

Fractures of the body of the talus in the sagittal plane

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S U M M A R Y. Fractures of the body of the talus in the sagittal plane are very rare. The definition, however, is unclear. We therefore reviewed nine cases of this type of fracture in our series. The rate of occurrence was 4.6% of major talar fractures. Analysis of radiographs revealed a characteristic fracture line which follows a particular path from the lateral entrance of the sinus tarsi to the sulcus of the flexor hallucis longus on the inferior surface of the talus. Based on this finding, we re-defined sagittal fractures of the talar body on the basis of this distinctive fracture line. This line corresponds to the structural weak point of the talus. Thus, concentration of stress at this point may cause either sagittal body fractures or talar neck fractures.

INTRODUCTION

Fractures of the talus are uncommon, and talar body fractures in the sagittal plane are still rarer. The definition of sagittal fracture of the talar body is not clear, but the vertical fracture line in these cases is very clear and characteristic. The rarity of this type of fracture may lead to the misunderstanding that it separates the head of the talus from the body. We report nine cases of this type of fracture and suggest a clear definition.

PATIENTS AND METHODS

There were nine cases of sagittal fracture of the talar body among 206 cases of fracture of the talus treated at Keio University Hospital and its affiliated hospitals

between 1971 and 1992 (Table 1). We evaluated them clinically and analyzed their radiological appearance. The mean age of the patients at the time of injury was 23.6 years (range 6-58 years). The sex distribution was eight males to one female. The right talus was fractured in four cases and the left talus in five cases. There were no open fractures. The cause of injury was a traffic accident in five cases, falling from a height in three cases and unknown in one case. Two patients had fracture-dislocations. There was a subtalar dislocation in one, and both a subtalar and ankle dislocation in the other. A fracture of the neck of talus on the same side complicated two cases, a medial malleolar fracture in three cases, a lateral malleolar fracture in one case and a calcaneal fracture in two cases. We describe the major cases below.

Table 1—Fracture and fracture-dislocation of the talus body in the sagittal plane

No.	Sex	Age	Side	Dislocation	Complication	Cause
1	Male	43	Left			Fall
2	Female	16	Right	Subtalar, talocrural		Traffic accident
3	Male	6	Right		Ankle fracture dislocation	Traffic accident
4	Male	22	Right		Both calcaneal fractures	Unknown
5	Male	23	Right	Subtalar		Traffic accident
6	Male	58	Left		L1, L2 fracture-dislocation	Fall
7	Male	22	Left		Medial malleolar fracture	Traffic accident
8	Male	17	Left			Fall
9	Male	6	Left		Medial malleolar fracture Calcaneal fracture	Traffic accident

Case 1

A 43-year-old male fell from a height and injured his left foot. An antero-posterior X-ray view of the ankle revealed a sagittal fracture of the talus (Fig. 1). There was a calcaneal fracture on the same side, but no malleolar fractures or dislocations. The lower limb was immobilized in a plaster cast, without reduction, for 4 weeks. Hawkin's sign, atrophy of the subchondral bone of the talar trochlea was detected on an X-ray film 6 weeks after injury, and thus aseptic necrosis did not occur.

Case 2

A 16-year-old female was thrown onto the road from the back seat of a motorcycle, and injured her right foot. Radiographs revealed a sagittal fracture of the talar body with subtalar and ankle dislocation and a medial malleolar fracture. Open reduction and internal fixation was performed 16 days after the injury. Aseptic necrosis was diagnosed in the lateral part of the talar body when Hawkin's sign could not be observed 2 months after the operation (Fig. 2). Non-weight bearing for 6 months was advised. The clinical outcome was good because there was no pain and the patient had a normal gait, whereas an X-ray revealed a slight depression on the weight bearing surface of the talar trochlea and mild degenerative changes in the subtalar joint.

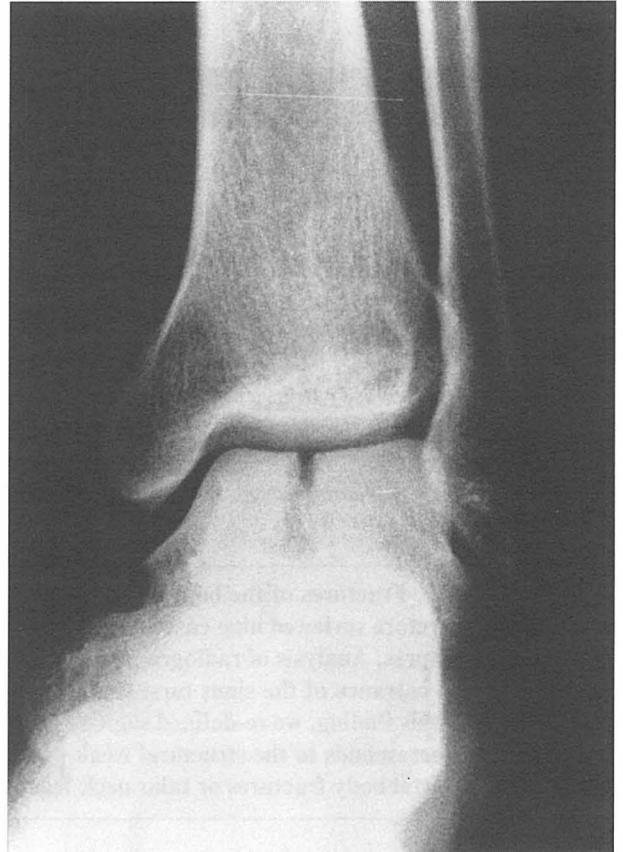


Fig. 1—Case 1. A 43-year-old male fell from a height and injured his left foot. The typical appearance of the sagittal fracture was revealed in the anteroposterior view of the radiograph.

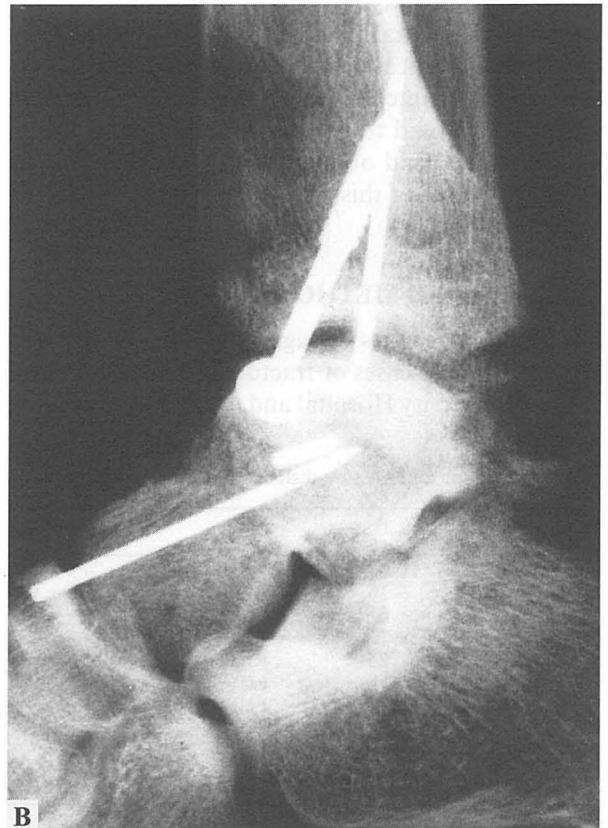
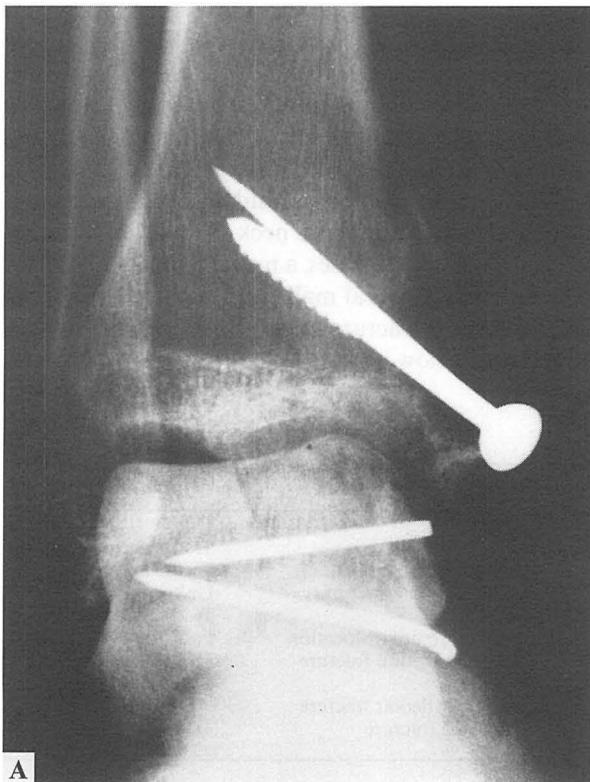


Fig. 2—Case 2. A 16-year-old female injured her right foot in a traffic accident. 2 months after the operation, aseptic necrosis occurred in the lateral fragment. (A) Anteroposterior view. (B) Lateral view.

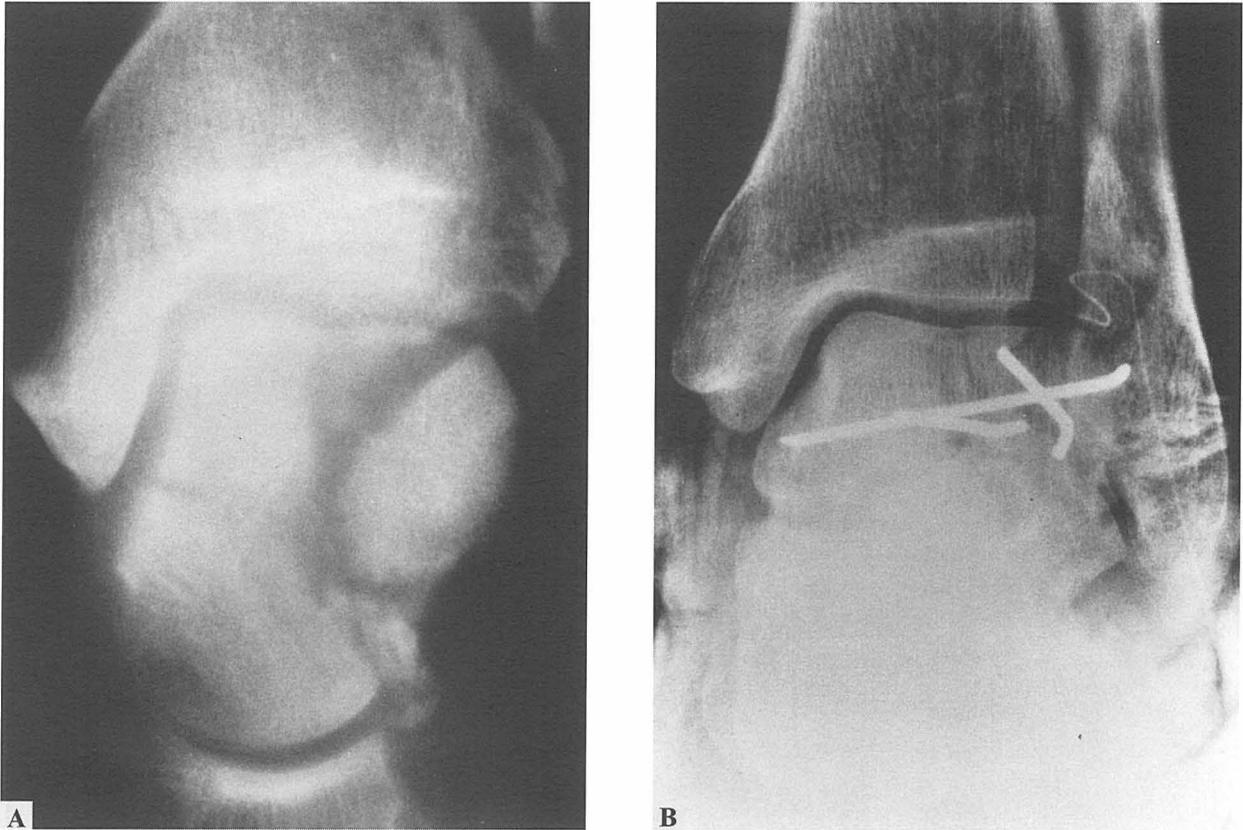


Fig. 3—Case 6. A 58-year-old male. (A) Tomography revealed the sagittal fracture of the trochlea combined with the neck fracture. (B) A radiograph just after reduction demonstrated the typical line of a sagittal fracture.

Case 6

A 58-year-old male injured his left foot in a fall from a height. Radiographs revealed both a body fracture in the sagittal plane and a neck fracture in the frontal plane of the same talus (Fig. 3). The former was reduced and fixed with a screw, and the latter with a Kirschner wire. Aseptic necrosis did not occur. Bone atrophy was observed, but no degenerative changes 6 months later.

Case 9

A 6-year-old boy injured his left foot in a traffic accident. A sagittal fracture of the talar body, a medial malleolar fracture and a calcaneal fracture were diagnosed radiologically (Fig. 4). Active exercise was started without weight bearing after plaster immobilization for 4 weeks. There was no pain or gait disturbance, but the deformity of the talar trochlea persisted.

DISCUSSION

1. Rate of occurrence

Sneppen et al¹ classified fractures of the talar body in the following manner, according to rate of occurrence:

1. Compression fractures.
2. Coronary shearing fractures.
3. Sagittal shearing fractures.
4. Fractures of the posterior tubercle.
5. Fractures of the lateral tubercle.
6. Crush fractures.

They defined fractures in the sagittal plane which occurred as a result of shearing force, as sagittal shearing fractures, but they did not report the rate of occurrence of this fracture independently. We found nine cases of sagittal fracture of the talar body among 206 cases of fracture of the talus, and the rate of occurrence was estimated at 4.4% of all talar fractures. Brinkmann et al² classified similar fractures as 'Sagittale Korperfraktur' and reported 14 cases among 1893 cases of talus fractures, amounting to 0.7% of the total.

Zifko et al³ reported 12 cases among 137 talus fractures, peripheral fractures excluded, and the rate of occurrence was estimated at 8.8%. The former paper reported the rate of occurrence based on the number of cases inclusive of peripheral talus fractures, and the latter paper confined itself to major fractures. This is why the rates in some reports are more than 10 times those in others.

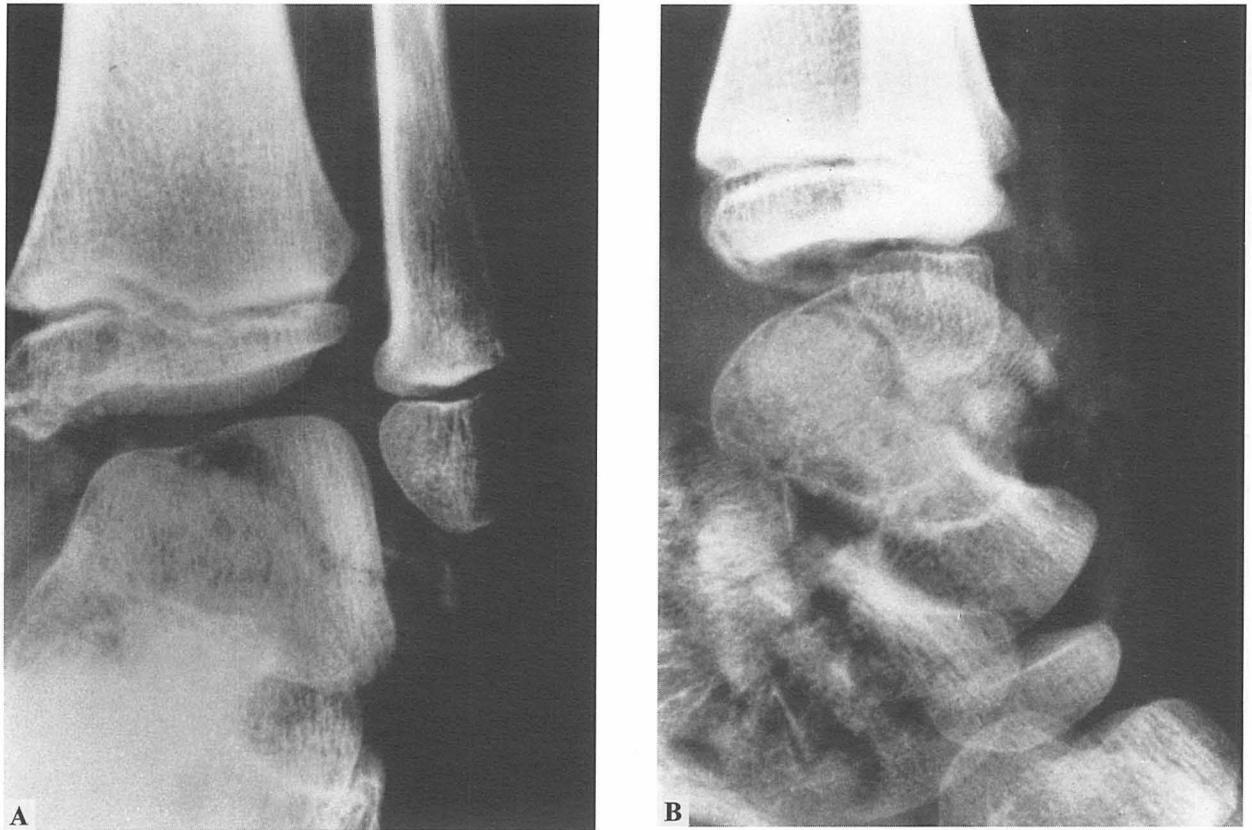


Fig. 4—Case 9. A 6-year-old boy. Sagittal fracture with a calcaneal fracture. (A) Anteroposterior view. (B) Lateral view.

2. Definition of sagittal fracture

Sneppen et al¹ defined fractures which occur in the vertical plane as shearing fractures. They defined fractures whose plane is close to the sagittal plane as sagittal shearing fractures. On the other hand, they called the fractures whose plane is close to the coronal plane as coronal shearing fractures. According to their definition, we found 20 cases of sagittal fracture, whose angle was within 45° of the longitudinal axis of the talar trochlea in our series. We have separated these cases into two groups, one group of nine fractures whose angle ranged between 10 and 15° with a laterally anterior open angle, and reported them as sagittal fractures in this paper. The other group consisted of 11 fractures whose angle ranged between 30 and 40° medially. The fracture line in the first group ran from the lateral entrance of the sinus tarsi to the sulcus of the flexor hallucis longus and was clearly seen as a vertical line on the talar trochlea in the routine anteroposterior X-ray view. The fracture lines in the second group ran from the medial entrance of the sinus tarsi to the lateral border of the posterior subtalar joint surface and could not be seen clearly in routine anterior-posterior view. Therefore, in spite of the fact that the latter fractures fit Sneppen's definition of sagittal fracture, they should not be called sagittal fractures. We propose to define sagittal fractures as

fractures which run from the lateral, not the medial, entrance of the sinus tarsi to the sulcus of the flexor hallucis longus on the inferior surface of the talus (Fig. 5). This definition is clear and specific, because almost all talar fractures in our series ran through the medial entrance of sinus tarsi on the inferior surface of the talus, and only less than 10% did not.

3. Pathomechanics

The cause of sagittal fractures has been reported to be as follows. The medial malleolus is fractured first, and the wedge of the malleolar fracture then breaks the trochlea. However, only two medial malleolar fractures were found in nine cases of sagittal fracture. This means that this wedge is not essential for sagittal fractures of the talus to occur. On the other hand, the mechanism is very similar to the usual explanation of the cause of the talar neck fractures, that is, that the anterior edge of the tibia strikes the neck of the talus and breaks it when the ankle dorsiflexes beyond its range. Peterson et al⁴ proved experimentally that the cause of neck fracture is concentration of stress onto the neck of the talus which is one of its weakest points structurally. Therefore, we can conclude that the cause of sagittal talar body fracture is the same as that of fractures of the talar neck and that they occur as

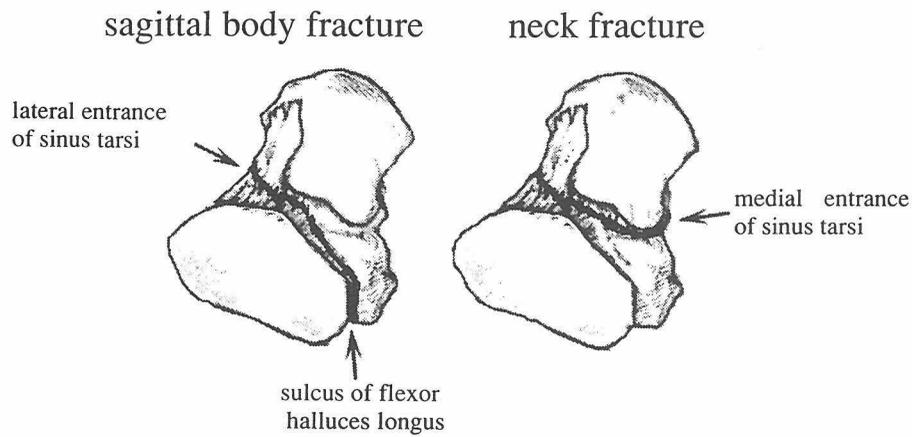


Fig. 5—A sagittal fracture runs from the lateral entrance of the sinus tarsi through the groove for the flexor hallucis longus tendon, just behind the medial tubercle on the inferior surface of the talus. A neck fracture runs from the same point through the medial entrance of the sinus tarsi just in front of the medial tubercle.

follows. If a large force acts on the sole of the foot with the ankle rigidly fixed, the stress concentrates at the weakest structural point in the talus. Hence, sagittal fractures occur on the line between the lateral entrance of the sinus tarsi and the sulcus of the flexor hallucis longus, which is one of the weakest structural points in the talus. Moreover, talar neck fractures were complicated by other fractures in the same talus in two cases of sagittal talar body fracture. This observation supports the idea that both sagittal talus body fractures and talar neck fractures occur in the same fashion.

CONCLUSION

We report nine sagittal talar body fractures. They are very rare fractures, and their rate of occurrence is

estimated as a few percent of major fractures of the talus. These fractures were characterized by distinctive fracture lines between the lateral entrance of the sinus tarsi and the sulcus of the flexor hallucis longus. We re-defined them based on this observation in X-ray film. We conclude that the mechanism of these fractures is the same as that of fractures of the talar neck.

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