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Musculoskeletal

Bilateral trampoline fracture of the proximal tibia in a child

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ABSTRACT

Trampoline fractures are transversely oriented impaction fractures of the proximal tibia sustained by young children jumping on a trampoline. Unaware of the mechanism of this specific nontraumatic fracture, physicians may fail to detect these fractures on plain radiographs, as radiological findings may be very subtle. In this case report, we present a rare case of bilateral trampoline fractures with an explanation of the trauma mechanism.

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Case report

A 6-year-old Caucasian girl without medical history was referred to the emergency department because of acute bilateral knee pain and refusal to bear weight on both her legs. The girl came directly from an indoor playground where she had been jumping on a commercial trampoline together with another child. No fall or direct trauma had occurred. The girl only remembered falling down on her knees on the middle of the trampoline after an acute pain onset in both knees. Physical examination showed an extreme asthenic habitus, some small

bruises on the ventral side of the knees, and pressure pain over both proximal tibiae.

Anteroposterior and lateral radiographs showed bilateral horizontal, linear, minimally displaced fractures of the metaphysis of the proximal tibia (Fig. 1, more evident on the right), with buckling of the upper anterior tibial cortex and a cortical breach at the upper posterior tibia (Fig. 2). The patient was treated conservatively with bilateral circular-split upper leg casting for 3 weeks. Repeated imaging after 5 weeks revealed reactive sclerosis and near-complete consolidation of both proximal tibial fractures (Figs. 3 and 4). Twelve months after the injury, follow-up imaging showed complete consolidation

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Fig. 1 – Baseline anteroposterior radiographs of the right (A) and the left (B) knees show bilateral minimally displaced fractures of the proximal tibial metaphysis (more evident on the right).

of both fractures without deformities or premature closure of the epiphyseal growth plates.

Discussion

Trampoline fractures are transversely oriented impaction fractures of the proximal tibia sustained by young children jumping on a trampoline [1]. These fractures are typically seen in children aged 2–5 years old, with incidence and prevalence decreasing with age. Usually, no history of fall or direct trauma is identified [2]. These fractures commonly occur when children jump on a trampoline with another person, particularly when this second person is heavier. It is thought that the upward bending of the trampoline mat after a jump of this heavier person exerts increased axial force on the child's proximal tibia when concomitantly jumping downward with the knee in (hyper)extension [1–4] (Fig. 5). The immature bone of the proximal tibia in young children, particularly in infants and



Fig. 3 – Anteroposterior radiographs of the right (A) and the left (B) knees at 5 weeks' follow-up show linear sclerosis in both proximal metaphyses, with a significant blurring of the fracture lines.

toddlers, is soft and less resistant to the kinetic energy of the increased axial load [2].

Trampoline fractures are a peculiar type of pediatric trampoline-related injury. First described in the 1980s [1], physicians have become more aware of this phenomenon. Nevertheless, the diagnosis was missed initially in 24% of cases in a large cohort of trampoline fractures ($n = 25$) [2]. Fractures may be subtle and hard to identify on plain radiographs, particularly when bilateral. The key radiographic features of trampoline fractures include transverse hairline fractures of the proximal tibia metaphysis, often accompanied by buckling of the anterior upper, medial, or lateral cortex, and an anterior tilting of the epiphyseal plate [3–5]. Measuring the anterior tilt angle of the epiphyseal plate on the lateral lower leg radiographs might be helpful in detecting the more subtle fractures, especially when no fracture line is visible [2]. A pitfall might be the nonfused apophysis of the tibial tubercle, which might simulate a fracture on the anteroposterior view [6], however seen in older children. Magnetic resonance imaging may be helpful for detection when suspected fractures are

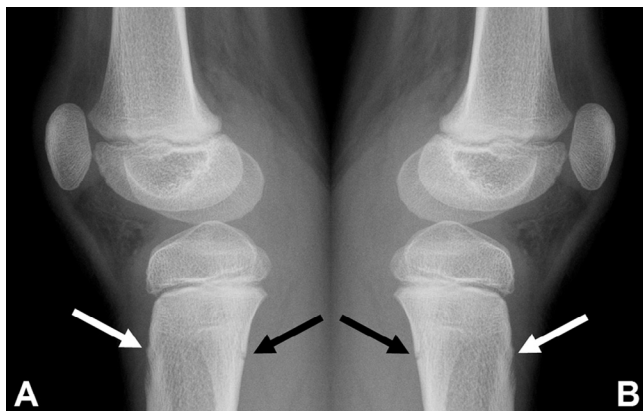


Fig. 2 – Baseline lateral radiographs of the right (A) and the left (B) knees show bilateral buckling of the upper anterior tibial cortex (white arrows) and a bilateral cortical breach at the upper posterior tibia (black arrows).



Fig. 4 – Lateral radiographs of the right (A) and the left (B) knees at 5 weeks' follow-up show linear sclerosis in both proximal metaphyses, from anterior to posterior, without clearly visible residual fracture lines.



Fig. 5 – Mechanism of injury in the so-called trampoline fractures, leading to increased axial loading on the proximal tibia of the child. Dotted arrows indicate the direction of movement of both the child (downwards) and the heavier second person on the trampoline (upwards). Solid arrows indicate the upward bending of the trampoline mat, with the solid red arrows indicating the consequential increased axial force on the child's proximal tibia.

radiographically occult [7]. Treatment of trampoline fractures consists of standard immobilization leading to a consistently good outcome without deformities or disabilities [1,8].

Bilateral fractures of the proximal tibiae are rare in children [9] and tend to occur mostly in overweight male adolescents or male adolescents during growth spurt [10]. To our knowledge, only unilateral cases of trampoline fractures have been published in the literature. The differential diagnosis of (bilateral) trampoline fractures includes nonaccidental injury or fractures due to direct trauma or fall.

With the increasing recreational use of trampolines, the number of injuries related to this high-risk activity has risen correspondingly. Most injuries occur in a domestic setting due to either a fall or a direct trauma [11–13]. Physicians should, however, be aware of the typical history, the mechanism of this

specific nontraumatic fracture, and its associated radiological findings when children are admitted with pain and inability to stand or walk after trampoline use.

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