The Journal of Foot & Ankle Surgery 50 (2011) 430–433

Contents lists available at ScienceDirect

The Journal of Foot & Ankle Surgery

journal homepage: www.jfas.org

Misdiagnosis of OTA Type B (Weber B) Ankle Fractures Leading to Nonunion

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ARTICLE INFO

Level of Clinical Evidence: 2
Keywords:
complication
fibula
open reduction internal fixation
pathogenesis
surgery
trauma

ABSTRACT

Little is known about the specific etiology of nonunion of stable Orthopaedic Trauma Association (OTA) type B fractures. In the present retrospective cohort study, we investigated all patients with a nonunion in a level 1 trauma center during an 8.5-year period. Patient history, clinical findings, radiographic features, and therapeutic aspects were critically evaluated to be able to predict the nonunion. In the predefined period, 388 patients were treated for a stable OTA type B fracture. Eight patients (2.1%) developed a nonunion. Retrospectively, the radiographic features in 6 of the 8 patients and clinical findings in 1 of the 8 patients could predict the nonunion. We conclude that in almost every nonunion occurring after a "stable" OTA type B fracture in the present study were, in fact, originally unstable fractures.

The systemic and local factors associated with the nonunion of fractures in general are pretty well understood. However, the etiology of nonunions in specific fractures can be less clear. The mechanisms of nonunion of the distal fibula have been a topic of research in the past. Almost 40 years earlier, Sneppen (1) found that pseudarthrosis was associated with fractures involving the medial malleolus, fractures of the supination type, and varus displacement of the talus. However, much has changed since then, and unstable ankle fractures are almost invariably surgically treated, dramatically reducing the incidence of non- and malunions. Nonunion after a stable Orthopaedic Trauma Association (OTA) type B fracture of the lateral malleolus is a relatively rare, but disabling, complication. Moreover, end stage ankle osteoarthritis occurs significantly more quickly after nonunion (2).

An estimation of the incidence of fibular nonunion after proper conservative treatment of stable OTA type B fractures and a reassessment of the risk factors has not been performed since the study by Sneppen (1). The aims of the present study were to assess the incidence of nonunion in conservatively treated, stable OTA type B ankle fractures, and to analyze the risk factors that might have attributed to this adverse condition. Another aim of our study was to estimate the incidence of nonunion in stable OTA type B ankle fractures to determine whether computed tomography (CT) or magnetic resonance imaging (MRI) is justified to identify covered instability on conventional radiographs. Our hypothesis is that the most important local factor to explain a nonunion after an OTA type B fracture is the underestimation of instability.

Patients and Methods

Patient Selection

Using a prospective electronic medical record system, all patients visiting the St. Elisabeth Hospital (level 1 trauma center) from January 1, 2000 to January 8, 2008, who were treated conservatively for a stable OTA type B ankle fracture, were identified. All patients referred from other hospitals were excluded. The database was searched using the "International Classification of Disease, 10th edition," code for lower leg fractures (code S82*), as well as free text for the terms "Weber B," "supination," and "eversion." Within this search, a new search was performed using the "International Classification of Diseases, 10th edition," code for pseudarthosis (code M84.1) and nonunion (code M96.0) and the free text for the terms "pseudarthrosis," "nonunion," "non-union," and "non union" (in the Dutch language). All medical records of the patients with a positive match for this search strategy were selected for detailed review.

Study Parameters

The following items were assessed:

1. Patient characteristics, history, and clinical findings: age, gender, fracture site, smoking, diabetes mellitus, corticosteroids, body mass index, alcohol abuse, and osteoporosis and evidence of medial malleolar pain, hematoma, or swelling in the acute and chronic phase.
2. Radiologic features known to be relevant for fracture classification: tibiotalar incongruity, medial (avulsion) fracture, medial joint space widening, talar tilt, secondary dislocation, fibular shortening, and indications of medial injury on later CT scans.

Financial Disclosure: None reported.
Conflict of Interest: None reported.

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doi:10.1053/j.jfas.2011.04.031

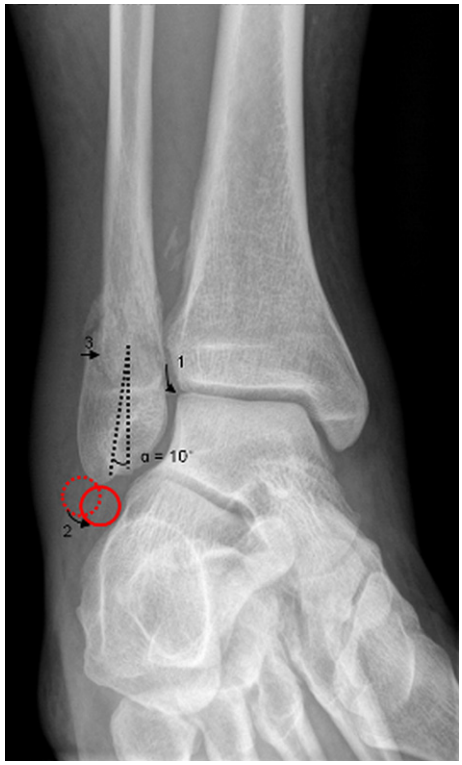

Fig. 1. Shenton's line. *Arrow 1* shows a 4-mm too proximal fibular notch. *Arrow 2* shows where Shenton's line (a small "coin" in the facies articularis and recessus peronealis) should be (uninterrupted circle). *Arrow 3* shows 3-mm lateral displacement of distal fibular fracture fragment. Fragment is 10° angulated. Dubious talar tilt is present.

3. Treatment aspects: treatment type and duration and interval to the diagnosis of nonunion and definite surgical treatment.

For each patient, the risk factors for nonunion were scored as present, not present, or unknown (not available) if because of inadequate documentation, no information could be obtained. All individual radiologic features were scored after discussion and agreement by all of us. According to our hospital protocol, every patient underwent at least 3 sets of radiographs (anteroposterior, mortise, and lateral view). A first set of radiographs to determine the diagnosis at the emergency department was followed by a second set of radiographs to determine the correct position of the ankle in a cast. One week later, a third set of radiographs of the ankle without the cast was performed to check whether conservative treatment could be continued. Medial joint space widening of 2 mm or more on any mortise view during treatment was scored as positive. If we detected progressive distal fibular fragment dislocation on the successive radiographs and if the patient had not undergone surgical treatment, secondary dislocation was scored as positive as a cause of nonunion. Fibular shortening was scored as positive when significant proximal displacement of the fibular notch (Shenton's line) and disruption of the 1/3 imaginary circle formed by the facies articularis of the lateral malleolus and the recessus peronealis were present (Figure 1).

Treatment Protocol

In our hospital, patients with malleolar fractures are treated in conformance with a strict protocol (3). All OTA type B fractures are subdivided into supination-eversion (SE) type II, III, and IV injuries according to the Lauge Hansen classification system (4). SE type II and III injuries are considered stable and were therefore treated conservatively. SE type IV injuries are considered unstable and were therefore treated with open reduction and internal fixation.

Results

In the predefined study period, 388 patients sustained an isolated lateral malleolar fracture (OTA type B) that was considered stable and was therefore treated conservatively (46 patients/year). Of these 388 patients, 8 (2.1%) developed a nonunion. All relevant items in the patient history of this subset are summarized in Table 1. The average age ± standard deviation at injury was 49 ± 20 years. Of the 8 patients, 5 were women; 4 fractures were right sided. At the initial presentation, 1 patient (patient 1) had medial malleolar swelling and pain, and 4 did not (patients 2, 3, 4, 5). For 3 patients (patients 6, 7, 8), no information on medial injury was stated in the medical record. Patients 2 and 5 had documented osteoporosis, patients 3 and 6 had known type 2 diabetes. None of the patients was known to have a history of alcoholism. The mean body mass index was 27.1 ± 4.1 kg/m^2.

The radiodiagnostic features are listed in Table 2. No clue for the development of a nonunion was found in the diagnostic imaging findings of patients 1 and 2. No CT or MRI scan was performed for patient 1. In patient 3, the lateral displacement of the distal fibular fragment increased from 2 mm at the emergency department to a maximum of 5 mm on a follow-up radiograph the next week. In the subsequent 6 months, patient 3 did not receive additional surgical reduction or stabilization of the distal fragment. Patient 4 had an avulsion fracture of the medial malleolus that was also seen on the CT scan approximately 3 months after the injury. For patient 5, radiographs showed minor valgus talar tilt and questionable medial joint space widening. A CT scan 16 weeks later showed evidence of medial involvement expressed in a medial talus cyst. Patient 6 had a 4-mm fibular notch shortening on the initial photographs taken 6 weeks after trauma. Because of later substantial calcifications in the area of the interosseous membrane, it was concluded that the membrane must have been ruptured. Patient 7 had tibiotalar incongruity with marked valgus talar tilt on the initial radiographs. In patient 8, a radiograph 15 weeks and a CT scan 19 weeks after trauma showed a medial malleolar avulsion fracture.

The various treatment aspects are shown in Table 3. The median duration of conservative fracture treatment was 13 weeks (range 6 to 33), varying from weight and non-weightbearing casts, tape bandage, a stabilizing shoe (5), and physiotherapy. Before his first hospital visit, patient 6 was treated with a tape bandage for 6 weeks by his family doctor. No other patient was referred from their family doctor. The

Table 1
Statistical description of the 8 cases (2.1% of 388 patients) identified with a nonunion associated with an isolated lateral malleolar fracture (OTA type B)

Variable	Patient No.							
	1	2	3	4	5	6	7	8
Age (y)	36	66	84	57	32	56	38	23
Gender	Male	Female	Female	Female	Male	Male	Female	Female
Fracture side	Left	Right	Right	Left	Right	Right	Left	Left
Medial malleolar swelling or pain	Yes	No	No	No	No	NA	NA	NA
Body mass index	24	28	27	25	27	31	21	34
Diabetes mellitus	No	No	Yes	No	No	Yes	No	No
Osteoporosis	No	Yes	No	No	Yes	No	No	No
Smoking	No	No	No	No	Yes	No	Yes	No
Use of corticosteroids	No	No	No	No	No	No	No	No

Abbreviation: NA, not available.