Arch Orthop Trauma Surg (2007) 127:277–280
DOI 10.1007/s00402-006-0196-4

Unusual malleolar fracture of the ankle with talocalcaneal coalition treated by arthroscopy-assisted reduction and percutaneous fixation

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Received: 16 March 2006 / Published online: 27 July 2006
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Introduction

Talocalcaneal coalition is an uncommon condition that is characterized by nonspecific symptoms such as vague pain of the hindfoot that often follows minor injuries such as repeated ankle sprain [16]. Most patients with talocalcaneal coalition have no symptoms, and thus generally require no treatment [4, 9, 12–16]. However, several authors have reported that restriction of the subtalar joint increases mechanical stress on the talocrural joint, which may lead to disruptions of the talocrural joint, or may cause peroneal spastic flat foot [4, 9, 12, 19]. We report herein a case of an unusual malleolar fracture of the ankle with talocalcaneal coalition, in which abnormal force may have been applied to the ankle mortise due to restriction of the subtalar joint motion, and may have produced the observed severe articular surface incongruity.

Case report

A 16-year-old boy sprained his right ankle in the supination-external rotated position while playing tennis. He immediately experienced severe ankle pain and was unable to walk. He was brought to our hospital, where physical examination revealed severe swelling and tenderness of the right ankle without an open wound, and no sensory or motor disturbance. He had a restriction of inversion in his contralateral hindfoot. Plain radiography demonstrated fractures of the lateral and medial malleolus (Fig. 1a, b). In the antero-posterior view, radiographs showed that the lateral malleolus was fractured transversely at the level of the syndesmosis, and the medial malleolus was fractured obliquely from the medial tibial plafond to the proximal medial cortex of the tibia, which was approximately 4 cm above the plafond. There was no widening of the space between the tibia and fibula at a distance of 1 cm proximal to the plafond. In the lateral view, radiographs showed no posterior malleolar fracture. According to the position of the injured ankle, we considered that he might have a supination-adduction-type fracture according to the Lauge-Hansen classification; however, this fracture line was placed on the medial one-third of the tibial plafond, which was more laterally positioned than in a typical supination-adduction-type fracture. Computed tomography showed that the fracture lines were defined in the medial malleolus and lateral malleolus. In the medial malleolus, the fracture line was defined on the tibial plafond level with 5 mm of displacement, and it looked like a spiral fracture. In the lateral malleolus, the fracture line was defined below the syndesmosis level with little displacement. Moreover, medial talocalcaneal coalitions could be seen on his bilateral hindfoot (Fig. 2). The patient had no symptoms, only a restriction of inversion. We performed surgery on this displaced fracture 2 days after the initial injury.

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Fig. 1 Plain radiographs made at the time of the initial injury. The anteroposterior view (**a**) and the lateral view (**b**) showed a bimalleolar fracture, which was classified as being of the supination-adduction type in the Lauge-Hansen classification. However, the medial malleolar fracture line was placed more laterally than in a typical case and had a 5-mm displacement on the tibial plafond

Fig. 2 Computed tomography of the right foot. The medial facets of the subtalar joint formed a bony union. The anterior and posterior facets were intact

The patient was placed in a supine position on an operating table under spinal anesthesia. The hip was flexed 45° in a leg holder by means of the bandage distraction technique with a force of 78.4 N. Initially, an arthroscope was inserted at the anterolateral or anteromedial portals; a probe was inserted at the opposite portal. We observed the articular surface via an arthroscope with probing. A curved fracture line existed from anterior to posteromedial of the tibial plafond with approximately 5-mm displacement (Fig. 3a). There was no widening of syndesmosis under the arthroscopic stress test [20]. According to these findings, we determined that there was no instability of the tibiofibular joint and therefore performed percutaneous fixation of the lateral and medial malleolus. We first performed a manual reduction of the lateral malleolar fracture. A guide-wire was inserted under a fluoroscopic view from the tip of the lateral malleolus to the proximal medial cortex of the fibula,

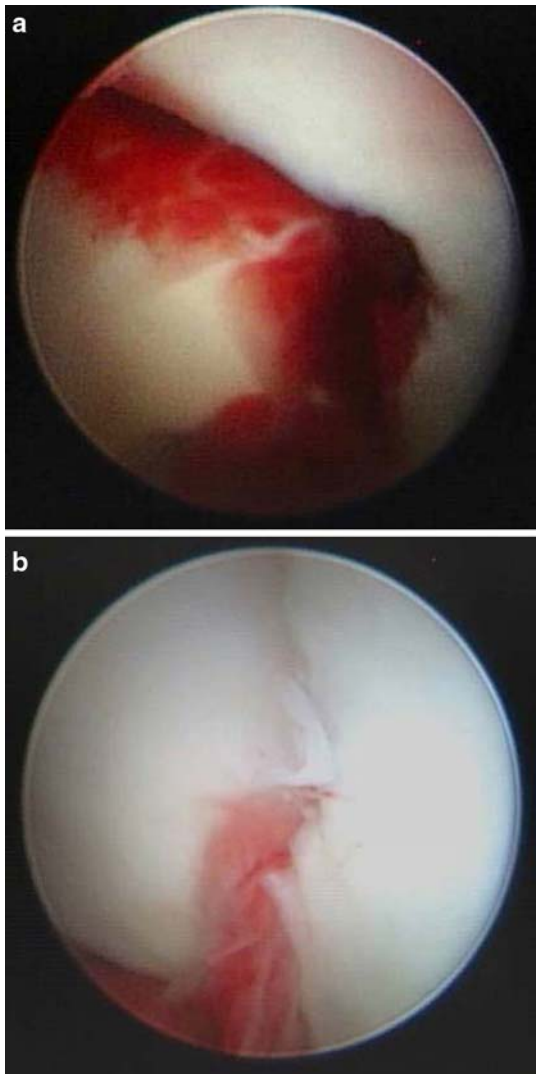

Fig. 3 **a** Arthroscopic findings before internal fixation. The *arrows* point to the fracture site with 5-mm displacement. **b** Arthroscopic findings after internal fixation. The *arrows* point to the fracture site. The displacement was reduced to less than 1 mm

and the bone was fixed with a cannulated cortical screw. We next reduced the medial malleolus manipulatively. Two Kirschner wires 1.8 mm in diameter were inserted into the distal fragment of the medial malleolus to reduce the fragment. We reduced the articular surface anatomically under an arthroscopic view, inserted a guide-wire from medial to lateral at the center of the epiphysis, and fixed a fragment with a cannulated cancellous screw, while viewing the articular surface at the fracture site under an arthroscopic view. After fixation, the fracture site of the articular surface was reduced to a displacement of less than 1 mm (Fig. 3b). We then augmented the fixation using a cannulated cancellous screw system and a cannulated cortical screw system, which were placed parallel from the end of the medial malleolus to the proximal lateral cortex of the tibia (Fig. 4a, b).

One day after the surgery, the patient was allowed to begin active range of motion exercise of the affected ankle. Partial weight bearing was allowed at 2 weeks after the surgery, and full weight was allowed at 4 weeks after surgery.

Two months after the surgery, the patient was able to walk without discomfort. Three months after the surgery, he felt no pain while running and was able to fully participate in athletic activities. One year after the surgery, second-look arthroscopy was performed to evaluate the intra-articular condition. The articular surface of the fracture area was found to be smooth and congruous, and the fracture line was filled with cartilage-like tissue. The patient had no pain when running and returned to full athletic activity. The range of motion of the ankle was full, and the American Orthopaedic Foot and Ankle Society score was 100 points. The plain radiographs showed a slight defect of the medial side of the tibia, but the alignment of the fracture site was good with no degenerative changes in the ankle. There were no symptoms associated with tarsal coalition, but a restriction in the range of motion of the subtalar joint was constantly present and he was almost unable to invert the hindfoot.

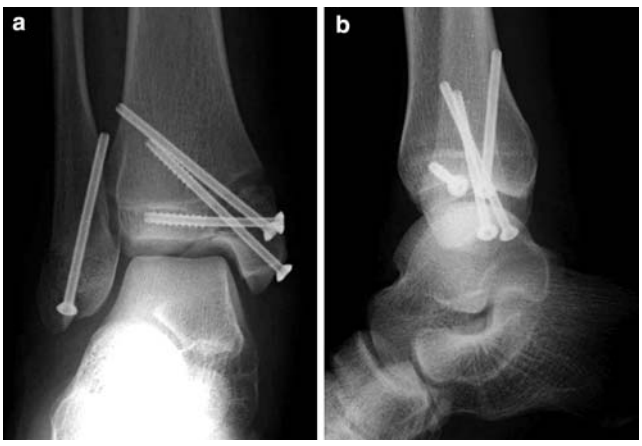

Fig. 4 The anteroposterior view **a** and the lateral view **b** of the right ankle after internal fixation

Discussion

Talocalcaneal coalition was described first by Zuckerkandl in 1877 [21]. The main symptoms associated with this condition are foot fatigue and vague pain about the hindfoot on increased activity. But many patients with tarsal coalition tend to be misdiagnosed and to receive inappropriate treatment. In addition, almost patients with talocalcaneal coalition have restricted or no movement of the subtalar joint.

The mechanical characteristics of the ankle complex have been reported by many investigators, but the details remain controversial [1, 3, 5, 6, 8, 11, 17, 18]. The ankle complex is composed of the talocrural and subtalar joints. The subtalar joint has rotational motion in the axis, which is variable, changing according to the range of motion. Therefore, the motion of this joint is often described as being screw-like, and the joint itself is sometimes called the polyaxial joint [8, 18]. The hindfoot motion is a complex motion of these two joints. Patients with talocalcaneal coalition have a restriction or absence of subtalar motion, so their ankle complex motion is considered to be abnormal. Leardini et al. [8] have reported that the range of motion of the subtalar joint accounts for more than 70–90% of the overall range of motion of the ankle complex. Also, Siegler et al. [17] observed the respective range of motion of the ankle complex in inversion. According to their findings, if the subtalar joint motion is lost either completely or incompletely, then excessive rotational force will be loaded onto the talocrural joint in inversion.

Ankle fractures are common musculoskeletal injuries and are commonly classified according to the schemes of the Lauge-Hansen classification [7]. In this classification, the translational injury pattern includes the supination and the pronation abduction types [2, 10]. If a patient sustains a supination adduction type of translation injury, the abnormal inversion force, which consists of a high-energy adduction force, is loaded to the ankle complex as a pathological force. At the time of injury, the rotation of the inversion force is absorbed on the subtalar joint and the residual adduction force is loaded on the talocrural joint. Therefore, the medial malleolar fracture occurs from the medial corner of the tibial distal end to the proximal medial cortex of the tibia.

Our case was considered to involve supination adduction type stage II in the Lauge-Hansen classification. The morphologic features of our case correspond to a pilon fracture. But the fracture line of the fibula didn't correspond to this; a pilon fracture has the fracture line of the fibula which should be defined proximal from the anterior tibiofibular joint, but in our case, the fracture line of the fibula was defined distal from the anterior tibiofibular joint, and the fracture type was a transverse fracture. Compared with a typical supination adduction type fracture, this was positioned more laterally and had changed to a spiral fracture. We therefore consider that the rotational force may not have been absorbed on the subtalar joint, because talocalcaneal coalition can restrict the range of motion of this joint; as such, excessive rotational force may be loaded on the talocrural joint, adding to the adductional force. It appeared that there was severe displacement of the articular surface of the distal tibial end, which is a weight-bearing zone. We therefore performed an accurate reduction of the articular surface arthroscopic to prevent mature osteoarthritis or other disorders.

We consider that patients with talocalcaneal coalition may be at increased risk of sustaining severe injury of the ankle. We do not think that treatment for asymptomatic talocalcaneal coalition is always necessary, but we do believe that it is important to provide patients with information regarding their increased level of risk.

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