Concurrent occurrence of Achilles tendon rupture and medial malleolar fracture of the ankle joint: a case report

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Abstract

A 32-year-old male jumped backward from the load-carrying platform of a truck (approximately 1.6 m high), and sustained Achilles tendon rupture and medial malleolar fracture of the ankle joint. These simultaneous injuries are considered to have different injury mechanisms according to previous reports, and we consider our case to correspond to axial impact and external rotation type injuries: in the pronated position, reflex contraction of the triceps surae muscle could occur and rupture the Achilles tendon on landing, while an external rotatory force with axial loading could be exerted on the foot causing fracture of the medial malleolus of the ankle joint. This injury combination is rare, and it is important to take into account the possibility of such complicated injuries at first examination, and to obtain both detailed physical findings and accurate imaging findings.

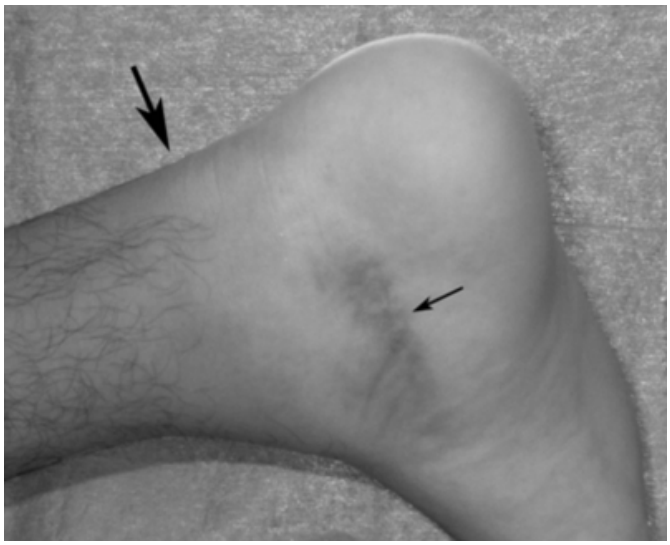
INTRODUCTION

Although Achilles tendon rupture and medial malleolar fracture of the ankle joint are common in routine medical practice, their concurrent occurrence is rare. In this report, we present a case in which Achilles tendon rupture and medial malleolar fracture occurred concurrently. In addition, the injury mechanism and diagnostic problems are discussed with reference to previous reports.

CASE REPORT

A 32-year-old male sergeant wearing Japanese army boots jumped backward from the load-carrying platform of a truck (approximately 1.6m high). He injured his right foot and was unable to walk. He visited a physician and received splinting on the day of injury, and was referred to our department on the following day. At the first examination, swelling, flare and subcutaneous hemorrhage were noted in the medial to posterior region of the right ankle joint. There was localized tenderness in the base region of the medial malleolus, and a concavity at approximately 3 cm proximal to the calcaneus attachment site of the Achilles tendon (Fig. 1). Thompson sign was positive. No other physical abnormality was observed. Plain X-ray radiography showed medial malleolar fracture of the ankle joint with a small dislocation density in the frontal view, and continuity disruption of the Achilles tendon in the lateral view (Fig. 2).

Figure 1



The injured ankle at the first visit. Localized tenderness and purpura in the base region of the medial malleolus (small arrow), and a concavity of the Achilles tendon (large arrow) were recognized on clinical examination.

Figure 2

Radiographs at the first visit.

A: Medial malleolar fracture with a small dislocation was noted in the A-P view (arrow).

B: The continuity disruption of the Achilles tendon was suggested in the lateral view (arrow).

Surgery was performed 5 days after injury. In the supine position, the medial malleolar bone fragment was reduced and fixed with a screw and K-wire through a small skin incision under fluoroscopy. The patient was then moved into the prone position, and the completely ruptured Achilles tendon was end-to-end anastomosed under direct vision (Fig. 3). Subsequently, the ankle joint was fixed in slight plantar flexion by casting for 5 weeks. Partial weight bearing was initiated 6 weeks after surgery, and complete weight-bearing walking was started 9 weeks after surgery. The screw and K-wire were removed approximately 16 months after surgery. As of approximately 24 months after surgery, the patient has felt a slightly strange sensation after work or sports. According to the standard rating system (ankle/hind-foot scale) of the Japanese Society for Surgery of the Foot (JSSF) [1, 2], the scores of pain, function and alignment were 30, 50 and 10, respectively; and the total score was 90.

Figure 3

Radiographs after surgery.

A: A-P view

B: Lateral view

DISCUSSION

PUBLISHED DATA

Achilles tendon rupture and medial malleolar fracture are often observed independently in routine medical practice, but their concurrent occurrence is rare. To our knowledge, there have been only 6 case reports of concomitant Achilles tendon rupture and medial malleolar facture in the English literature (Table 1) [3-8]. The causes of these concomitant injuries were a motor vehicle accident in 1 case, sport accidents in 2, and a fall or false step on stairs or a ladder in 3.

Concomitant Achilles tendon rupture and medial malleolar facture due to alpine skiing accidents have been described in some reports [9-12]. Moritz[9] and Clayton[10] describe such concomitant injuries caused by skiing accidents, but the number or frequency of cases is not indicated. Lugger et al. [11] reported in 1977 that Achilles tendon rupture caused by an alpine skiing accident was complicated by medial malleolar fracture in 10 (5.3%) of 189 cases, and this ratio had not changed in the past 15 years. Obrist et al.[12] reported in 1989 that, out of 408 cases of Achilles tendon rupture caused by alpine skiing accidents, 41 cases (10.0%) also exhibited osteopathy and 37 cases (9.1%), medial malleolar fracture. Based on the above 2 reports, approximately 5 - 9% of cases of Achilles tendon rupture caused by alpine skiing accidents were complicated by medial malleolar fracture. To our

knowledge, only one case of such concomitant injuries caused by an alpine skiing accident has since been reported in Japan (oral presentation). Since the incidence of injury to the foot including the ankle joint has generally decreased as ski boots and bindings are developed, improved and spread,[10, 13, 14] the incidences of these concomitant injuries may have subsequently decreased. Furthermore, the improvement of alpine ski devices might have contributed specifically to the prevention of these injuries.

Obrist et al.[12] report that, of 222 cases of Achilles tendon rupture with causes other than alpine skiing accidents, 5 (2.3 %) were complicated by medial malleolar fracture (causes were non-skiing sport accidents in 3 cases and non-sport accidents in 2), in total, including the 37 cases caused by alpine skiing accidents, 42 (6.6 %) of 630 cases of Achilles tendon rupture were complicated by medial malleolar fracture.

Based on the above, the frequency of Achilles tendon rupture complicated by medial malleolar fracture is estimated to be approximately 2 - 9%, showing that these concomitant injuries are relatively rare.

Figure 4

Table 1. Cases of concurrent occurrence of Achilles tendon rupture and medial malleolar fracture of the ankle joint

Reference number	Reported year	Author	Age	Sex	Cause of injury	Suggested type of injury
—	—	Current report	32	Male	Fall (1.6-m height)	Type 1
3	2006	Maffulli et al	38	Male	Fall (6-m height)	Type 1
4	2002	Assal et al	35	Male	Fall (2-m height)	Type 1
5	2000	Lubin et al	40	Male	Fall (0.6-m height)	Type 1
6	1998	Pieper et al	45	Male	Throwing of basketball	Type 1
7	1993	Barron et al	30	Female	Exercise (Gymnastics)	Type 1
8	1986	Martin et al	61	Male	Motor vehicle accident	Type 2

INJURY MECHANISM

The mechanism of these concomitant injuries is inconsistent among previous reports: Achilles tendon rupture precedes medial malleolar fracture in some cases, and vice versa in others. Moreover, the presumed cause of medial malleolar fracture is eversion in some cases, and inversion in others.

Lauge-Hansen[15, 16] classified malleolar fractures based on the injury mechanism in an experiment using amputated legs. Medial malleolar fracture corresponds to one of the following 3 types of injury: stage I of a pronation-external rotation (PER) injury, stage I of a pronation-abduction (PA) injury, and stage I of a pronation-dorsiflexion (PD) injury. Among 6 cases in the previous reports which refer to the Lauge-Hansen classification, 5 cases correspond to PER or PA injury, and 1 to PD injury. Since solitary medial malleolar fracture does not occur in supination-external rotation (SER) injury or supination-adduction (SA) injury, medial malleolar fracture in these cases could not have been caused by inversion.

Since contraction of the triceps surae muscle creates inversion motion of the subtalar joint with ankle flexion, the pronated position or eversion motion of the foot causes hypertension of the Achilles tendon [17]. Therefore, medial malleolar fracture and Achilles tendon rupture might occur concomitantly in the pronated position or during hyper-eversion motion of the foot. The foot should always be in the pronated position in alpine skiing, which may be a reason why relatively many investigators have reported these concomitant injuries in alpine skiing. On the contrary, the tension of the Achilles tendon may be relieved in the supinated position or during inversion motion of the foot. Therefore, lateral malleolar fracture and Achilles tendon rupture could not occur concomitantly.

Complication of Achilles tendon rupture suggests the presence of axial loading as the external force causing injury, but axial load is not taken into consideration in the experiment performed by Lauge-Hansen. Funk et al.[18] investigated the relationship between the axial loading noted in traffic injuries and malleolar fracture in cadavers, and showed that axial loading increases the compatibility of the talocrural joint and its stability against the external rotatory force. Thus, external rotatory force loaded with axial impact reaches a maximal value at a small rotation angle, and causes malleolar fracture.

Based on the above, concomitant Achilles tendon rupture and medial malleolar facture are considered to be classified into the following 2 types based on their injury mechanisms: 1) Axial impact and external rotation type injury (Stage I PER injury in the presence of axial impact), and 2) Excessive dorsal flexion type injury (Stage I PD injury). Hyper-eversion motion, axial impact or excessive dorsal flexion may cause strong contraction of the triceps surae muscle which may result in Achilles tendon rupture. Therefore, axial impact and external rotation type injury may occur when external rotation or hyper-eversion force is

loaded in the pronated position in the presence of axial impact on the middle sole which is insufficient to cause plafond fracture. Excessive dorsal flexion type injury may occur when strong dorsal flexion force is loaded on the sole of the forefoot in the pronated position.

Based on the conditions at the time of injury, our case might be caused by the type 1 injury mechanism of "Axial impact and external rotation type injury". In the pronated position, reflex contraction of the triceps surae muscle might occur and rupture the Achilles tendon on landing, and an external rotatory force with axial load might be applied to the foot and fracture the ankle joint's medial malleolus.

DIAGNOSTIC PROBLEMS

Obrist et al.[12] report that Achilles tendon rupture was not accurately diagnosed at first examination in 2 of 42 cases of these concomitant injuries. In at least 3 reported cases, medial malleolar fracture or Achilles tendon rupture was not accurately diagnosed at the first examination.[5, 7, 8] In these reports, Achilles tendon rupture was diagnosed based on the physical findings, but medial malleolar fracture was overlooked because only the lateral view was acquired on plain X-ray examination. In contrast, at an emergency outpatient clinic, medial malleolar fracture was diagnosed by plain X-ray radiography without detailed physical findings and Achilles tendon rupture was overlooked. It is therefore important to consider concurrent occurrence of Achilles tendon rupture and medial malleolar fracture at first examination, and to obtain both detailed physical findings and accurate imaging findings.

The patient was informed that data from the case would be submitted for publication, and gave his consent.

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