve during rest, but in cases where an inflamed bursa is present pain might persist, and even be troublesome at night. Unless a significantly swollen bursa is present, and this is uncommon, palpation might only reveal localised tenderness and no swelling.

The utility of ultrasound and MRI scans in this condition has been questioned. Ultrasound can demonstrate a clearly enlarged bursa and changes of tendinopathy, but it should be recalled that, on MRI scans, fluid can be demonstrated in 5% of asymptomatic bursae.[19]

Management commences with a period of rest and substitution of activities that will not aggravate the condition. Assessment and correction of biomechanical factors as mentioned above, and perhaps hamstring tightness, might be useful, but there is little data demonstrating the efficacy of this intervention. If the pathology involves a clearly inflamed bursa, the application of ice and the use of NSAIDs can be useful; failing this, and if infection is not suspected and can be confidently excluded, corticosteroid injection into the bursa is likely to be effective. In cases where tendinopathy appears to be the primary lesion, a program focusing on a progressive eccentric/concentric exercise might be effective.[20] Referral to a physiotherapist for such a program is appropriate.

Differential diagnoses to be considered

- Nerve root compression: Compression of the L4 and 5 roots can cause pain to be felt in the anterior shin region. L3 root compression could lead to pain in the upper medial aspect of the shin and S1 compression could lead to pain felt in the region above the lateral malleolus of the ankle.
- Nerve entrapment: Saphenous nerve entrapment in the adductor canal can cause pain in the medial half of the shin. This presents as a dull ache or burning sensation. Initial management involves injection of local anaesthetic with corticosteroid at the site of compression, which might be indicated by the point of maximum tenderness. Persistent symptoms warrant a surgical opinion.
- Distal anterior pain and swelling due to tenosynovitis of the muscles of the anterior compartment of the leg due to compression at the proximal extensor retinaculum, most often seen in race walkers and ultra-marathon runners. Management is via conservative anti-inflammatory measures and, in some resistant cases, injection of corticosteroid into the tendon sheath.
- Primary muscle disease; if suspected, and particularly if inflammatory in nature, refer to a rheumatologist.

- Bony pathology not specifically related to exercise such as acute fracture, primary or secondary bone tumour and osteomyelitis.
- Other malignancies.
- Delayed onset muscle soreness (DOMS): This follows unaccustomed exercise and might be of particular relevance to the recreational athlete who is overkeen to improve their level of fitness. DOMS is described as a dull, aching pain associated with stiffness and muscle tenderness. Onset varies between 6 and 24 hours after exercise. Rest of the affected muscles leads to spontaneous resolution within 7–10 days.[21]

Conclusion

Although many of the conditions described above lead to only infrequent visits to the GP, awareness of them, their key diagnostic features and their management, which might include early referral, is important. Serious athletes can be demanding patients and have high expectations of themselves and others. Improved knowledge of the conditions mentioned herein will do much to enhance the athlete–doctor relationship.

Key points

- Each of the conditions highlighted is related to overuse.
- Pain related to these conditions should resolve or reduce significantly with cessation of activity. Persistence of pain should lead to a search for alternative, potentially serious, pathologies.
- For most of these conditions, although many conservative therapies have been suggested, few have high-quality evidence to support them.
- Where an exercise program is suggested, referral to a physiotherapist is recommended.
- For assistance with diagnosis and a management plan, referral to a sports physician might be required.
- In cases of compartment syndrome that fails to resolve or ATSF, referral to an orthopaedic surgeon is appropriate.

Author

Kieran Fallon MBBS (Hons), MD, MSpExSc, MHEd, FRACGP, FACSEP, SFHEA, Professor of Musculoskeletal, Sport and Exercise Medicine, School of Medicine and Psychology, ANU College of Health and Medicine, Australian National University, Canberra, ACT; Visiting Medical Officer, Department of Rheumatology, Canberra Hospital, Canberra, ACT

Competing interests: None.

Funding: None.

Provenance and peer review: Commissioned, externally peer reviewed.

Correspondence to:
kieran.fallon@anu.edu.au

References

1. Venes D, editor. Taber's cyclopedic medical dictionary. 24th edn. F.A. Davis, 2021.
2. Winters M. The diagnosis and management of medial tibial stress syndrome: An evidence update. Unfallchirurg 2020;123 Suppl 1:15–19. doi: 10.1007/s00113-019-0667-z.
3. Burrus MT, Werner BC, Starman JS, et al. Chronic leg pain in athletes. Am J Sports Med 2015;43(6):1538–47. doi: 10.1177/0363546514545859.
4. Newman P, Witchalls J, Waddington G, Adams R. Risk factors associated with medial tibial stress syndrome in runners: A systematic review and meta-analysis. Open Access J Sports Med 2013;4:229–41. doi: 10.2147/OAJSM.S39331.
5. Winters M, Bakker EWP, Moen MH, Barten CC, Teeuwen R, Weir A. Medial tibial stress syndrome can be diagnosed reliably using history and physical examination. Br J Sports Med 2018;52(19):1267–72. doi: 10.1136/bjsports-2016-097037.
6. Lohrer H, Malliaropoulos N, Korakakis V, Padhiar N. Exercise-induced leg pain in athletes: Diagnostic, assessment, and management strategies. Phys Sportsmed 2019;47(1):47–59. doi: 10.1080/00913847.2018.1537861.
7. Blackman P. Shin pain in athletes – Assessment and management. Aust Fam Physician 2010;39(1–2):24–29.
8. McClure CJ, Oh R. Medial tibial stress syndrome. StatPearls, 2023. Available at www.ncbi.nlm.nih.gov/books/NBK538479/#:~:text=Medial%20tibial%20stress%20syndrome%20(MTSS)%20is%20a%20frequent%20overuse%20lower,shin%20splints."%5B2%5D [Accessed 7 June 2023].
9. McGinley JC, Thompson TA, Ficken S, White J. Chronic exertional compartment syndrome caused by functional venous outflow obstruction. Clin J Sport Med 2022;32(4):355–60. doi: 10.1097/JSM.0000000000000929.
10. Vogels S, Ritchie ED, van der Burg BLSB, Scheltinga MRM, Zimmermann WO, Hoencamp R. Clinical consensus on diagnosis and treatment of patients with chronic exertional compartment syndrome of the leg: A Delphi analysis. Sports Med 2022;52(12):3055–64. doi: 10.1007/s40279-022-01729-5.
11. Ding A, Machin M, Onida S, Davies AH. A systematic review of fasciotomy in chronic exertional compartment syndrome. J Vasc Surg 2020;72(5):1802–12. doi: 10.1016/j.jvs.2020.05.030.
12. Campano D, Robaina JA, Kusnezov N, Dunn JC, Waterman BR. Surgical management for chronic exertional compartment syndrome of the leg: A systematic review of the literature. Arthroscopy 2016;32(7):1478–86. doi: 10.1016/j.arthro.2016.01.069.
13. Zimmermann WO, Hutchinson MR, van den Berg R, Hoencamp R, Backx FJG, Bakker EW. Conservative treatment of anterior chronic exertional compartment syndrome in the military, with a mid-term follow-up. BMJ Open Sport Exerc Med 2019;5:e000532. doi: 10.1136/bmjsem-2019-000532.
14. Chaudhry ZS, Raikin SM, Harwood MI, Bishop ME, Ciccotti MG, Hammoud S. Outcomes of surgical treatment for anterior tibial stress fractures in athletes: A systematic review. Am J Sports Med 2019;47(1):232–40. doi: 10.1177/0363546517741137.
15. Robertson GA, Wood AM. Return to sports after stress fractures of the tibial diaphysis: A systematic review. Br Med Bull 2015;114(1):95–111. doi: 10.1093/bmb/ldv006.
16. Feldman JJ, Bowman EN, Phillips BB, Weinlein JC. Tibial stress fractures in athletes. Orthop Clin North Am 2016;47(4):733–41. doi: 10.1016/j.ocl.2016.05.015.
17. Rennie WJ, Saifuddin A. Pes anserine bursitis: Incidence in symptomatic knees and clinical presentation. Skeletal Radiol 2005;34(7):395–98. doi: 10.1007/s00256-005-0918-7.
18. Helfenstein M Jr, Kuromoto J. Anserine syndrome. Rev Bras Rhematol 2010;50(3):313–27.
19. Tschirch FT, Schmid MR, Pfirrmann CW, Romero J, Hodler J, Zanetti M. Prevalence and size of meniscal cysts, ganglionic cysts, synovial cysts of the popliteal space, fluid-filled bursae, and other fluid collections in asymptomatic knees on MR imaging. AJR Am J Roentgenol 2003;180(5):1431–36. doi: 10.2214/ajr.180.5.1801431.
20. Fallon K. Overuse injuries in the athlete. Aust J Gen Pract 2020;49(1–2):7–11. doi: 10.31128/AJGP-07-19-5016.
21. Nosaka K, Newton M, Sacco P. Delayed-onset muscle soreness does not reflect the magnitude of eccentric exercise-induced muscle damage. Scand J Med Sci Sports 2002;12(6):337–46. doi: 10.1034/j.1600-0838.2002.10178.x.

correspondence **ajgp@racgp.org.au**