First Metatarsal Bilateral Stress Fracture: A Case Report

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Learning Point of the Article:

Bilateral metatarsal stress fractures are a very uncommon event and when it occurs, foot deformity and osteoarthritis should be investigated.

Abstract

Introduction: Metatarsal stress fractures typically occur in the second and third metatarsus metaphysis, with only rare cases in the fourth and first. The main factors influencing its onset are repetitive stress from prolonged training, biomechanical factors and bone weakness. There is only a paucity of literature documenting first metatarsal stress fractures; the authors present a rare bilateral first metatarsal stress fracture.

Case Report: A Caucasian 52-years-old amateur female runner with no other risk factors or medical condition was admitted in our institute with complaints of severe bilateral forefoot pain for 2 weeks arisen after a 20 km run of an amateur race. The patient presented bilateral hallux valgus (HVA) and advanced osteoarthritis of the first metatarsal-phalangeal joint, which is not usually considered a biomechanical risk factor for metatarsal stress fractures. Radiographs of both feet showed linear sclerosis, perpendicular to the diaphysis of the first metatarsal, approximatively in the half of the bone. Signs of osteoarthritis of the first metatarsal-phalangeal were also detected bilaterally.

The patient was treated with rest, bilateral post-operative rocker sole shoes that she has worn for 6 weeks, cryotherapy, analgesics as needed and pulsed electromagnetic fields for 8 h per day for 40 days with a complete resolution of symptoms and the previous radiological findings.

Conclusion: The authors believed that the bilateral HVA condition could be considered an indirect sign of overuse, and it may be investigated and eventually treated as a responsible for this pathologic condition.

Keywords: Stress fracture, first metatarsal, pulsed electromagnetic fields.

Introduction

Metatarsal stress fractures are the most common stress fracture in the foot. They typically involve athletes, soldiers, and ballet dancers and represent up to 22.5% of all stress fractures; Metatarsal stress fractures are caused by repetitive stress and were first described in 1985 and are also known as "March fractures," because of Prussian soldiers who suffered this injury as they used to practice long marches [1, 2, 3, 4, 5, 6].

Metatarsal fractures represent 5–6% of fractures encountered in primary care [7].

Most metatarsal stress fractures occur in the second or third metatarsal, with fewer occurring in the fourth metatarsal [8]. The first metatarsal is rarely involved in this kind of lesion, accounting for less than 8% of all metatarsal stress fractures; When they occur, they have a typically metaphyseal location [5, 9]. The most common location of metatarsal stress fractures in

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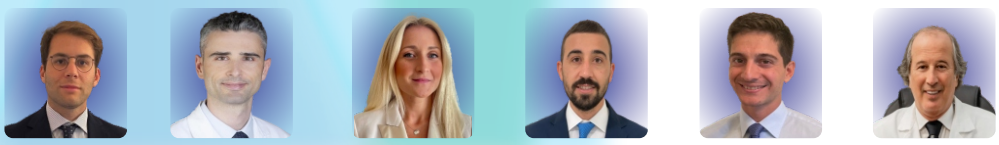

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Figure 1: (a) Lateral view of the left foot. (b) Lateral view of the right foot. (c) anterior-posterior view. X-ray of the boot foot shows a thin fracture rhyme at the first metatarsal base, approximatively perpendicular to the bone's major axis (arrows); Fracture line of the left first metatarsal is not really clear a thin line of increased sclerosis can be appreciated around the fracture itself.

the second metatarsal neck; it is due to low flexibility and the higher torsional forces given by its strong ligamentous attachment to the first and second cuneiforms [10].

Bone stress injuries result from repetitive stresses, which may be created by prolonged training and overuse and can be influenced by weight distribution on foot. Precipitating factors are repetitive traumas, rapid uncontrolled muscular forces, and pathologic bone weakness [11, 12].

The forefoot has unique biomechanical features: Loads are distributed asymmetrically across the bones; Griffin and Richmond have shown that the second, third, and fourth metatarsals have the weakest geometrical properties; moreover, the second and third metatarsals usually experience high relative peak pressures [13].

Biomechanical factors associated with multiple stress fractures include high longitudinal arch of the foot, leg-length discrepancy or lower limb malalignment, and forefoot varus [14, 15, 16]. Runners and militaries with high weekly training mileage are at risk for lower extremities' initial and recurrent stress fractures. Non-modifiable risk factors also include female sex, increased age, and race [16].

Half of all female patients with stress fractures have menstrual irregularities; hormone changes influence bone metabolism, leading to stress fractures [17].

Here, the authors report a rare bilateral simultaneous fist metatarsal fracture as in the literature, only one other case is reported [18].

Figure 2: RM of the left foot shows the first metatarsal base stress fracture and bone edema extending from the base to the shaft.

Figure 3: RM of the right foot shows the first metatarsal base stress fracture, bone edema extending from the base to the shaft, and bone bruising of the posterior side of the first cuneiform.

Case Report

A 52-year-old female lawyer, Caucasian, came to our clinic complaining of bilateral forefoot pain for 2 weeks. Her referred symptoms have arisen after a 20 km run of an amateur race. She was used to running 10 km per week as an amateur runner. She denied any relevant trauma or joint sprain. She described the pain increasing during walking or jumping and decreasing at rest. She was ambulatory without any supporting tools. She had been taking non-steroidal anti-inflammatory drugs with mild benefits.

The patient had no relevant medical history, and she was not

taking any other medications or supplements.

On physical examination, she had local swelling without erythema over the first metatarsal dorsum bilaterally, especially on the medial side. Tenderness to palpation was noted in this area as well. She suffered moderate pain during gait and the flexion and extension of the first metatarsal-cuneiform (Lisfranc's) joint. The pain did not modify with ankle or significant toe motion, neither passive nor active. She had a bilateral unpainful, non-rigid hallux valgus (HVA), more pronounced on the left foot. No other foot deformity was detected. She was 165 cm tall and weighed 56 kg (body mass index 20.6 kg/m2).

X-ray of both feet showed linear sclerosis, perpendicular to the diaphysis of the first metatarsal, approximatively in the half of the bone. Signs of osteoarthritis of the first metatarsal-phalangeal were also detected bilaterally. HVA bilateral was confirmed (on the left foot, HVA angle 25° and intermetatarsal angle (IMA) 16°, on the right foot HVA 27° and IMA 12°) (Fig. 1).

In the left foot, magnetic resonance imaging (MRI) revealed a fracture at the base of the first metatarsal with bone marrow edema extending from the base into the shaft, consistent with a stress fracture (Fig. 2).

In the right foot, MRI showed a fracture of the dorsal base of the first metatarsal with associated bone marrow edema. The radiologist also noted bone bruising of the first cuneiform posteriorly (Fig. 3).

It is possible to appreciate initial radiological sign of osteoarthritis of the fist metatarsal-phalangeal joint (subchondral sclerosis and narrowing of the joint space)

The patient was treated with bilateral post-operative rocker sole shoes that she has worn for 6 weeks. Then, she transitioned to rigid sole shoes. She was allowed to walk with free weight-bearing. She was also instructed to use cryotherapy and prescribed analgesics as needed.

Pulsed electromagnetic fields (PEF) were also prescribed; the device used was BIOSTIM (IGEA, Carpi, Italy), which generates pulses 1.3 milliseconds in duration, with a frequency of 75 Hz. She underwent PEF for 8 h per day for 40 days. Sports activities were restricted for 1 more month.

After an overall period of 10 weeks, a new MRI showed a complete resolution of the previous finding; at the clinical evaluation, no symptoms were recorded. The patient returned to sport with no limitation. No specific shoes were suggested. At the last follow-up, 1 year after the injury, she reported no problem, and she reports that she has returned to running and practicing sport at the same level she had before the fractures. At the last follow-up, she was given the American Orthopaedic Foot and Ankle Society Hallux Metatarsophalangeal-Interphalangeal questionnaire [19], and the scores obtained were 93 for both sides underlying an excellent resumption of patients' daily life activities [19].

Discussion

A first metatarsal stress fracture is an unusual diagnosis and there is only one other case in the literature reporting a bilateral condition in a young athlete [18]. Stress fractures of the first metatarsal occur in the cancellous bone at the base near the medial cuneiform as it occurred with this case [20]. March fractures usually occur in militaries or athletes because they are typically subjected to cyclic overload that is not properly the patient's condition. Even if she was an amateur runner, her activity level seems not high enough to justify the fractures, as a deficit of Vitamin D, low body mass density, and menstrual disorders can play their role in the pathophysiology of stress fractures, the patient was also prescribed an endocrinological examination, which did not show any pathological condition [10].

In the author's opinion, it is crucial to consider the HVA and the advanced osteoarthritis of the first metatarsal-phalangeal joint, which can be considered an indirect sign of overuse; those two conditions could have played a role in the pathogenesis [21].

Even if the patient had no symptoms due to her HVA, it could be interesting to investigate if the correction of HVA could have prevented, somehow, these fractures.

Conclusion

Although uncommon, first metatarsal stress fractures can occur in a non-high-risk population and could be bilateral.

This case report highlights the risk of first metatarsal stress fractures in a non-common high-risk population, which, however, present as a risk factor for an asymptomatic HVA with significant osteoarthritis of the first metatarsal-phalangeal joint.

Clinical Message

Diagnosing a metatarsal stress fracture can be challenging. First metatarsal stress fractures' risk factors commonly admitted are cyclic overload, deficit of Vitamin D, low body mass density, and menstrual disorders. In the author's opinion, it is crucial to consider two more conditions that could play a role in the pathogenesis: The HVA and the advanced osteoarthritis of the first metatarsal-phalangeal joint, which can be considered an indirect sign of overuse. A detailed evaluation is essential.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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