

'TRAMPOLINE FRACTURE' OF THE PROXIMAL TIBIA IN CHILDREN: REPORT OF 3 CASES AND REVIEW OF LITERATURE

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We present three cases of fracture of the proximal tibia in young children who were jumping on a trampoline. The typical radiological findings and the underlying mechanism of trauma are discussed.

The key radiological features are: a transverse hairline fracture of the upper tibia often accompanied by a buckle fracture of the lateral or medial tibial cortex, buckling of the anterior upper tibial cortex and anterior tilting of the epiphyseal plate.

New types of injuries related to specific recreational activities are recognized. It is often helpful to associate a typical injury with a particular activity. Trampoline related injuries have increased dramatically over the last years. The most common lesions are fractures and ligamentous injuries, in particular a transverse fracture of the proximal tibia. However the radiological findings can be very subtle and easily overlooked. It is therefore important to be aware of the typical history and radiological findings.

Key-words: Extremities, injuries – Infants, skeletal system.

Case reports

Case 1

An 18-month-old boy presented at the emergency unit because he did not want to walk or bear weight on the left leg. This occurred after jumping on a trampoline.

Standard radiograph of the left leg (Fig. 1A) and comparative view (Fig. 1B) were performed and showed a cortical buckle at the anterior portion of the proximal tibia.

Case 2

A 2-year-old boy complained of sudden onset of severe pain in the left leg after playing on a trampoline with two older boys. There was no history of a fall. He could not walk or bear weight on the left leg.

Standard radiographs of the left knee (Fig. 2A) were performed and showed a transverse impaction fracture of the upper tibia accompanied by a buckle fracture of the anterior tibial cortex. There was also an increased concavity of the notch for the tibial tubercle on the lateral view and anterior tilting of the growth plate.

Follow-up radiograph after a few weeks demonstrated endosteal callus in the proximal tibia (Fig. 2B).

Case 3

A 4-year-old boy presented at the emergency unit with a history of

jumping on a trampoline, no specific accident happened. He also refused to walk or bear weight on the right leg. He complained of pain around the knee.

Standard radiographs of the left leg (Fig. 3A, B) showed a hairline fracture of the upper right tibia and an associated cortical buckle fracture at the anterior portion of the proximal tibia as well as an increased concavity of the notch for the tibial tubercle on the lateral view and slight anterior tilting of the epiphyseal plate.

In addition, a cortical buckle of the lateral distal femoral metaphysis was present.

Discussion

Trampoline related injuries have increased dramatically over the last years. The most common lesions include fractures and ligamentous lesions, more rare injuries of the head and the cervical spine (1). The 'trampoline fracture' of the tibia or so called 'Toddler's fracture type II' is a transverse fracture of the proximal tibia.

This fracture typically occurs in young children who jump on a trampoline with another person who is heavier. As the heavier person jumps, the trampoline mat recoils upward from its stretched downward position. If the smaller child lands on the upward moving mat at the time

when its elasticity is reversed by recoil and the springs are shortening to their unstretched length, there is significant upward impaction force applied to the descending child's legs. So a transfer of kinetic energy from the larger mass to the smaller mass occurs (Fig. 4). The 'trampoline fracture' of the proximal tibia occurs when the impaction force is applied at the right time and angle on a hyperextended leg, causing compressive forces to the anterior cortex of the tibia and distracting forces over the posterior cortex (2, 3).

Typically these children present at the emergency unit and do not want to walk or bear weight after jumping on a trampoline, often without clear evidence that an accident had occurred (2). On physical examination there is a decrease range of motion of the leg. Hyperextension of the knee will be painful and decreased, especially when compared to the other side, which demonstrate that the problem is focused on the knee (4, 5).

However, the problem often remains a mystery, until radiographs are obtained. The non systematic use of comparative views can be useful as radiological findings may be subtle.

Findings on plain radiographs are variable, ranging from a hairline fracture of the upper tibia often accompanied by a buckle fracture of the lateral or medial tibial cortex, buckling of the anterior upper tibial cortex and/or increased concavity of the notch for the tibial tubercle on the lateral view, and anterior tilting of the epiphyseal plate. All of these findings are not necessarily present in every patient. Buckling of the anterior cortex and/or increased concavity of the notch for the tibial tubercle

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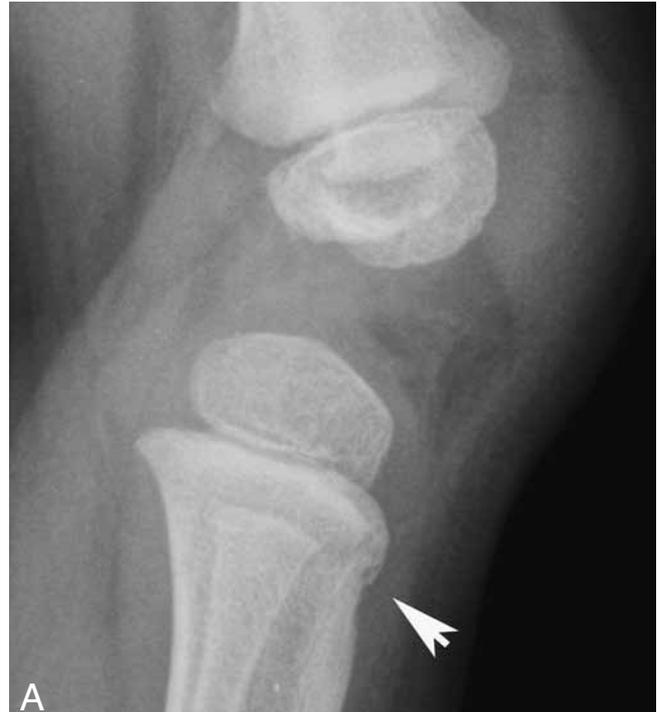


Fig. 1. — A. Standard lateral radiograph of the left knee shows a cortical buckle at the anterior portion of the proximal tibia. B. Comparative lateral view of the right knee.

Fig. 2. — A. Standard lateral radiograph of the left knee shows a transverse impaction fracture of the upper tibia accompanied by a buckle fracture of the anterior tibial cortex, an increased concavity of the notch for the tibial tubercle and anterior tilting of the growth plate. B. Lateral radiograph of the left knee after a few weeks demonstrates callus in the proximal tibia.

are the predominant findings. In older children or adults, there is impaction of the trabecular and cortical bone, but only minor buckling (4).

The three typical radiological findings were present in case 2 and 3. In case 1, a buckling of the anterior upper tibial cortex was the only finding, illustrating that the radiological findings can be subtle. Occasionally associated buckle fractures of the distal femur occur, as seen in case 3.

This 'angled buckle' fracture occurs when the axial forces applied are somewhat lateralized or because of a varus/valgus position at the moment of the impaction force (4).

Treatment consists of routine immobilization. These fractures have a good outcome, without impairment or significant deformities of the tibia and knee (2).

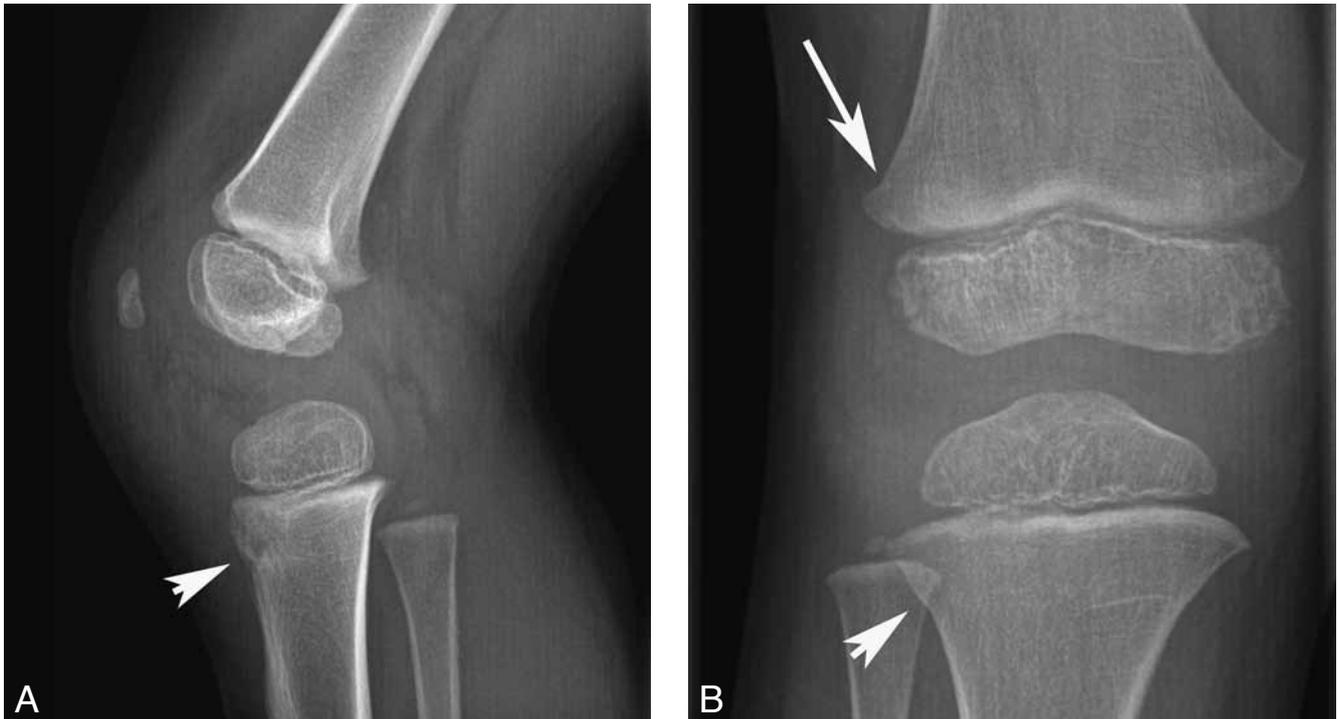


Fig. 3. — A. Lateral standard radiographs of the left leg with a hairline fracture of the upper right tibia, cortical buckle fracture at the anterior portion of the proximal tibia, an increased concavity of the notch for the tibial, and slight anterior tilting of the epiphyseal plate. B. Frontal standard radiographs demonstrate an associated fracture: a cortical buckle of the lateral distal femoral metaphysis.

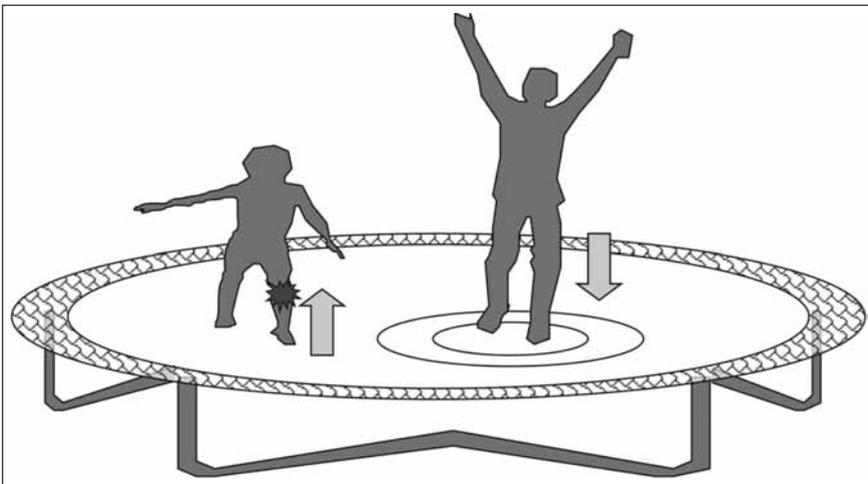


Fig. 4. — Mechanism of injury in 'trampoline fracture'.

Conclusion

The upper tibial hyperextension induced buckle fracture in infants, also known as the trampoline frac-

ture is becoming more common, since the introduction of trampoline jumping on garden parties. The key to the diagnosis is the combination of the typical history of the trampo-

line jumping and the typical location of the injury. Radiological findings are often subtle and meticulous analysis of the anterior aspect of the upper tibia is mandatory to avoid misdiagnosis.

References

1. Hurson C., Browne K., Callender O., et al.: Pediatric trampoline injuries. *J Pediatr Orthop*, 2007, 27: 729-732.
2. Boyer R., Jaffe R., Nixon G., Condon V.: Trampoline fracture of the proximal tibia in children. *AJR*, 1986, 146: 83-85.
3. Menelaws S., Bogacz A., Drew T., Paterson B.: Trampoline-related injuries in children: a preliminary bio-mechanical model of multiple users. *Emerg Med J*, 2011, 28: 594-598.
4. Swischuk L.: The limping infant: imaging and clinical evaluation of trauma. *Emerg Radiol*, 2007, 14: 219-226.
5. Swischuk L.: Musculoskeletal injury in the right leg of a child who jumped a lot on a birthday party. *Emerg Radiol*, 2009, 16: 331-333.