ANKLE INJURIES

Isadore G. Yablon, M.D.
David Segal, M.D.
Robert E. Leach, M.D.

CHURCHILL LIVINGSTONE

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Edited by

Isadore G. Yablon, M.D.
Professor of Orthopaedic Surgery
Director of Research
Department of Orthopaedic Surgery
Boston University School of Medicine
Boston, Massachusetts

David Segal, M.D.
Professor of Orthopaedic Surgery
Department of Orthopaedic Surgery
Boston University School of Medicine
Director
Department of Orthopaedic Surgery
Boston City Hospital
Boston, Massachusetts

Robert E. Leach, M.D.
Professor and Chairman
Department of Orthopaedic Surgery
Boston University School of Medicine
Boston, Massachusetts

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CONTRIBUTORS

A. Seth Greenwald, D. Phil. (Oxon)
Executive Director
Cleveland Research Institute
Cleveland, Ohio

Robert E. Leach, M.D.
Professor and Chairman
Department of Orthopaedic Surgery
Boston University School of Medicine
Boston, Massachusetts

G. Richard Paul, M.D.
Associate Professor of Orthopaedic Surgery
Department of Orthopaedic Surgery
Boston University School of Medicine
Associate Director
Department of Orthopaedic Surgery
Boston City Hospital
Senior Attending Orthopaedic Surgeon
Boston University Hospital and
Boston University Medical Center
Boston, Massachusetts

Robert Y. Pick, M.D.
Instructor in Orthopaedic Surgery
Department of Orthopaedic Surgery
Boston University School of Medicine
Associate Director
Department of Orthopaedic Surgery
Boston City Hospital
Boston, Massachusetts

Anthony Schepsis, M.D.
Instructor in Orthopaedic Surgery
Department of Orthopaedic Surgery
Boston University School of Medicine
Boston, Massachusetts

David Segal, M.D.
Professor of Orthopaedic Surgery
Department of Orthopaedic Surgery
Boston University School of Medicine
Director
Department of Orthopaedic Surgery
Boston City Hospital
Boston, Massachusetts

Isadore G. Yablon, M.D.
Professor of Orthopaedic Surgery
Director of Research
Department of Orthopaedic Surgery
Boston University School of Medicine
Boston, Massachusetts

PREFACE

The subject of ankle injuries has for a long time been embedded in controversy. Strong differences of opinion exist regarding the preferred method of treatment, the length of time immobilization is necessary, the postreduction management, and the criteria of what constitutes an acceptable reduction.

In this book we have attempted to address these questions on the basis of personal, clinical, and experimental experience involving large numbers of cases. Where our conclusions depart from traditional methods, the reasons for these departures are given and justified not only on the basis of our own observations but on the experience of others who have done work in this field.

The surgical and postoperative management have, in certain instances, been given in some detail because we believe that the results obtained will be more predictable if salient operative principles are emphasized and important procedural techniques clarified.

The aim has been to provide the reader with an approach which is practical, achieves uniformly satisfactory results, and affords the patient a much-improved chance for success.

We wish to express our thanks to our secretaries, Sue-Ann Brown, Tyra Anderson, Joanne Catarius, and Kathleen Ashman for their invaluable assistance in the preparation of the manuscript, to David Heskiaoff for his assistance in the biomechanical studies, and finally to Lewis Reines of Churchill Livingstone for his understanding and endless patience.

Isadore G. Yablon
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1 Introduction

David Segal, M.D.

FUNCTIONAL ANATOMY

Ankle trauma may vary from a mild ligamentous sprain to a severe disruption of the articular surfaces. The ankle joint comprises the distal tibial articulating surfaces, with extensions on each side consisting of the medial and lateral malleolus. Together, these structures form the ankle mortise, into which the talus fits snugly, creating a complex hinge-type motion: dorsiflexion combined with external rotation, and plantarflexion with internal rotation. Approximately 50 percent of the talus is covered by articular cartilage, and during the normal motion of dorsi- and plantarflexion, different portions of the articulating surfaces come in close contact with the ankle mortise. The stability of the ankle joint is provided by the configuration of the mortise, also known as "the malleolar fork," and by the ligamentous structures.

Two groups of ligaments are directly related to the stability of the ankle joint. On the lateral side (Fig. 1-1) are the syndesmotic ligaments, which include the anterior tibiofibular ligament, the posterior tibiofibular ligament, the inferior transverse ligament, and the interosseous ligament. The anterior tibiofibular ligament has strong fibers extending from the distal tibia (anterior tuberosity) in a downward and lateral direction to insert into the anterior aspect of the distal fibular. The posterior tibiofibular ligament extends across the posterior aspect of the tibia and fibula; the inferior transverse ligament extends between the lateral malleolus and the posterior aspect of the tibia, distal to the posterior tibiofibular ligament (Fig. 1-2). The interosseous membrane extends down the respective sides of the tibia and fibula and expands distally to form the interosseous ligament, which binds together the opposed,

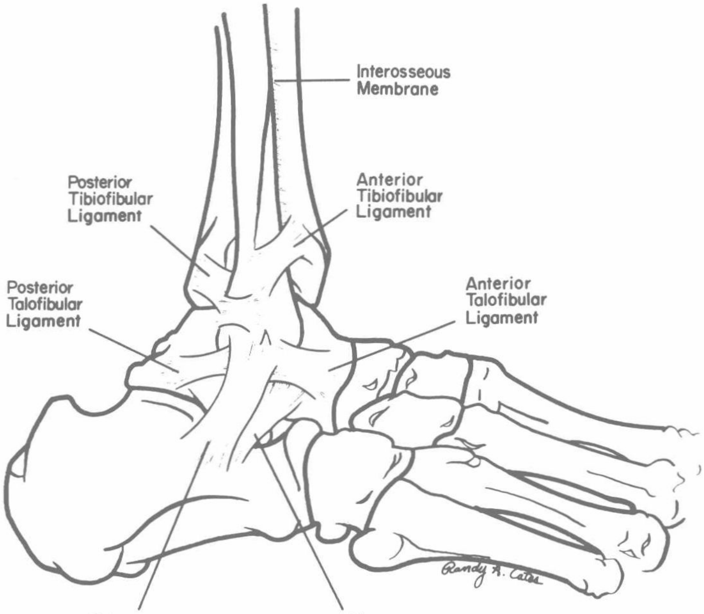

Fig. 1-1. Two distinct groups of ligaments are present at the ankle joint: the syndesmotic ligaments, stabilizing the distal tibiofibular articulation; and the fibular collateral ligaments, stabilizing the tibiotalar and subtalar joints. The latter group includes the anterior and posterior talofibular ligaments, the talocalcaneal ligament, and the calcaneal fibular ligament.

triangular areas of the distal tibiofibular joint. The other group of ligaments are the fibular collateral ligaments (anterior and posterior talofibular, calcaneofibular, and posterior talocalcaneal), which stabilize the talofibular and subtalar joints.

The ligaments that originate at the distal aspect of the lateral malleolus—the anterior and posterior talofibular ligaments and the calcaneofibular ligament—are not usually involved in ankle fractures, but play a considerable role in stabilizing the talus, preventing talar tilt and anterior displacement. These ligaments are injured most frequently in ankle sprains. The joint capsule is not a stabilizing structure of the ankle joint and will be considered separately.

The medial collateral or deltoid ligament is present on the medial side of the ankle (Fig. 1-3). The literature describing the layers of the deltoid ligament is somewhat confusing. Bonnin[3] described the deltoid ligament as a single layer divided into three parts which blend into each other: the anterior and posterior tibiotalar, and the tibiocalcaneal ligaments. Grath[12] divided the deltoid ligament into superficial and deep parts, considering the tibionavicular and tibiocalcaneal ligaments to represent the superficial part, and the anterior

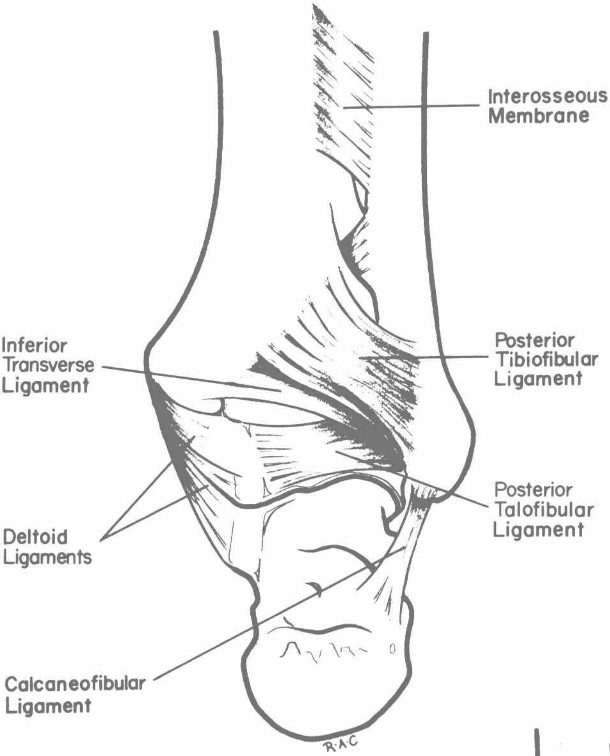

Fig. 1-2. The posterior aspect of the ankle joint, illustrating the inferior transverse ligament distal to the posterior tibiofibular ligament.

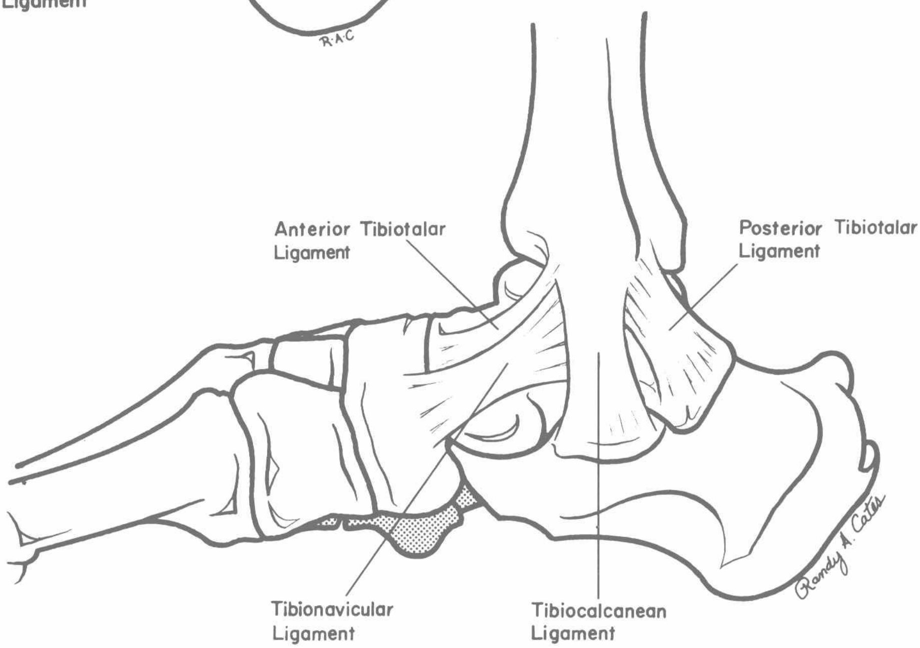

Fig. 1-3. The four components of the deltoid ligament, with the posterior tibiotalar ligament representing the deep and strongest part of the ligament.

and posterior tibiotalar ligaments to represent the deep part of the deltoid ligament.

The 35th British edition of Gray's Anatomy,[13] describes the deltoid ligament as consisting of two layers: a superficial and a deep layer. The superficial fibers fan out in three directions. The tibionavicular fibers run anteriorly, the tibiocalcaneal are the middle fibers, and the tibiotalar are the posterior fibers. The deep layer consists of the anterior tibiotalar fibers, which originate from the tip of the medial malleolus and insert into the nonarticulating medial surface of the talus.

A new and more recent description of the deltoid ligament has been published by Pankovich,[24] in which the superficial and deep parts have been described in detail. The superficial part consists of tibionavicular, tibiocalcaneal, and tibiotalar fibers, all originating from the anterior colliculus of the medial malleolus. The deep part of the deltoid ligament consists of the anterior and posterior tibiotalar ligaments, which are primarily attached to the posterior colliculus and the intercollicular groove. It is the deep part of the deltoid ligament that is considered to be the strongest layer. While an isolated tear of the deltoid ligament is a rare occurrence, the ligament is frequently torn in conjunction with distal fibular fractures.

The ankle is the most congruous joint in the lower extremity,[30] bearing up to five times the body weight.[29,31] Ramsey and Hamilton[25] have demonstrated that 1 millimeter of lateral displacement of the talus causes a 42 percent reduction in the tibiotalar articulation. With further lateral displacement of the talus, the tibiotalar contact area was progressively reduced, but to a lesser degree. Many clinical studies of ankle fractures have proven that good results depend upon an anatomic reduction of the fracture, and there is a direct correlation between displaced fractures and the occurrence of degenerative arthritis.[4,5,20,23,32] Brodie and Denham[4] found that "only nine out of thirty-nine patients who had malunion were symptom free." Burwell and Charnley[5] found arthritic changes in 25 percent of their patients who had a good reduction, but in all patients graded as having a poor reduction. Thus the displaced ankle fracture, left unreduced, will result 100 percent of the time in degenerative arthritis. Incomplete reduction of the fracture, with the talus displaced or tilted, will also result in degenerative arthritis, although this process may take many years, with the patient experiencing increasing disability. Rarely, late degenerative arthritis may occur despite an accurate reduction. It is thought that this is due to a crushing injury to the articular cartilage which alters the normal metabolic activity of the chondrocytes.[33]

Most ankle fractures occur when a force applied to the ankle displaces the talus beyond the normal elasticity of the ligaments. When this force is in an axial direction, vertical compression fractures of the tibial plafond will occur. On the basis of the position of the foot and the direction of the force, numerous classifications have been described, the most popular being that of Lauge Hansen's[19] (see Table 3-1). These classifications are important in understanding the mechanism of injury, and in the treatment of fractures by closed reduction. They are less important when surgical reconstruction is considered.

The surgical treatment of ankle fractures is aimed at achieving two goals:

1. Obtaining an anatomic restoration of the articular surfaces.
2. Providing stability to the ankle joint and allowing for normal function.

This is not to say that surgical reconstruction is the only method of treating ankle fractures in order to achieve these aims. Nonsurgical treatment of ankle fractures can also result in an anatomic reduction and good function, but accurate reduction is more predictable when surgical techniques are utilized. Open reduction combined with adequate internal fixation, and followed by early range-of-motion and weight-bearing exercises, has proved successful in treating ankle fractures, thus eliminating the side effects and morbidity of prolonged immobilization.

PHYSICAL EXAMINATION

Careful examination of the foot and ankle can provide the necessary information upon which to establish the accurate diagnosis of an ankle fracture. The decision of whether or not to obtain stress x-rays or to x-ray the entire fibula will depend on the history, physical examination, and type of injury.

Fig. 1-4. Displaced ankle fracture; note no swelling on immediate arrival.

Fig. 1-5. (A) Fracture of the lateral malleolus associated with tenderness at the medial malleolar area.

The presence of gross deformity of the ankle joint indicates significant displacement of the talus (Fig. 1-4). The talus is confined to the "malleolar fork," and its displacement beyond 2 mm is possible only by fracturing both malleoli or one malleolus combined with a ligamentous tear. Isolated dislocations of the talus without fractures have been rarely documented.[27] In the absence of an obvious deformity, tenderness and swelling at the malleoli or ligaments indicate a bony or ligamentous injury. A systematic examination of the ankle provides the working diagnosis, which is confirmed by appropriate

Fig. 1-5. *(continued).* (B) The same patient after external rotation and abduction stress was applied. The talus is displaced laterally, indicating a torn deltoid ligament.

radiographs. Swelling can be minimal in patients who are examined immediately, but these patients generally cannot bear weight on the injured extremity, and are often aware that a bone has been broken.

In contrast to the medial and lateral malleolar injuries, the fracture of the posterior lip of the tibia is best diagnosed and confirmed by x-rays rather than by physical examination, because of the overlapping tendons and soft tissues. Fractures of the posterior lip of the tibia, associated with a fractured

Fig. 1-6. (A) Fracture of the lateral malleolus with undiagnosed torn deltoid ligament treated by closed reduction.

malleolus, always indicate posterior displacement of the talus, and are evidence of significant trauma. Posterior lip fractures are of major significance when they involve 25 percent or more of the articular surface.[5,16,17]

Fractures of the lateral malleolus accompanied by tenderness along the medial side of the ankle joint should make one suspect a tear of the deltoid ligament. This is a very important observation, since it may indicate a far more significant injury than what is demonstrated on routine radiographs (Fig. 1-5A and B). Many displaced fractures are so unstable that they may be reduced as the extremity is splinted for radiologic examination. Stress x-rays are indicated in such instances, and will reveal the status of the deltoid ligament by a lateral shift of the talus. Similarly, fractures of the lateral malleolus, with tenderness over the distal anterolateral tibia area, may denote a

Fig. 1-6 *(continued).* (B) The same patient two weeks later; notice cast immobilization did not prevent lateral talar displacement.

tear of the anterior tibiofibular ligament (Fig. 3 Chapter 3). This can also be demonstrated by stress x-rays, in which a talar tilt will be present.

Fractures of the medial malleolus with tenderness along the middle or proximal fibular shaft may indicate a Dupuytren or Maisonneuve injury involving a medial malleolar fracture and a diastasis (see Chapter 4). Similarly, fractures of the distal fibular with tenderness over the deltoid ligament may indicate an unstable fracture. The "benign" appearance of the initial x-rays in such cases, combined with incomplete clinical and radiologic evaluation, will lead to misdiagnosis and mistreatment (Fig. 1-6A and B).

Examination of the foot and of the subtalar and metatarsal joints should be included in a complete examination of the ankle joint. Neurovascular complications are rarely associated with ankle fractures unless there is marked