Ministry of Defence

Synopsis of Causation

Shin Splints
(Medial Tibial Stress Syndrome)

Author: Dr Adrian Roberts, Medical Author, Medical Text, Edinburgh
Validator: Mr Fares S Haddad, University College Hospital, London

September 2008

Disclaimer

This synopsis has been completed by medical practitioners. It is based on a literature search at the standard of a textbook of medicine and generalist review articles. It is not intended to be a meta-analysis of the literature on the condition specified.

Every effort has been taken to ensure that the information contained in the synopsis is accurate and consistent with current knowledge and practice and to do this the synopsis has been subject to an external validation process by consultants in a relevant specialty nominated by the Royal Society of Medicine.

The Ministry of Defence accepts full responsibility for the contents of this synopsis, and for any claims for loss, damage or injury arising from the use of this synopsis by the Ministry of Defence.

1. Definition

1.1 For the wider public, the term “shin splints” has been employed for many years and remains in common usage to describe **lower leg pain resulting from overuse**, usually caused by running or marching. Medically, the preferred title is **medial tibial stress syndrome**, and the two terms may be considered interchangeable.

1.2 The condition is associated with exercise-induced pain localised to the mid leg and is thought most likely to be due to a stress reaction of the bone, or muscle originating from the bone, in response to repetitive use. Some authorities consider that the title should be applied to any exertional pain in the shins, others believe that it should be used generically once compartment syndrome, stress fractures, and hernias have been excluded. The precise definition of the “shin” has also been subject to debate. These distinctions have given rise to problems in comparing studies into shin splints.

1.3 The condition is one of a number of overuse injury syndromes that affect the lower leg and foot. Shin splint syndrome often affects athletes, ballet dancers, and military recruits. Much of the published literature in this area is based on studies that have been carried out on military personnel. The precise pathology may vary between different sports and activities.

1.4 Disagreement persists amongst various medical authorities as to a precise definition. The American Medical Association in 1966 defined shin splint syndrome as “pain and discomfort in the leg from repetitive activity on hard surfaces, or due to forceful, excessive use of foot flexures. The diagnosis should be limited to musculoskeletal inflammations excluding stress fractures or ischaemic disorders.”

1.5 Several theories, some of which are highly speculative, have been advanced to explain the pathological process that underlies the development of shin splints. The most favoured explanation is a periostitis occurring along the tibia caused by musculotendinous strain associated with inflammation. The increased metabolic activity manifested on the radionuclide scan is attributed to a periostitis with new bone formation. Anatomical investigation has demonstrated that the site of tenderness to direct palpation and of increased activity on bone scans corresponds to the medial origin of the soleus muscle.[1] An alternative explanation, attributing the condition to an overload on the posterior tibial tendon, is probably incorrect. Other theories implicate micro-stress fractures, ischaemia, and soft tissue injuries.

2. Clinical Features

2.1 Emphasis on a well-directed history and physical examination will usually serve to identify the cause of exercise-induced leg pain and preclude the need to resort to unnecessary testing.[2] Differential diagnosis focuses mainly on exertional compartment syndrome and stress fracture, and also on spinal stenosis, vascular claudication, and referred discogenic pain.

2.2 In shin splints, the presenting symptom is pain, most commonly located over the posteromedial border of the tibia in the middle and distal thirds of the leg. Initially, pain is felt on exertion, may be relieved with continued effort, and may recur towards the end of the workout. If the condition becomes more severe, the pain can extend throughout the period of exertion and inhibit performance. With further deterioration, pain may be evident on activities of daily living. Pain is often described as a dull ache or soreness, although with progression, the pain may be perceived as sharp, penetrating and severe.[3]

2.3 Physical examination elicits tenderness along the posteromedial border of the tibia, usually beginning about 4cm above the medial malleolus and extending proximally for a variable distance up to 12 cm. Typically, up to a third of the posteromedial border of the tibia may be tender, this area usually being centred around the junction of the distal and middle thirds of the leg. Slight swelling may be apparent. Passive and active flexion, extension, inversion and eversion of the foot or ankle are usually pain free. Active resisted plantarflexion and toe raises may, however, elicit the pain.[3] These findings contrast with stress fracture, which is associated with a much more localised site of exquisite tenderness.

2.4 Routine plain X-rays are usually normal in patients with shin splints but bone scans have proved useful in diagnosis. Typically, a moderate increase in radionuclide activity along the posteromedial border of the tibia is demonstrated in shin splints, but only on the delayed images. In contrast, in acute stress fractures, abnormal tracer activity is demonstrated typically on all three phases of the bone scan. However, results from bone scans have not always proved consistent with the histological findings. Therefore, MRI scans have become the preferred method for evaluating the osseous manifestations of stress injury, MR imaging having been found useful in the evaluation of shin splints, early osseous stress injuries and overt stress fracture.[4]

3. Aetiology

3.1 Shin splints often occur following a **significant change** in a subject's level of activity. In particular, unconditioned individuals are at risk when they **commence strenuous exercise** e.g. jogging, or the rigorous physical education regime associated with the **intensive basic training** given to military personnel.

3.2 Published studies have shown that shin splints account for 6-16% of injuries in runners. In studies involving military personnel, 4-10% of recruits have been diagnosed with the condition during basic training of 8-12 weeks duration. In one prospective study of shin splints at the United States Naval Academy, an incidence of around 4% was observed during the physically demanding inaugural summer camp for midshipmen. The incidence of shin splints in midshipmen who had no physical training immediately before entering the programme was twice as high as that found in their counterparts who had undergone prior training.[5]

3.3 The majority, if not all of the recognised risk factors for shin splints are the same as those associated with stress fractures, lending support to the theory of a microfracture aetiology.

3.4 There is broad agreement on a number of factors that predispose athletes to overuse injuries of the lower limb, including shin splints. These include:[6]

- Lack of running experience
- Competitive running
- Excessive weekly running distances
- Poor physical condition
- Previous injury

3.5 There is less of a consensus surrounding a number of other intrinsic and extrinsic factors implicated in the development of shin splints. Extrinsic factors that have been associated with shin splints include the following:[6]

- Type of sport, especially running, basketball and tennis
- Terrain e.g. running on hills, running on one side of the road
- Hard or uneven running surface
- Time of day
- Weather conditions such as winter training
- Unsuitable footwear and changes in footwear.

3.6 Intrinsic factors that may be associated with shin splints include the following:[6]

- Body build, extremes in height and weight
- Anatomical variations such as femoral neck anteversion, genu valgum, pes cavus, and pronated feet
- Imbalance between quadriceps and hamstring muscles
- Participation in other sports
- Lesser skill
- Poor coordination
- Lack of flexibility training

- Inadequate warm-up / incomplete stretching
- Smoking
- Psychological factors
- Female gender, although this association is controversial and may be more relevant to military service than to civilian situations
- Older age, although this association is also considered controversial

3.7 Biomechanical evaluations have identified two variables that correlate significantly with the occurrence of shin splints, namely maximum pronation velocity and maximum pronation. Thus, excessive pronation or excessive velocity of pronation have been identified as important specific risk factors. These parameters can apply increased stress to supporting musculature including the medial soleus, mediated through increased internal tibial rotation occurring during the stance phase of running.[3]

3.8 Prevention strategies aim to obviate the range of risk factors listed above, although evidence for the effectiveness of any of these interventions is limited. Strategies that have been advocated include warm-up exercises, stretching exercises, activities to increase flexibility and strength, training techniques that promote balanced muscle development, minimisation of running on hills and hard surfaces, and appropriate footwear. Screening for biomechanical or anatomical risks may be feasible to identify appropriate adaptations. On current evidence, conditioning and the use of shock absorbent orthoses are likely to prove the most effective interventions.

3.9 Four randomised controlled trials conducted in military establishments between 1972 and 1990 have sought to investigate the effectiveness of various preventative measures. These have involved the use of foam heel pads, heel cord stretching exercises, a graduated running programme, hot weather combat boots, and different types of boot inserts. None of these studies have shown a statistically significant beneficial effect, with the exception of one trial involving South African military recruits. This study concluded that the incidence of total overuse injuries and tibial stress syndrome can be reduced by wearing shock-absorbing neoprene insoles.[7] However, all these studies have been subject to criticism as having serious methodological flaws.[6] A more recent randomised controlled trial, published in 2002, concluded that custom-made biomechanical shoe orthoses may be effective in preventing shin splints in military conscripts, although routine use is likely to be prohibited by cost.[8]

4. Prognosis

4.1 As yet, no combination has proved more effective in the treatment of shin splints than a regime of **"relative" rest** whereby the patient's activities are restricted to those that can be performed comfortably.[3] However, other conservative measures merit consideration, including the following:

- Heel cord stretching and dorsiflexion stretching exercises
- Biomechanical orthoses e.g. for use in cases involving excessive foot pronation
- Shock-absorbing cushion insoles, which absorb impact forces at heel strike and thus dissipate stress
- Anti-inflammatory medication, although long-term treatment should be avoided if there is any suspicion of stress fracture because of the effects on bone healing
- Ultrasound, phonophoresis, whirlpool, and acupuncture may serve as adjuncts

4.2 The time taken to recover from shin splints is variable and does not necessarily correlate with the duration of symptoms before treatment. A period of 7-10 days is usually sufficient to allow individuals to resume training at some level. Once the patient is pain free, a gradual return to full activity over a 6-week period is recommended. During this period, realistic goals and timetables form a vital element.[3]

4.3 Where recurrence occurs, it is often within the first 1 to 3 weeks following the resumption of training. Allowing the patient to return too quickly to pre-injury levels of training may precipitate recurrence.[3]

4.4 Surgical intervention is uncommon, although patients who have resistant shin splint syndrome, with at least two or three recurrences following adequate trials of rest and rehabilitation, are candidates for surgical treatment. Relief of symptoms may be achieved by release of the superficial investing fascia around the soleus insertion. This may be combined with cauterisation of the periosteum. A recent study demonstrated pain levels reduced by 72% following surgery (as indicated on a visual analogue pain scale) with an excellent, good or fair result achieved in 91% of patients. However, despite the significantly reduced pain level attained following surgery, athletes often fail to achieve an uninhibited return to sports activity.[9]

5. Summary

5.1 Shin splint syndrome is a relatively common overuse injury syndrome, often associated with an increase in the intensity or duration of exercise. Unconditioned individuals are at particular risk when initiating strenuous exercise, such as the intensive basic training delivered to military recruits. When making a diagnosis of shin splints, it is particularly important to exclude compartment syndrome and stress fracture.

5.2 Several risk factors have been postulated, providing scope for a range of prevention strategies, of which conditioning and the use of shock absorbent orthoses are likely to prove the most effective.

5.3 Relative rest is advocated as the cornerstone of treatment, followed by a gradual return to full activity once symptoms have subsided. Various conservative measures may also be considered as an adjunct to rest. Surgery may be effective in recalcitrant cases.

6. Related Synopses

Compartment Syndrome

7. Glossary

active movement	Movement of a joint initiated and carried out by a subject unaided by external influences.
cauterisation	A surgical process, performed on the skin or on a membrane, intended to promote scarring.
claudication	Blockage of leg arteries from poor circulation, leading to an aching, tired and sometimes burning pain in the legs provoked by exercise and relieved by rest.
dorsiflexion	Turning upward of the foot or toes.
fascia	Flat layers of fibrous tissue separating different layers of tissue.
genu valgum	Angulation of leg, commonly known as “knock-knee”.
histological	Pertaining to the study of the microscopic structure of tissues.
ischaemic	Suffering from a deficiency in the arterial blood supply.
medial malleolus	The projection at the lower end of the tibia, which is clearly evident on the medial (inner) side of the ankle.
orthosis (-es)	An external orthopaedic appliance, designed to either prevent or assist movement.
passive movement	Movement of a joint induced by another person, without effort on the part of the subject.
periosteum	The membrane that forms the outer lining of bones.
periostitis	Inflammation of the periosteum (q.v.).
pes cavus	A foot with too high an arch.
plantarflexion	Turning downward of the foot or toes.
posterior tibial muscle (tibialis posterior)	A muscle running between the bones of the lower leg (tibia and fibula) and the foot.
pronation	The act of turning the forefoot (or palm) downward.
soleus muscle	A muscle running between the bones of the lower leg (fibula and tibia) and the heel (calcaneous).
stenosis	Narrowing to the extent of complete closure.

8. References

[1] Michael RH, Holder LE. The soleus syndrome. A cause of medial tibial stress (shin splints). Am J Sports Med 1985;13(2):87-94.

[2] Hester JT. Diagnostic approach to chronic exercise-induced leg pain. A review. Clin Podiatr Med Surg 2001;18:285-306.

[3] Andrish JT. The leg. In: DeLee JC, Drez D, Miller MD, editors. DeLee and Drez's orthopaedic sports medicine: principles and practice. 2nd ed. Philadelphia, PA: W B Saunders; 2003. p. 2155-9.

[4] Spitz DJ, Newberg AH. Imaging of stress fractures in the athlete. Radiol Clin North Am 2002;40(2):313-31.

[5] Andrish JT, Bergfeld JA, Walheim J. A prospective study on the management of shin splints. J Bone Joint Surg Am 1974;56:1697-1700.

[6] Thacker SB, Gilchrist J, Stroup DF, Kimsey CD. The prevention of shin splints in sports: a systematic review of literature. Med Sci Sports Exerc 2002;34:32-40.

[7] Schwellnus MP, Jordaan G, Noakes TD. Prevention of common overuse injuries by the use of shock absorbing insoles. A prospective study. Am J Sports Med 1990;18(6):636-41.

[8] Larsen K, Weidich F, Leboeuf-Yde C. Can custom-made biomechanic shoe orthoses prevent problems in the back and lower extremities? A randomized, controlled intervention trial on 146 military conscripts. J Manipulative Physiol Ther 2002;25(5):326-31.

[9] Yates B, Allen MJ, Barnes MR. Outcome of surgical treatment of medial tibial stress syndrome. J Bone Joint Surg Am 2003;85-A(10):1974-80.