

# Fibular stress fracture in a female cross-country runner: a case report

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## ABSTRACT

### Introduction

Stress fractures are probably the most feared class of injuries amongst endurance athletes, especially runners, since they require lengthy rehabilitation periods and temporary but drastic modifications of their training regime. A detailed literature review is presented with the aim of highlighting the importance of athlete education as well as pre-participation screening in female athletes for one or more components of the triad.

### Case Presentation

The case of a female adolescent cross-country runner is presented. Her only complaint of note prior to being reviewed at the clinic was of bilateral anterior shin pain during running that was dismissed by herself and her coach as being shin splints. The patient was not limited by these symptoms and managed to persist with her training regime. She was referred for review by a medical professional after she felt excruciating pain in her right lower leg associated with swelling during a race. Following a detailed history and examination, a plain X-Ray confirmed the presence of a complete transverse fracture of the shaft of her right fibular bone. X-Rays of the unaffected limb were not taken.

### Conclusion

Although the case presented depicts a possible complication of the female athlete triad, confirmation of the presence or absence of the triad (disordered eating, amenorrhea and osteoporosis) could not have been made in view of the omission of essential investigations. The case serves to raise the notion of pre-empting through earlier assessment and exercise modification with particular attention to all three components of the triad. Nonetheless, despite an increased risk of sustaining musculoskeletal injuries during physical activity, the safe participation in physical activity that is preceded by pre-participation screening, benefits the long-term health of girls and women and should be encouraged.

## Keywords

Female triad, fibular fracture, screening, energy balance

## INTRODUCTION

The American College of Sports Medicine (ACSM) described the association of disordered eating, amenorrhea and osteoporosis as the female athlete triad, which is especially prominent in sporting disciplines emphasizing a lean physique (Nattiv *et al.*, 2007). Although interrelated, the simultaneous occurrence of all three components in a female subject is rare. Lauder and colleagues (1999) failed to identify the simultaneous presence of all three components in a study of 423 female military personnel (Lauder *et al.*, 1999) whilst Nichols and colleagues (2006) in their study of high-school athletes identified all three components in only 2 of 170 screened athletes (Nichols *et al.*, 2006). Furthermore, although frequently described in the literature with reference to athletes, any of the components of the triad may occur in non-athletes (Torstveit and Sundgot-Borgen, 2005).

## CASE REPORT

### Background

A case is presented of an adolescent female cross-country runner who had been selected by the Maltese National Olympics Committee (MOC) to compete in a 3.5 kilometre run that was scheduled to take place in six months time. Consent for presenting this case report was sought by the authors from the patient. Furthermore, the case and the accompanying images have been anonymised.

The patient had attained the standards required by the MOC over a span of six months, prior to which she did not undertake physical training (including running) on a regular basis and according to a structured training programme. Prior to starting her training, she was given a medical screening form which had to be filled in by her General Practitioner to notify her trainers and coaches of

any medical conditions of note. It is important to note that her dietary and menstrual history was not taken into consideration in this screening form. Furthermore at no point was a nutritionist asked to review the athlete's dietary intake.

The athlete followed her training regime meticulously and was progressing as planned. She was advised to start a two hour per week running programme (mostly conducted on asphalted surfaces) increasing by 45 minutes every three to four weeks to a maximum of four hours per week. Apart from running exercises she also participated in interval training with variable running speeds. She was also undertaking core stability exercises during her rest days and was making an effort to improve her nutritional intake. Despite this, her diet remained lacking in dairy and meat products (especially red meat) and she was not on any regular food supplements. Her dietary habits were not precipitated by her desire to lose weight or because of a distorted bodily image but rather because eating was not a priority for her with most of her time being dedicated for physical training.

### History of Presenting Complaint

She first noticed the onset of bilateral lower medial shin pain, worse on her right leg, during the first three months of regular training. She described this as a nagging pain that did not limit her in her running. Her symptoms were provoked by running and stopped without the need of any treatment soon after she finished her training. In view of an increasing frequency of these episodes she consulted a physiotherapist who advised changing her running technique, strapping and calf stretching exercises. Despite this the pain still persisted. She described that the intensity of the pain was highest two days before her 3.5 kilometre run, being associated with some swelling over her right lower leg. She did not seek medical advice for fear of being advised to withdraw from the race.

### Diagnosis and management

A few minutes into the race, the athlete recalled feeling a sudden increase in pain over her right lower leg compared to the sensation of being kicked in her shin. Despite this she managed to persist with the race and managed also to sprint the last 500 metres of the race. On crossing the finish line she was in severe pain and also noticed a significant amount of swelling over her right lower leg. She was reviewed by a sports physician later in the day who in the context of a history of shin splints,



**Figure 1:** X-Ray, antero-posterior view of the right ankle held in inversion showing a comminuted fracture of the distal third of the right fibular bone (Day 0)

probable sub-optimal calorie intake and the presence of pes-planus on examination made a preliminary diagnosis of stress fracture of her right tibia. It is important to note that the athlete did not give a history of menstrual irregularity.

After undertaking a plain X-ray of her right leg, she was found to have a complete comminuted fracture of the lower distal third of the shaft of her right fibula (Figure 1). This was surprising considering that her symptoms were always located over the anterior surface of her right lower tibia. Her right leg was immobilized in plaster and she was asked to attend for review after 6 weeks (Figure 2). Since the patient's fracture was complicated by delayed union (as evident in Figure 3 representing a radiographic image taken nine weeks after her injury), blood tests were taken to assess nutritional status. At no point in her management was a Bone Mineral Density (BMD) assessment performed. She was prescribed iron and calcium tablets, customized insoles (as prescribed by a podiatrist) and advised to optimize her dietary intake of calcium and iron-rich foods.



**Figure 2:** X-Ray, antero-posterior view of the right ankle showing satisfactory alignment of the fracture of the distal third of the right fibular bone (Day 40)



**Figure 3:** X-Ray, lateral view of the right ankle in plaster showing satisfactory alignment and callous formation at week 9 of the fracture of the distal third of the right fibular bone (Day 68)

## DISCUSSION

### Mechanism

The negative energy balance resulting from inadequate dietary intake to compensate for the increasing energy expenditure from physical training results in physiological interruption of bodily functions not deemed essential for survival, including reproduction (Wade *et al.*, 1996). The resulting disruption of the hypothalamic-pituitary-gonadal axis from the ensuing negative energy balance leads to hormonal imbalance, menstrual irregularity including amenorrhea, defined as the absence of menses for three or more months (American Society for Reproductive Medicine, 2004). Menstrual irregularities are associated with lower BMD scores in adolescent athletes (Drinkwater *et al.*, 1990) which is an independent risk factor for stress fractures (Bennell *et al.*, 1999).

Apart from affecting BMD indirectly through a decrease in estrogen levels, which as a hormone reduces bone resorption, a negative energy balance may also directly result in reductions in BMD scores through metabolic hormones which promote bone formation – see Figure 4 (Nattiv *et al.*, 2007). Endurance training in an athlete in chronic negative energy balance was found by Zanker and Swaine (2000) to reduce levels of insulin-like growth factor-1 (Zanker and Swaine, 2000). The latter peptide hormone is known to promote bone formation (Rosen, 1999).

### Screening

The female athlete triad coalition is a group of representatives from a number of sporting and medical organizations who formulated a pre-participation questionnaire (listed in Table 1 hereunder) for female subjects spanning disordered eating, menstrual dysfunction and bone health (Mencias *et al.*, 2012). Rather than being suggested for use as a questionnaire it represents suggestions of questions that the physician should ask during history taking to recognize at-risk athletes. The information obtained coupled with the physical examination may guide requests for investigations which may include BMD testing (Nattiv *et al.*, 2007).

Despite the ACSM recommendations of BMD testing in female subjects after six months of menstrual irregularity, in a study by Pollock and colleagues (2010) of BMD scores in elite athletes, no significant differences were found between athletes with regular menses and those with irregular menses (Pollock *et al.*, 2010). In the latter study, however, reproductive hormones were not analysed and therefore athletes with menstrual irregularities secondary to pathology other than that caused by the functional hypothalamic amenorrhea seen in the female athlete triad, may have been recruited. Furthermore, some of the athletes with menstrual irregularity were taking the oral contraceptive pill which may affect BMD scores (Cobb *et al.*, 2007)

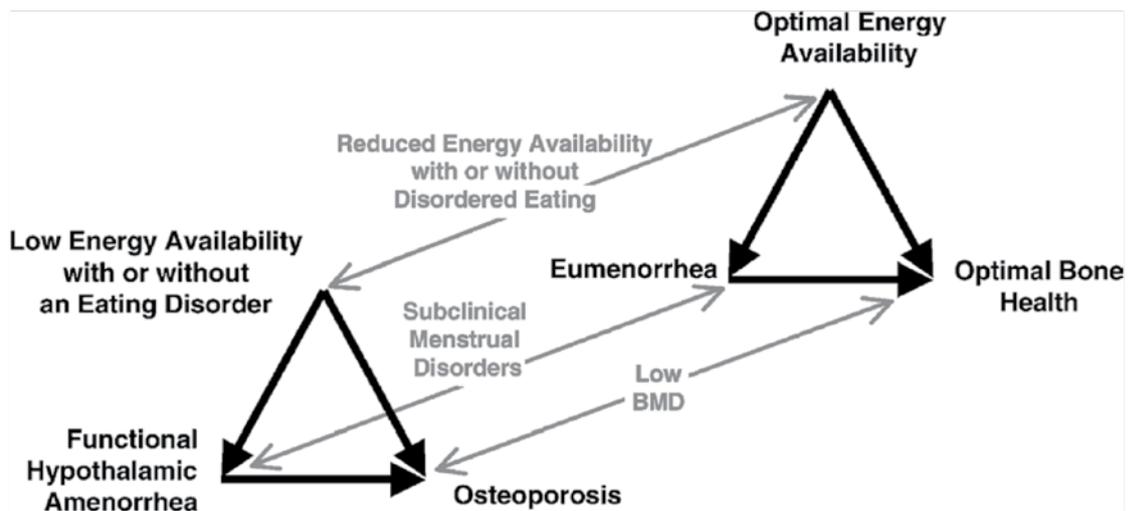


Figure 4: Spectrums of energy availability, menstrual function and BMD forming the female athlete triad. BMD, Bone Mineral Density (Nattiv *et al.*, 2007).

Spectrum	Suggested questions
<b>Disordered eating</b>	
	Do you worry about your weight?
	Do you limit the foods you eat?
	Do you lose weight to meet image requirements for your sport?
	Does your weight affect the way you feel about yourself?
	Do you feel you have lost control over what you eat?
	Do you make yourself vomit; use diuretics or laxatives after you eat?
	Have you ever suffered from an eating disorder?
	Do you ever eat in secret?
<b>Menstrual dysfunction</b>	
	What age was your first menstrual period?
	Do you have monthly menstrual cycles?
	How many menstrual cycles have you had in the last year?
<b>Bone health</b>	
	Have you ever had a stress fracture?

Table 1: Recommended questions by the Female Athlete Triad Coalition for the purpose of screening on pre-participation forms (Mencias 2012).

## Summary and relevance of above to the case

The presented case highlights one of the components of the female athlete triad, that is disordered eating, which combined with the rapid progression in her training regime and biomechanical errors missed during screening, resulted in a stress fracture. Further assessment of all components of the female triad, with BMD calculation and accurate energy input and output charting, have unfortunately been omitted from this case by the managing medical team. Therefore, despite the aim of the presented case to raise awareness regarding the female triad, it cannot be concluded with certainty whether the presented case is in fact secondary to the female triad. Confirmation of the presence or absence of the female triad is clinically important since management of all components of the triad would require the input of a multidisciplinary team.

A further point of interest in this case is pain distribution on presentation, that is, the distal anteromedial surface of the leg which is not typical of a fibular fracture. The latter might be suggestive of injury to the anterior talofibular ligament (high ankle sprain); however, specialized testing and/or imaging to confirm or exclude this injury were not performed. The fibular bone plays a minimal role in weight bearing and in fact, fibular fractures should lead the medical professional to screen for associated biomechanical errors, which in the presented athlete's case were excessive pronation and soft tissue tightness (Wilder and Sethi, 2004).

## CONCLUSION

This case highlights the importance of recognizing the early warning signs of an impending stress fracture as well as the investigations which may be considered in female athletes at risk of the female triad. This screening should go hand in hand with a full medical history inclusive of a dietary and menstrual history to identify issues which may need addressing before an athlete engages in regular physical training. The latter can be facilitated further by using a questionnaire as listed above, as well as with the involvement as necessary of a multidisciplinary team comprising of physiotherapists, nutritionists and physical trainers. Screening should be repeated at follow-up sessions to reaffirm the initial advice and help identify early warning signs of the triad. Furthermore, since the number of women participating in sports is increasing, coaches, trainers and the athletes themselves should be informed on the particular risks faced by female athletes as elucidated by the female athlete triad.

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