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Review

Tibial cortical lesions: A multimodality pictorial review

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ABSTRACT

Shin pain is a common complaint, particularly in young and active patients, with a wide range of potential diagnoses and resulting implications. We review the natural history and multimodality imaging findings of the more common causes of cortically-based tibial lesions, as well as the rarer pathologies less frequently encountered in a general radiology department.

1. Introduction

Shin pain is a relatively frequent cause of patient presentation to clinicians and there are a wide variety of cortically based tibial lesions that should be considered in the differential diagnosis. This can cause difficulty for both the clinician and the radiologist when trying to appropriately diagnose and manage the patient. Although an accurate clinical history and examination are extremely important, with the advent of modern techniques, imaging is now essential to either make a definitive diagnosis or to identify those lesions that require biopsy or surgical excision. As a general rule, all patients with a suspected tibial cortical lesion should have a radiograph performed and depending on the findings, cross-sectional imaging can then be used for further evaluation if required. We present a pictorial review of the commonly encountered and important tibial cortical lesions, emphasising the role of CT and MRI and subdividing lesions (for ease of evaluation) into: non-neoplastic and neoplastic.

2. Non-neoplastic tibial cortical lesions

2.1. Tibial stress injuries

Tibial stress injuries are the commonest cause of exertional leg pain in athletes, accounting for up to 75% of cases [1]. Stress injuries cause remodelling of bone which progresses as a continuum from osteoclastic bone resorption initially to increased osteoblastic activity as well as periosteal and endosteal proliferation. This results in an imbalance that weakens bone and if untreated can be complicated by fracture.

When stress injuries are present, they may be classified as due to fatigue (increased stresses on normal bone) secondary to prolonged repetitive activity or, less commonly, to insufficiency (normal stresses on abnormal bone) secondary to a variety of conditions including osteoporosis, osteomalacia and rheumatoid arthritis [2]. Medial tibial stress syndrome (shin splints) is the term given to stress injuries of the tibia due to fatigue usually in long distance runners. It was first described by Hutchins in 1913 as

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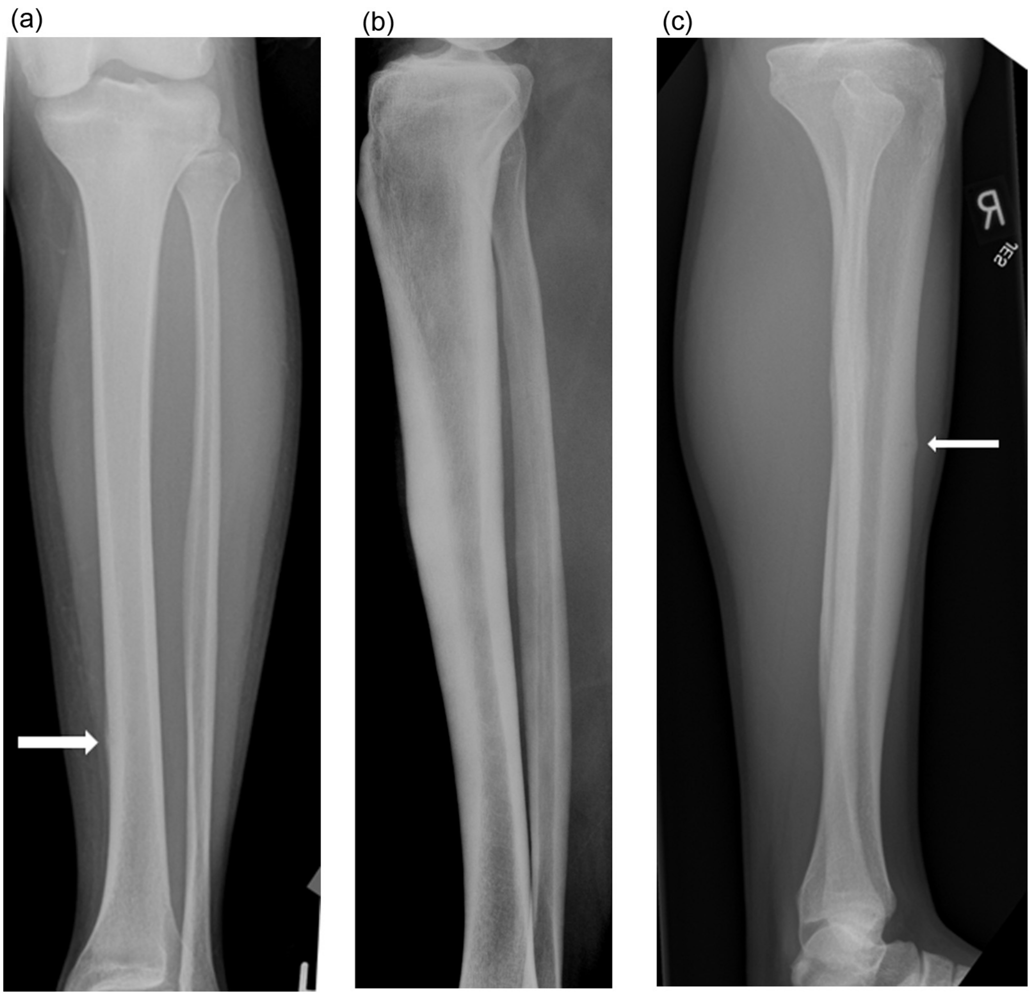

Fig. 1. (a) AP radiograph of the leg demonstrating a periosteal reaction associated with a stress fracture (arrow). (b) Lateral radiograph of the leg, showing diffuse cortical thickening of the anterior tibial diaphysis. (c) Lateral radiograph of the leg demonstrating a subtle linear lucency (arrow).

"spike soreness" in athletes wearing running spikes and is characterised by exercise-induced pain along the posteromedial aspect of the distal 2/3 of the tibia [3]. It results from repetitive mechanical stresses at the insertions of Sharpey's fibres that connect the medial soleus, the flexor digitorum and their investing fascia to the periosteum of the tibia. In children and short distance runners, fatigue stress injuries occur more proximally in the tibia [4]. Overt fractures may be sclerotic (due to compressive forces) or lucent and transverse, oblique or longitudinal depending on the type and direction of stress [5].

2.1.1. Plain radiography

Radiographs are often used as the first imaging test for a suspected stress injury due to easy availability and relatively low cost. However, they are negative in roughly one third of symptomatic patients and the majority of cortical fractures (up to 94%) go undetected [6,7]. They demonstrate relatively late findings of stress injury including a benign-appearing periosteal callous reaction (Fig. 1a), eccentric thickening and increased sclerosis of the cortex and endosteum (Fig. 1b) and a lucent fracture line (Fig. 1c). The affected cortex may also be osteopaenic and contain small lucent foci, cavitations and striations.

2.1.2. Bone scintigraphy

Bone scintigraphy is much more sensitive than radiography and used to be the gold standard imaging test for a stress injury. However, magnetic resonance imaging (MRI) in particular is now felt to be more sensitive and specific [6,8]. Bone scintigraphy is used preferentially over MRI in patients who are claustrophobic or have contraindications or in patients with multiple suspected insufficiency fractures. Scintigraphy demonstrates the increased bone metabolic activity associated with a stress injury as an area of increased uptake of Technechium-99m methylene diphosphonate (Fig. 2a and b).

2.1.3. MRI

MRI is the most sensitive test for diagnosing the early signs of stress injury, particularly those of the periosteum and cancellous bone (marrow) and it demonstrates adjacent soft tissue abnormalities (Fig. 3a) [7]. The most commonly used classification is by Fredericson et al. [8]:

Grade 0: No abnormality.
Grade 1: Periosteal oedema with no marrow signal abnormalities.
Grade 2: Periosteal oedema and marrow oedema visible only on fluid sensitive sequences (short tau inversion recovery (STIR)/T2-weighted).
Grade 3: Periosteal oedema and marrow oedema visible on both fluid sensitive and T1-weighted sequences.
Grade 4a: Multiple focal areas of intracortical signal abnormality and marrow oedema visible on both T1-weighted (Fig. 3b) and fluid sensitive (Fig. 3c) sequences.

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