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Case Report

Multiple stress fractures: A case report and discussion ☆,☆☆

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ABSTRACT

Stress fracture is the result of bone destruction with prolonged and repetitive loading. It usually occurs among various groups, including athletes, military recruits, and others. Early stress fractures often undergo undiagnosed or misdiagnosed because of atypical symptoms and effective medical examination. Here, we report a rare clinical case about the multiple stress fractures in one adolescent. Expect for the pathological biopsy, it hardly gets confirm diagnosis. With the increasing population of sports lover, healthcare institutions should be enhanced their understanding of stress fractures and enable effective management at an early stage.

Stress fractures, also referred to as fatigue fractures, occur when a particular area of a bone is subjected to prolonged and repetitive high force or loading. The repetitive movements gradually lead to the weakening of the bone structure, which can result in either partial or complete disruption. It is worth noting that stress fractures account for approximately 20% of all sports-related injuries [1]. Stress fractures are prevalent among various groups, including athletes, military recruits, and others. Among these fractures, the tibia is the most commonly affected site, accounting for approximately 49% of cases, followed by the metatarsals (25%) and the phalanges (9%). Additionally, stress fractures can also occur in the femur and fibula [2]. Early stress fractures often go undiagnosed or misdiagnosed in clinical practice due to various factors. These fractures typically lack obvious traumatic history and exhibit an insidious onset, slow progression, and atypical symptoms. Additionally, the sensitivity and specificity of X-ray examinations are limited, further contributing to the challenges in accurate diagnosis [3]. Conservative treatment is often effective in treating most stress fractures. However, in cases where the fractures occur in complex or special locations, delayed or nonunion fractures may develop without timely intervention.

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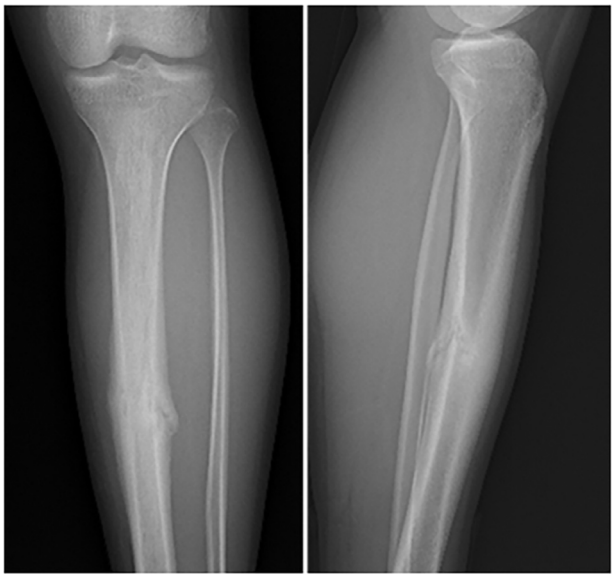

Fig. 1 – X-ray of the left tibiofibular.

These complications can result in various consequences, such as alterations in the arch and force distribution of the foot, long-term persistent pain, impairment of limb function, and even disability [4]. In 2022, our hospital encountered a patient with multiple stress fractures affecting various areas of the body. We have prepared a summary report outlining the details of the case.

Case summary

In 2022, our hospital treated a 15-year-old male track and field athlete who was admitted with complaints of pain and discomfort in the left lower leg. The patient reported experiencing this pain for a month, with a recent recurrence over the past 6 days. The initial onset of pain in the left lower leg occurred without any obvious cause and worsened with physical activity. There was no history of headache, dizziness, nausea, or vomiting. The patient had previously undergone treatments aimed at anti-infection, promoting blood circulation, and pain relief, which provided some improvement compared to before. However, 6 days prior to admission, the patient experienced a relapse of pain and discomfort while participating in a running test, leading him to seek further treatment at our hospital. No history of fever, trauma, tumors, etc. An outpatient left tibia-fibula X-ray and CT scan revealed increased density in the midshaft of the left tibia's medullary cavity, along with a fracture in the posterior cortical bone. Additionally, periosteal reaction around the fracture site and nearby soft tissue swelling were observed Figs. 1 and 2. There is a high possibility of osteomyelitis in the tibia. Therefore, the patient was diagnosed and admitted to our department with the provisional diagnosis of "osteomyelitis of the left tibia." Physical examination upon admission: The skin temperature is slightly higher, the color is normal, and there is no obvious tenderness. Furthermore, the patient exhibits good mobility in the ankle joint, and normal sensory, motor, and blood circulation in the affected limb. Further investigations were conducted, including infection markers and tumor markers, all of which returned normal results. Additionally, magnetic resonance of both lower limbs and whole-body bone scintigraphy (PCT) was performed Figs. 3 and 4, revealing the following findings: 1. Increased metabolic activity was observed in the proximal right femur and bilateral tibial cortical bones, indicating a high possibility of benign lesions, possibly osteomyelitis;2. The signal in the medullary cavity of the proximal femur and distal tibia on the right side appears abnormal, with discontinuous fractures observed in portions of the cortical bone and surrounding periosteal reactions, suggested the stress fractures cannot be ruled out;3. No definite signs of tumor bone metastasis

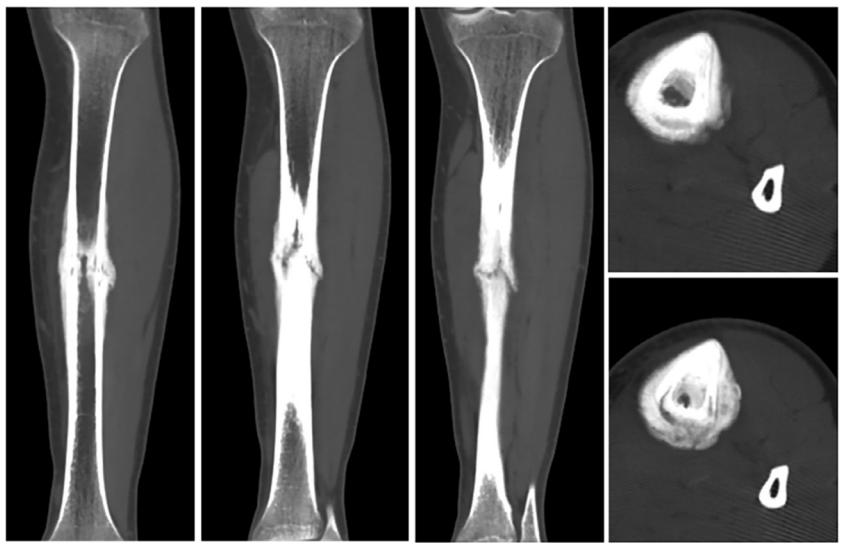

Fig. 2 – CT Scan of the left tibia.

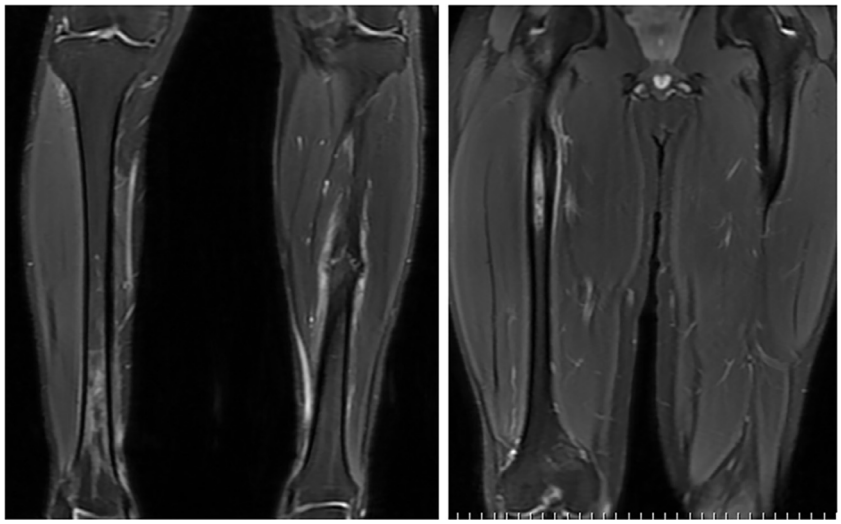

Fig. 3 – Magnetic resonance of the lower limbs.

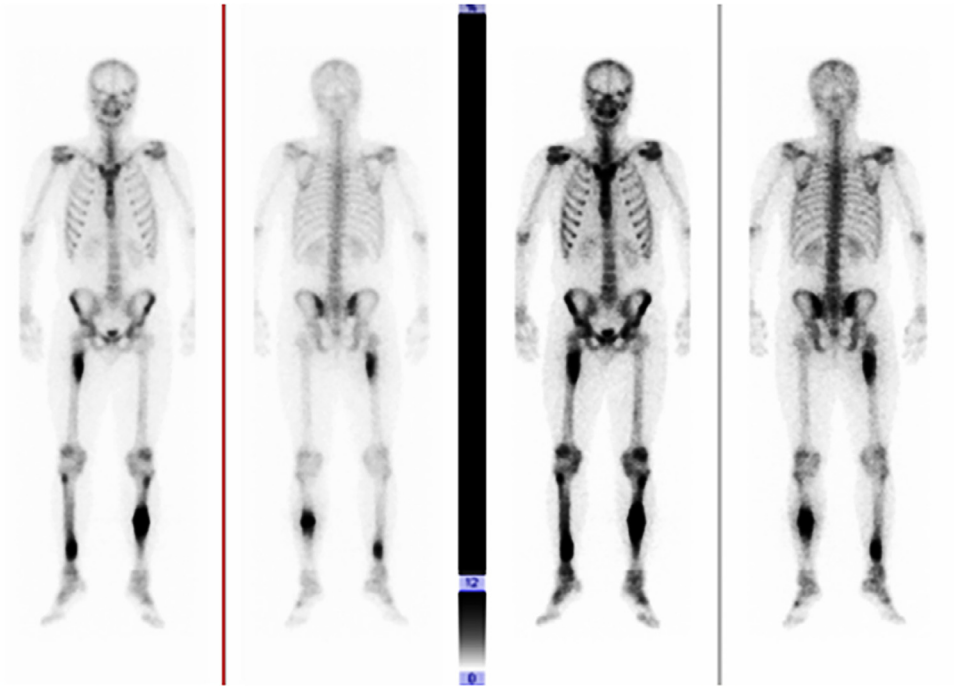

Fig. 4 – PCT of the whole body bones.

were identified upon examination of the whole-body bone scan. Considering the patient's medical history, physical signs, and auxiliary examinations, it is not possible to definitively exclude the possibility of chronic sclerosing osteomyelitis. Chronic sclerosing osteomyelitis is a condition characterized by peripheral bone and periosteal sclerosis, along with localized bone resorption and destruction. It shares similarities with regards to atypical presentation and high diagnostic challenge [5]. In order to proceed with further diagnostic measures, a "right tibia window biopsy" was performed under spinal anesthesia. During the procedure, a well-established blood supply to the periosteum was observed, accompanied by an elevated level of sclerosis in the bone cortex. No abscess or inflammatory tissue proliferation was observed. Pathological examination of the bone marrow tissue revealed the following findings: In the left tibial bone marrow, a benign bone disease was identified, with predominantly reactive proliferative bone tissue observed under the microscope. Ad-

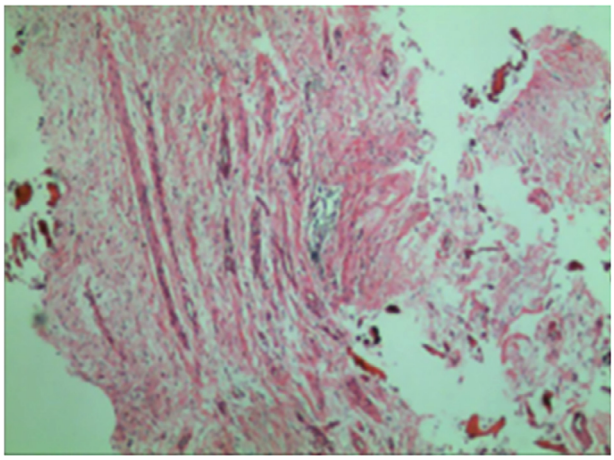

Fig. 5 – HE staining of pathologic tissues.

ditionally, changes resembling osseous callus were also noted Fig. 5. PCR sequencing was conducted to analyze mutations in the GNAS gene (exon 8, exon 9). However, no gene mutations were detected, thereby excluding the diagnosis of fibrous dysplasia.

Discussion

Stress fractures are typically observed in the proximal tibia, metatarsals, and other areas, while multiple stress fractures throughout the body are extremely rare. In this case, reaching a definite diagnosis is challenging, and routine examinations may not be effective for differential diagnosis. It is therefore necessary to conduct further tissue biopsy to obtain a definitive diagnosis. Although the initial examination resulted in a misdiagnosis, it is worth noting that the patient showed improvement with symptomatic treatments such as anti-inflammatory medications and pain relief. However, imaging studies revealed sclerosis and edema at the fracture site, which indicates a higher likelihood of osteomyelitis. However, taking into consideration the patient's specific occupation and the implementation of rest and immobilization during the initial treatment, along with the observed improvement in symptoms compared to before, the possibility of multiple stress fractures is still being considered. The pathogenesis of stress fractures remains a topic of debate, with 3 primary theories: the stress theory, microdamage accumulation theory, and muscle traction theory. The stress theory proposes that repetitive, sustained, and concentrated external forces exceed the bone's fixed load-bearing capacity, resulting in progressive changes in the internal structure of the bone and eventually leading to the development of fractures [6]. The microdamage accumulation theory proposes that microdamage within the bone helps distribute stress and prevent the occurrence of brittle fractures. However, when the accumulation of microdamage exceeds the bone's capacity for self-repair, stress fractures occur [7]. The muscle traction theory proposes that prolonged and excessive loading activities cause muscle traction to exceed the bone's load-bearing capacity, leading to fractures at sites where stress is concentrated [8]. In general, prolonged and continuous loading activities are the primary factors contributing to stress fractures in most cases. Research has indicated that engaging in regular high-intensity exercise can help reduce the risk of stress fractures [9]. However, according to Damsted [10], sudden increases in exercise volume can exceed the threshold of load-bearing capacity of the bones, thus increasing the risk of stress fractures. Additionally, medication factors can also play a role, as certain studies have reported that the use of nonsteroidal anti-inflammatory drugs (NSAIDs) can increase the incidence of stress fractures by 1-2 times [11]. Although nonsteroidal anti-inflammatory drugs (NSAIDs) are commonly used in clinical practice for pain relief and to reduce inflammation, it is worth noting that they inhibit the synthesis of prostaglandins, which are essential factors in promoting bone formation [12]. Bone density is a crucial indicator for assessing bone quality. Tenforde discovered that athletes with low bone density (T-value <-1.0 SD) had a significantly higher incidence of stress injuries, with a 4.6 times greater risk [13].

Based on the patient's medical history, participating in daily long-distance running activities of at least 4 kilometers and recently increasing the exercise load can indeed raise the risk of stress fractures. In addition, the use of oral nonsteroidal anti-inflammatory drugs (NSAIDs) may inhibit bone formation and potentially further increase the occurrence of stress fractures [14,15]. If early stress injuries are not promptly diagnosed and effectively treated, continued participation in load-bearing activities can cause the destruction of bone to outpace the body's ability to repair, resulting in progressive hardening at the fracture site. Indeed, X-ray and CT scans have limitations in detecting early stress fractures due to their low sensitivity and poor specificity. As a result, they are not typically recommended as routine diagnostic methods [16]. Currently, MRI (magnetic resonance imaging) is considered the preferred method for diagnosing stress fractures due to its higher sensitivity and specificity [17]. While MRI can provide valuable information by showing bone marrow edema and the condition of surrounding soft tissues, it may still pose challenges in effectively differentiating and diagnosing stress fractures from conditions like osteomyelitis. In some cases, an invasive surgical procedure followed by a biopsy is necessary to establish a definitive diagnosis. With the increasing popularity of sports and physical activities for both athletes and the general population, the occurrence of stress fractures is a concern that everyone should be vigilant about. Stress fractures can affect not only athletes and military personnel but also individuals who engage in regular physical activities. It is essential to be aware of the signs and symptoms of stress fractures and take preventive measures to avoid them. Early detection, diagnosis, and treatment are crucial in preventing further aggravation of physical damage and impairment of limb function. To avoid misdiagnosis or missed diagnosis, healthcare institutions should enhance their understanding of stress fractures and enable effective management at an early stage. Moreover, some preventive measures have been suggested. First, reasonable training schedule should be made individually. Sudden changes in routine or excessive mileage will lead to running injuries and adequate rest should been ensured [18]. Second,

Calcium and vitamin D play a role for bone metabolism. It is reported that daily supplementation of calcium (2000 mg) and vitamin D (800 IU) can prevent the stress fracture effectively [19]. Third, some biomedical instruments such as shock-absorbing shoes and preventive equipment can reduce the incidence of stress fractures in athletes and military personnel [20]. However, because of the difficult to detect and diagnose stress fractures, it is important to engage in moderate exercise gradually and seek timely medical attention if sports injuries occur.

Patient consent

We hereby confirm that appropriate consent has been obtained from the patient presented in this case report to publish their medical information, including images and other relevant data. The patient has been informed about the purpose of the publication and understands that their identity will be kept confidential. They have been given the opportunity to review the manuscript and have provided their consent for its publication.

Ethical Approval

This article was approved by the Ethics Committee of Shiyan Taihe Hospital. Informed consent was obtained from the patient involved in this case report.

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