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Pediatric stress fractures

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Abstract Stress fractures in children are uncommon. This report describes the findings of 8 cases in 6 children. One patient had 3 stress fractures: 2 consecutive midshaft stress fractures of the same tibia associated with one of the fibula. Signs and symptoms may be misdiagnosed as malignant tumors or osteomyelitis. Serial radiographs and computed tomography scans are the key to the diagnosis, although bone scan and magnetic resonance imaging can be helpful. Biopsy is unnecessary and might even be misleading.

Résumé Les fractures de stress sont pas fréquentes chez l'enfant. Ce travail montre les caractéristiques de 8 cas chez 6 enfants. Un patient présentait 3 fractures de stress: 2 fractures diaphysaires consécutives sur le même tibia avec une fracture sur le péroné. Les signes cliniques peuvent conduire à la confusion avec une néoplasie ou une infection. Le diagnostic dépend des radiographies sériées et de la tomographie axiale. La gammagraphie osseuse et l'exploration par résonance magnétique nucléaire aident aussi au diagnostic. La biopsie n'est pas nécessaire, et même elle peut entraîner des risques.

Introduction

Stress fractures are frequently reported in adults during military or sport activities. Pediatric stress fractures are less common, and may also present some differences compared to skeletally mature patients [4,14]. The most relevant aspect of such fractures in children is that pain and a significant radiological periosteal response may

lead to a delayed diagnosis, require unnecessary diagnostic methods and result in a misleading diagnosis.

Patients and methods

We have retrospectively reviewed 6 patients treated in the pediatric orthopaedic division. Five patients were male and one female, who presented with a total of 8 stress fractures. Age at diagnosis ranged from 2 to 14 years. All cases were diagnosed on the basis of conventional radiographic views, although 4 patients needed magnetic resonance imaging (MRI) to confirm the diagnosis, and 1 patient a computed tomography (CT scan); no biopsies were performed. Details on fractures and history can be seen in Table 1.

Results

There were 6 patients with 8 stress fractures. Four fractures were in the tibia, two in the diaphysis and 2 in the posteromedial part of the proximal metaphysis. Two fractures were in the fibula, one in the femoral diaphysis and one in the second metatarsal bone. The diagnosis was delayed by an average of 4 1/2 weeks from the onset of the symptoms.

One patient was treated with a plaster cast and 5 were treated with non-weight-bearing for 3–4 weeks followed by a restriction of physical activities for another 4–6 weeks. All cases consolidated and the time of consolidation ranged from 2 weeks to 5 months without angulation or any other complication.

Two patients (cases 4 and 6) were referred to us for a biopsy with the initial diagnosis of an osteoid osteoma and possible osteomyelitis. One patient gave a history of 2 weeks of a painful tibia with a spontaneous onset. After radiographic examination and a supplementary MRI, stress fractures in both tibia and fibula were diagnosed (Fig. 1). The patient was kept non-weight bearing using crutches for 3 weeks, and physical activities were restricted for another 3 weeks. Afterwards, another isolated diaphyseal tibial fracture was observed. The patient was otherwise healthy. No biopsy

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Table 1 Case reports (*CT* computed tomography, *MRI* magnetic resonance imagin)

Sex/age	Location of fracture	Time from onset of symptoms to diagnosis	Time from diagnosis to union	Associated conditions	Diagnosis based on:	Previous suspected diagnosis	Treatment	Complications
Male 7 years	Femoral shaft	4 weeks	5 weeks	No	X-ray, CT, MRI	Osteoid osteoma	Non-weight-bearing	No
Male 2 years	Fibula	8 days	5 month	Tibia vara	X-ray	No	Cast	No
Female 8 years 9 months	2nd Metatarsal bone	Unknown	Unknown	Cerebral palsy flat foot	X-ray	No	Non-weight-bearing	No
Male 8 years	Tibia diaph: 2 fibula:1	3 weeks	3 month	No	X-ray, MRI	Osteomyelitis	Non-weight-bearing	No
Male 14 years	Metaph Tibia	2 weeks	4 weeks	No	X-ray, MRI	No	Non-weight-bearing	No
Male 13 years	Metaph tibia	6 weeks	2 weeks	No	X-ray, MRI	Osteoid osteoma	Non-weight-bearing	No

Fig. 1A,B Anteroposterior views of consecutive midshaft tibial stress fractures. **A** typical radiographic appearance: periosteal reaction and endosteal thickening. **B** The same tibia with another stress fracture

was performed, routine blood test did not show any abnormality and the fractures finally healed without complications.

Discussion

Stress fractures in prepubescent children are uncommon. Devas [5] has published the largest series in the literature with 43 fractures. The most prevalent site is the upper-

most third of the tibia, involving the posteromedial cortex. In adults stress fractures in the upper part of the tibia are found in the anteromedial part of the metaphysis [7]. In the tibial shaft stress fractures are very rare. Only 8 fractures in 7 children (1 bilateral) have previously been reported [1,5,6,8,14], and 3 fractures progressed to non-union [8]. Unilateral stress fractures occurring one after another in the tibia has only been reported once previously [1]. All our reported tibial stress fractures healed without complications. None resulted in nonunion, or angulation.

The two diaphyseal fractures were located in the same tibia of an otherwise healthy child of 8 years. The fractures were associated with a stress fracture in the fibula of the same leg. No similar cases have previously been reported and we cannot explain the possible etiology.

The second most frequent location is in the fibula [9,14] whereas stress fractures of the metatarsal bones are less common in children. Usually they are observed with an underlying mechanical abnormality [9,14]. In our reported case (no. 3) spasticity and stiffness of the hindfoot after a Grice procedure may be of etiological importance.

Stress fractures of the femoral shaft (Fig. 2) are also very rare, and have primarily been reported as single case reports [10,12,13] or small series [2,3,4,11,14]. Davies [4] published the largest series with only 3 such cases. These fractures may easily be confused with neoplastic or infectious processes. In the femur of skeletal immature patients stress fractures are more frequently seen than primary sarcomas of bone [4]. The typical site along the medial cortex of the lower femoral diaphysis, the uninterrupted nature of the periosteal new bone and the absence of both a soft-tissue mass and bone destruction should enable the surgeon to differentiate between stress fracture and bone sarcoma. Bone scan, CT and MRI are helpful methods in confirming the diagnosis. Biopsy is unnecessary and may even be misleading.

Fig. 2 A Plain radiographs of the femur with periosteal reaction.
B CT scan of the femur through the area of pathology

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