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CASE REPORT

D. Tshering-Vogel
C. Waldherr
S. T. Schindera
L. S. Steinbach
E. Stauffer
S. E. Anderson

Adductor insertion avulsion syndrome, "thigh splints": relevance of radiological follow-up

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D. Tshering-Vogel · C. Waldherr (✉) ·
S. T. Schindera · S. E. Anderson
Department of Diagnostic,
Interventional and Paediatric Radiology,
University of Bern, Inselspital,
3010 Bern, Switzerland
e-mail: Christian.Waldherr@insel.ch
Tel.: +41-31-6322471

L. S. Steinbach
Department of Radiology,
University of California San Francisco,
San Francisco, California, USA

E. Stauffer
Department of Pathology,
University of Bern,
Bern, Switzerland

Abstract We present a case of chronic osteomyelitis in a 13-year-old girl which was originally diagnosed as adductor insertion avulsion syndrome ("thigh splints") on the basis of the clinical presentation, patient history, initial radiographs and MRI examination. However, at follow-up with persistent pain and altered radiographic and MRI appearances, surgical biopsy was indicated. Histopathological findings confirmed a bone abscess. This case underlines the necessity of clinical follow-up and imaging in certain patients with apparent thigh splints.

Keywords Adductor insertion avulsion syndrome · Osteomyelitis · Radiography · Magnetic resonance imaging

Introduction

Adductor insertion avulsion syndrome, or "thigh splints", is a painful condition affecting the insertion of the adductor muscles of the thigh from the proximal to the mid-femoral level. It has been described in adults [1] and children [2]. In children magnetic resonance imaging (MRI) findings may mimic a sarcoma [2].

We present a case of chronic osteomyelitis which was originally diagnosed as thigh splints on the basis of the clinical presentation, patient history, initial radiographs and MRI examination. However, at follow-up with persistent pain, altered radiographic and MRI appearances, surgical biopsy was indicated. Histopathological findings confirmed a bone abscess. Either the diagnosis of thigh splints was initially incorrect or misleading, or alternatively the adductor insertion avulsion syndrome was secondarily infected by repeated bacteremia from an untreated infected neurodermatitis. This case underlines the necessity of clinical-follow up and imaging in certain patients with apparent thigh splints.

Case report

A 13-year-old girl presented with pain in the right thigh and was hospitalized for diagnostic purposes. There was a history of intense thigh pain after hyperabduction-adduction (dance tournament) decreasing after 1 week of bed rest. The initial radiographs were unremarkable. The MRI (Fig. 1) findings combined with the clinical history were diagnosed as compatible with an adductor strain syndrome. The patient had no fever and unremarkable hematology and other laboratory results.

Two months later a control radiograph was performed because of increasing thigh pain, which showed an osteolytic region with a smooth periosteal reaction (Fig. 2A). A repeat MRI examination

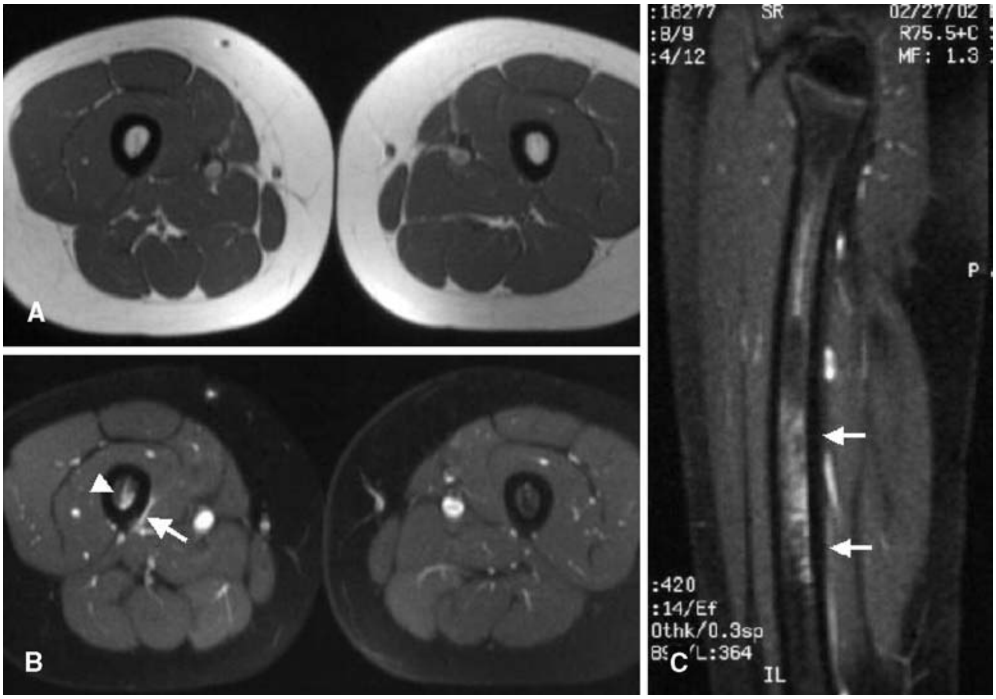


Fig. 1A—C Thirteen-year-old girl with a history of intense thigh pain after hyperadduction injury caused by dancing. **A** Initial MRI examination shows, on the axial T1-weighted image (TR: 600, TE: 14), no evidence of fracture or a focal bony defect. **B** Corresponding T2-weighted fat-suppressed image (TR: 5080, TE: 104) shows subtle increased signal intensity within the muscle of vastus intermedius, adjacent to the posterior-medial femoral cortex (*arrow*) and subtle increased signal intensity within the bone marrow (*arrowhead*). **C** Fat-suppressed sagittal image (TR: 420, TE: 14) following intravenous contrast administration shows subtle contrast enhancement within the medullary bone of the femoral diaphysis (*arrows*). There was additionally some subtle contrast enhancement within the vastus medialis muscle adjacent to the femoral cortex

was carried out. The second MR images showed a definite progression of altered signal intensity within the bone accompanied by a focal cortical defect (Fig. 2B—D). At this time there was still no fever or raised C-reactive protein level (CRP). Surgical biopsy and resection was performed and revealed Gram-positive cocci (Fig. 3A, B). *Staphylococcus aureus* grew on cultures. The histopathological findings confirmed the presence of abscess formation with some evidence of muscle fiber avulsion in adjacent areas. Treatment with antibiotics (dalacin) was started and continued for 2 weeks.

At the time of her second admission the patient was found to be suffering from severe neurodermatitis involving both hands with signs of secondary infection. While she was being treated with antibiotics for her abscess, she was referred to the dermatology department. At follow-up she was asymptomatic.

Discussion

In this case of a presumed superinfected avulsion injury to the thigh, the development of a focal abnormality on both radiography and MRI necessitated biopsy.

An avulsion injury is a structural failure of bone at a tendon or aponeurotic insertion related to excessive force applied from a musculoskeletal unit. The injury may be related to a single violent tensile action or to multiple repeated events [3]. Children and adolescents are prone to avulsive injuries due to their propensity for forceful activities, ability to sustain extreme levels of activity and immature growing apophyses [4]. The insertions of muscles capable of generating great forces are most prone to avulsion injuries. The most commonly described regions of injuries in children are the insertions in the pelvis and proximal femur [4]. The irregularity and periosteal reaction on radiographs can easily be misinterpreted as a malignant process such as Ewing's sarcoma or osteosarcoma; however, on MRI there is usually absence of a true mass.

Anderson et al. reviewed the imaging appearances of five patients with avulsion injury who were originally diagnosed with sarcomas [2]. In all five cases there was a history of abrupt exercise of the adductor muscles. In three of five cases, the MRI appearances were very similar to the initial MRI findings in this young patient. Like those three patients, after bed rest and a period of non-weight-bearing our patient's thigh pain had markedly decreased. However, in this patient the pain gradually increased over time, and at follow-up imaging a focal defect had developed.

The MR features of avulsion injury can appear sinister and may sometimes be misleading. Anderson et al. defined a characteristic set of findings for the diagnosis of

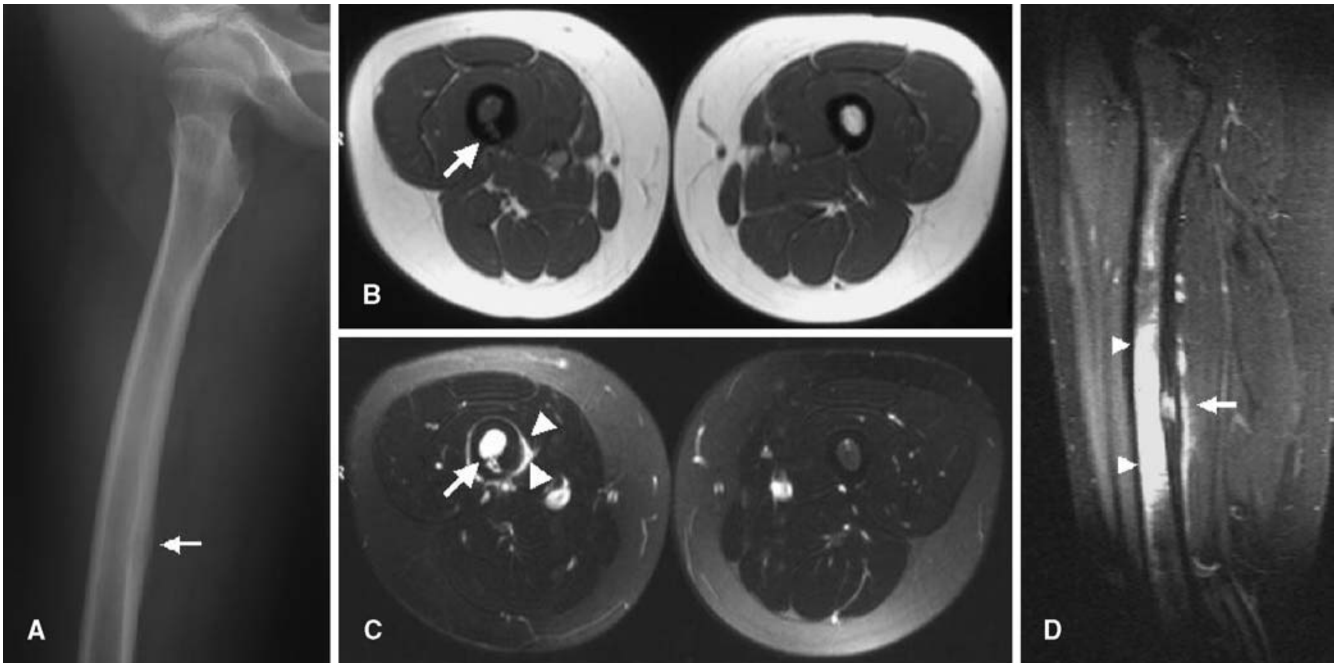
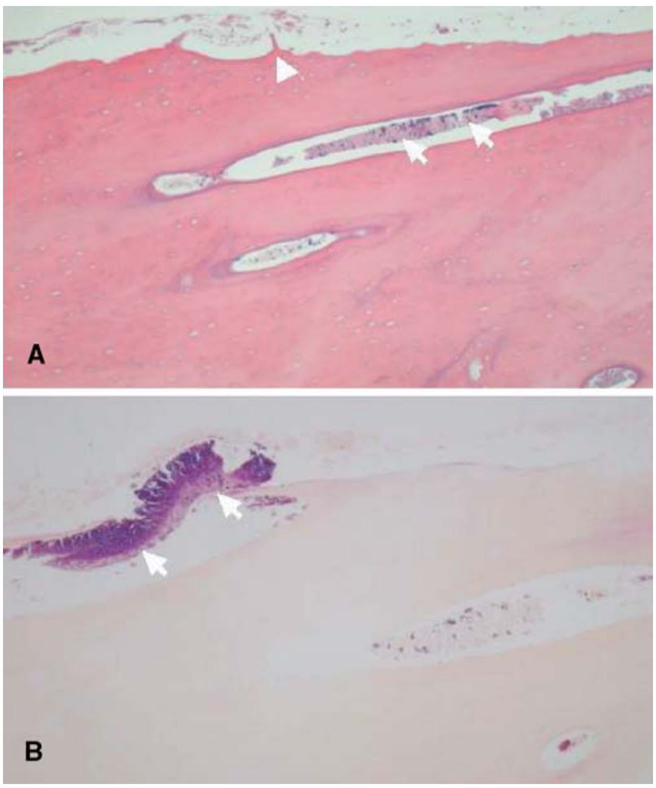


Fig. 2 **A** Follow-up radiograph at 2 months shows a focal lytic region within the posterior femoral cortex, associated with some bony expansion (*arrow*). **B** T1-weighted MR image (TR: 600, TE: 14) shows two small focal cortical defects within the posterior femoral cortex (*arrow*) with increased associated cortical and periosteal reaction. **C** Corresponding T2-weighted fat-suppressed image (TR: 4500, TE: 120) shows focal high signal intensity (*arrow*) within the thickened posterior femoral cortex associated with increased high signal intensity adjacent to the cortex (*arrowheads*). There is a marked increase in signal intensity within the intramedullary bone. **D** Sagittal STIR image (T1:150, TR: 5035, TE: 30) shows extensive increase in the intramedullary altered signal intensity (*arrowheads*) and the focal cortical abscess (*arrow*)



partial avulsion of adductor muscles from the femoral diaphysis with the exclusion of malignant disease [2]. In children, this may be especially helpful in cases of equivocal clinical findings or if a history is not obtainable. The features of avulsion injury are described as smooth periosteal reactions along the femoral diaphysis, increased cortical enhancement on bone scan, and periosteal reactions along the posteromedial aspect of the femur centered at the muscle-bone interface of the muscle insertions of vastus medialis, vastus intermedius and the adductor muscle group on the femoral shaft with diffuse widespread intramedullary edema on MRI. There is an absence of stress fracture and bone or soft tissue mass. Anderson et al. [5] described a thin rim of high signal intensity along the periosteum of the proximal to mid-femoral shaft compatible with periosteal reaction on turbo spin T2-weighted and Short Tau Inversion Recovery (STIR) images, suggesting that the high signal intensity of the bone marrow may be interpreted as being due to a stress reaction and high signal intensity of the adjacent cortex

Fig. 3 **A** The surface of the cortical abscess cavity (*arrowhead*) and positively stained pus within a cortical tunnel (*arrows*) (hematoxylin and eosin, ×10). **B** An adjacent region shows osteomyelitis with pus within a cortical tunnel and positively stained *Staphylococcus aureus* (*arrows*) (Gram stain, ×20) consistent with development of a stress fracture. Davies et al. described fatigue fractures of the medial aspect of the femoral diaphysis in the skeletally immature which may simulate malignancy [6]. In two of three patients periosteal callus and cortical fracture of the medial femoral cortex was identified with computed tomography. There was absence of a soft tissue and bone mass.

In our case it is presumed that MRI presented an early periosteal reaction after partial adductor muscle avulsion. The initial differential diagnosis was a primary bone tumor such as Ewing's sarcoma or osteogenic sarcoma, monostotic Langerhans cell histiocytosis or lymphoma. These were excluded as there was no bone or soft tissue mass and there was less intense uptake in the early vascular phase of the bone scan. Osteoid osteoma and osteomyelitis were excluded as there was an absence of nidus or focal mass. Stress fracture was also excluded because of an absent fracture line.

Knowledge of the MRI features of adductor strain avulsion injury may improve the correct diagnosis of avulsion injury without the need for biopsy. However, MRI cannot exclude superinfection. Thus, clinical follow-up with imaging is necessary, particularly in patients with increasing or altered pain symptomatology, or with possible sources of secondary infection. In our patient the secondary infection was thought to arise from the untreated markedly infected dermatitis, as no other source for the infection was found.

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