Intra-articular Calcaneal Fracture in a 14-year-old Competing Skier: Case Report

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Intra-articular calcaneal fracture as a skiing injury in children is extremely rare. We report on what we believe is a unique and previously unreported mechanism of a skiing injury, which caused intra-articular calcaneal fracture in a young competing skier, a member of the Croatian national ski team. This 14-year-old boy sustained a heel injury while training for giant slalom. There was no fall on the heel or obvious axial force that could have caused this type of calcaneal fracture. The skier had sophisticated equipment and used carving skies. We speculated that, when the skier tried to establish the lost balance during the fall, a violent contraction of triceps muscle occurred. Instead of an injury of a well-protected tuber or Achilles tendon, the strong pulling force of the Achilles tendon was transmitted more distally and anteriorly, generating axial compression force, which caused an intra-articular fracture of the calcaneus bone. Obviously, the existing ski boot did not sufficiently protect the calcaneus bone. We postulate that the calcaneal tuber and Achilles tendon were protected on the expense of the intra-articular calcaneal fracture. Our case warns of the possibility of a serious foot injury in young top skiers in spite of extensive improvement in the ski equipment. Sophisticated carving skies could be a contributing factor to an injury.

Key words: adolescent; athletic injuries; calcaneus; fractures; skiing

Calcaneal fractures are very rare in children, accounting for <0.05% of all fractures in that age (1). Intra-articular calcaneal fractures are even rarer: our review of the literature identified only two reported cases of this type of fracture as skiing injury in children (1,2).

We describe a unique, previously unreported mechanism of skiing injury, which caused an intra-articular calcaneal fracture in a young top skier, member of the Croatian national ski team. The purpose of this paper is to explore the mechanisms of intra-articular calcaneal fractures in young competing skiers, as well as to emphasize the possibility of an unusual and severe foot injury despite the use of sophisticated ski equipment and excellent physical fitness.

Case Report

A 14-year-old boy was admitted to our hospital one week after injuring his left heel during giant slalom training. He skied on carving skies and used other sophisticated equipment. While trying to perform a high-speed left curve, he was drawn by carving skies to the left more violently than he expected. Trying to change the direction into the next right curve, he was catapulted aside and fell down over the tip of the left, non-released ski (Fig. 1).

Physical examination revealed a painful edematous hind foot. Clinical inspection of other body systems and laboratory findings were normal. Past medical history was unremarkable. He did not use any medications. Lateral and axial X-ray evaluation on admission revealed an intra-articular calcaneal fracture of the left foot (Fig. 2). The surgical treatment was indicated because the fracture of calcaneus bone was of joint depression type and quite heavy, and the patient was young (3). An open reduction was carried out via lateral approach by use of a plate for stable internal fixation (Fig. 3). The defect beneath the depressed fragment was filled with a supplemental cancellous bone graft. Postoperatively, non-weight bearing exercises were continued for eighth weeks. Ambulation was started with partial weight-bearing with crutches and gradually increased to full weight-bearing in the next two months. The patient was encouraged to carry out supervised exercises of the toes and ankle and, as soon as the pain subsided, to exercise subtalar movements. The patient returned to sport activities five months after the surgery and was fit for competitive skiing in the next two months.

Discussion

Neither the fall nor collision could explain the intra-articular calcaneal fracture in our patient. When a skier is falling, the ski acts as a lever and the most vulnerable parts of the leg are the knee joint and the lower leg above modern, high, and rigid ski boot
On the other hand, collision with a solid object may result in an injury of any part of the body. To the best of our knowledge, only two cases of an intra-articular calcaneal fracture as a skiing injury in children have been reported so far. In both cases, the mechanism of injury causing fracture was explained as a consequence of landing on the skis after a several meters long jump. An intra-articular fracture of the calcaneus bone occurs when the resultant compression force acts along the body axis. However, our patient did not fall on the heel, and there was no obviously present axial force that might have caused this type of calcaneal fracture.

The foot is protected by the ski and ski boots. The foot injury is not likely to occur even in the case of an axial compression force due to large absorption area of the ski. On the other hand, a modern rigid ski boot, acting as a firm envelope around the foot, disables the contraction of the crural triceps to cause the avulsion of calcaneal tuber or rupture of the Achilles tendon. In our case, the question is why intra-articular calcaneal fracture occurred in spite of the boot protection. We speculate that, when the skier tried to establish the lost balance during the fall, a violent contraction of the triceps muscle occurred (Fig. 1B). Instead of an injury of the well-protected tuber or Achilles tendon, the strong pulling force of the Achilles tendon was transmitted more distally and anteriorly, generating axial compression force that caused the intra-articular fracture of the calcaneus bone. Another possibility was that a direct energy impact under an exceptional angle to the heel caused this rare injury. This force could be generated when the skier fell down over the tip of the left, non-released ski (Fig. 1C and 1D). However, the existing ski boot did not sufficiently protect the calcaneus bone. We postulate that the calcaneal tuber and Achilles tendon were protected on the expense of the intra-articular calcaneal fracture.

Figure 1. Reconstruction of the injury according to the patient, his coach, and eyewitnesses from the rest of the team. A. The skier tried to perform a high-speed left curve but was drawn by carving skies to the left more violently than he expected. B. Trying to change the direction into the next right curve, he was catapulted out of the track. C and D. The skier fell down over the tip of the left, non-released ski.

Figure 2. Fractured calcaneus. Axial (left) and lateral (right) X-ray of the left calcaneus presenting decreased Böhler’s angle due to an intra-articular fracture.
In conclusion, our case warns of the possibility of a serious foot injury in young top skiers in spite of extensive improvement of ski equipment during past years. Moreover, sophisticated carving skis could be a contributing factor to an injury. The intra-articular calcaneal fracture in children as a skiing injury should be taken into account when an injured skier is examined, especially when he or she is a competing athlete.

References


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Figure 3. Reconstructed calcaneus. Lateral (up) and axial (down) X-ray of the fractured calcaneus after reconstruction (restored Böhler’s angle).