Stress fractures:

diagnosis and management in the primary care setting

Stress fractures or fatigue fractures are common overuse injuries that occur following repetitive bouts of mechanical loading to bones. They most often occur in the weight-bearing bones of the lower limbs. Their diagnosis can be challenging due to their insidious onset and requirement for imaging to confirm a diagnosis. The risk factors for such injuries include an increase in load, which can be from an increase in volume, intensity, or duration of exercise, abnormal biomechanical factors, and reduced bone mineral density. Their management can be relatively straightforward, but symptoms can persist for many months if load management is not adhered to. If missed, the clinical consequences can be substantial, particularly when involving the femoral neck.

PATHOPHYSIOLOGY

Stress fractures occur when bones undergo repetitive stress at a rate greater than their ability to remodel. The initial microtrauma can cause symptoms, such as a pain and swelling, without the presence of a fracture on X-rays. This phenomenon is known as a 'stress reaction' and cannot be detected on X-rays in the early stages. If the causative factor continues, this can cause the cortex of the bone to weaken, leading to crack initiation. If this crack propagates across the bone then a complete fracture can occur. Stress fractures should not be confused with insufficiency fractures, which occur when physiological abnormal bone fractures under normal load (that is, secondary to osteoporosis).

EPIDEMIOLOGY AND RISK FACTORS

The incidence of stress fractures in the general population is not clear and most research has studied their incidence in the athletic and military populations. The career incidence of stress fractures in military personnel has been described as ranging between 5–20% and is two to five times more common in females.^{1,2} In the athletic population, incidence ranges from 5–10%^{3,4}

and stress injuries compromised 2% of all injuries seen at the 2016 Rio Olympic Games.⁵ In the paediatric population, one study showed an incidence of 4% over 7 years in females aged 9–15 years.⁶ In athletes, the tibia, metatarsals, pelvis, and femur, are the most commonly affected bones, and fractures are bilateral in about 16% of cases.⁷ Although upper limb and axial stress fractures are less frequent, they do exist in particular sports such as golf, cricket, and tennis.

Risk factors for stress fracture or reactions can be classified as intrinsic and extrinsic. Intrinsic factors include female sex, steroid use, and nutritional deficits of calcium and vitamin D.⁸ Extrinsic factors include high volume or intense exercise, a sudden increase in volume or intensity of exercise, individual biomechanical factors, changes to foot-ground interface, that is, shoe modification, and environmental factors, such as running on hard surfaces. Usually a combination of these factors is responsible.

DIAGNOSIS

Thorough history taking can identify characteristic features suggestive of a stress fracture. The previously mentioned risk factors should be explored, with a focus on establishing the patients' current exercise load and if this has changed or increased in intensity recently. There is unlikely to be a history of trauma. Pain at the offending site is typically reported during and following activity, and relieved by rest. On examination, findings of oedema, redness, muscle contracture, tenderness, and painful range of movement may be found. Pain will tend to be localised, in contrast to medial tibial periostitis, where pain is more diffuse. The 'Hop Test' can be a useful examination technique to use, particularly for assessing pain secondary to a bone stress reaction. Ask the patient to stand on the injured leg and hop up and down. A positive result is one that elicits pain.

Imaging is crucial to the diagnosis. Plain X-rays are not sensitive and 70% are negative in the early stages of stress

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Box 1. Advice to patients regarding the prevention of stress fractures

1. Ensuring a balanced diet and adequate intake of vitamin D/calcium.
2. Correct equipment including well-fitting, supportive walking/running shoes.
3. Consider less load-bearing activities, such as cycling and swimming.
4. Start new activities slowly, with a gradual increase, that is, 10% increase per week.
5. Strength training to prevent loss of bone density with ageing.

REFERENCES

1. Bhatnagar A, Kumar M, Shivanna D, *et al*. High incidence of stress fractures in military cadets during training: a point of concern. *J Clin Diagn Res* 2015; **9**(8): RC01–RC03.
2. Cosman F, Ruffing J, Zion M, *et al*. Determinants of stress fracture risk in United States Military Academy cadets. *Bone* 2013; **55**(2): 359–366.
3. Yagi S, Muneta T, Sekiya I. Incidence and risk factors for medial tibial stress syndrome and tibial stress fracture in high school runners. *Knee Surg Sports Traumatol Arthrosc* 2013; **21**(3): 556–563.
4. Wentz L, Liu PY, Haymes E, Ilich JZ. Females have a greater incidence of stress fractures than males in both military and athletic populations: a systemic review. *Mil Med* 2011; **176**(4): 420–430.
5. Hayashi D, Jarraya M, Engebretsen L, *et al*. Epidemiology of imaging-detected bone stress injuries in athletes participating in the Rio de Janeiro 2016 Summer Olympics. *Br J Sports Med* 2018; **52**(7): 470–474.
6. Field AE, Gordon CM, Pierce LM, *et al*. Prospective study of physical activity and risk of developing a stress fracture among preadolescent and adolescent girls. *Arch Pediatr Adolesc Med* 2011; **165**(8): 723–728.
7. Matheson GO, Clement DB, McKenzie DC, *et al*. Stress fractures in athletes. A study of 320 cases. *Am J Sports Med* 1987; **15**(1): 46–58.
8. Shaffer SW, Uhl TL. Preventing and treating lower extremity stress reactions and fractures in adults. *J Athl Train* 2006; **41**(4): 466–469.
9. Wright AA, Hegedus EJ, Lenchik L, *et al*. Diagnostic accuracy of various imaging modalities for suspected lower extremity stress fractures: a systematic review with evidence-based recommendations for clinical practice. *Am J Sports Med* 2016; **44**(1): 255–263.
10. Gaeta M, Minutoli F, Scribano E, *et al*. CT and MR imaging findings in athletes with early tibial stress injuries: comparison with bone scintigraphy findings and emphasis on cortical abnormalities. *Radiology* 2005; **235**(2): 553–561. DOI: 10.1148/radiol.2352040406. [Published online first: 29 April 2005].
11. Wheeler P, Batt ME. Do non-steroidal anti-inflammatory drugs adversely affect stress fracture healing? A short review. *Br J Sports Med* 2005; **39**(2): 65–69.
12. Batt ME, Kemp S, Kerslake R. Delayed union stress fractures of the anterior tibia: conservative management. *Br J Sports Med* 2001; **35**(1): 74–77.

Figure 1. Base of 5th metatarsal stress fracture. Case courtesy of Dr Andrew Dixon, Radiopaedia.org

fractures (and almost always negative during 'stress reactions'). However, it is the first-line investigation given its availability and low cost. Findings of new periosteal bone formation, endosteal thickening, or a radiolucent fracture line may be seen (Figure 1). Magnetic resonance imaging (MRI) scanning is currently the gold-standard investigation and it has the ability to diagnosis a stress reaction as well as a fracture (Figure 2).⁹ CT scanning can also be of use for the diagnosis of stress reactions or fracture, although it is less sensitive.¹⁰

MANAGEMENT IN PRIMARY CARE

Many aspects of the management of stress fractures are heterogeneous across all anatomical areas and these include activity modification or stopping the causative stressor, pain control, avoiding non-steroidal anti-inflammatories,¹¹ smoking cessation (if applicable), and occasionally wearing foot orthoses to reduce load through the affected limb. Time to bony union varies between anatomical sites but most fractures heal between 6–12 weeks. Healing can take longer¹² and return to activity should be gauged by the cessation of symptoms. Only when patients are pain-free walking should gradual activity load be reintroduced.

If initial X-rays are negative, but a strong suspicion of a stress fracture still exists, then referral to the local musculoskeletal service for the assessment of an MRI scan would be indicated. In cases of 'high risk' anatomical regions, such as the femoral neck and the navicular, then immediate protected weight bearing with crutches would be advisable until confirmation of diagnosis. The consequences of displacement of a femoral neck fracture are significant and would require operative treatment. Advice regarding the prevention of stress fractures can be seen in Box 1.

EXAMPLE CASE

A 55-year-old male recreational road-runner was undertaking a 10-mile road run when he felt pain in his right groin. Over the next week he noticed worsening pain in the groin but

Figure 2. Proximal tibia stress fracture. Credit: Dr P.I.J.M Wuisman and The Radiology Assistant.

remained able to weight bear. At this point, he was reviewed by his GP who took a history and performed a clinical examination (which was unremarkable). The patient had a BMI of 19 with a previous history of anabolic steroid use and usually ran 40–50 miles per week on roads. Subsequent X-rays of his hip a week later were normal.

The following week, the patient's hip gave way when he was walking on level ground. He was unable to weight bear thereafter, and X-rays in the emergency department confirmed a displaced intra-capsular neck of femur fracture. Bloods were performed and showed a testosterone level of 2.0 nmol/L (range 6.7–25.7) and a luteinising hormone level of 0.8 nmol/L (range 1.7–8.6). The patient underwent surgical fixation of his fracture under the care of the orthopaedic team 2 days later.

SUMMARY

Stress fractures are an important differential diagnosis in active patients with new, acute, atraumatic bony pain. The included case report further illustrates that X-rays alone cannot rule out stress fractures. MRI scanning must be performed to ascertain a diagnosis if initial plain radiographs are negative or if symptoms persist, and establishing a diagnosis is sufficiently important. Knowing the risk factors and initial management of stress fractures in the primary care setting can help to reduce the delay to diagnosis, accelerate recovery, and avoid serious complications.

Provenance

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Competing interests

The authors have declared no competing interests.

Patient consent

The patient gave consent for publication of this case report.

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