

## INTRODUCTION

Management of these fractures depends on careful identification of the extent of bony injury as well as soft tissue and ligamentous damage.

### Mechanism of Injury

The vast majority of ankle fractures are sustained via a rotational mechanism. Patients may describe a twisting motion around a planted foot or a sudden inversion type injury when landing from a jump. The mechanism of the injury is similar to those sustained in simple ankle sprains and in fact represents the continuum of this injury.



Injuries often associated with ankle fractures are at times difficult to diagnose. The most commonly missed injuries include Achilles tendon ruptures, lateral process of the talus fractures, metatarsal fractures, and anterior process of the calcaneus fractures.

### History and Physical Examination

1. Mechanism of injury
2. P.M.H: neuropathy, diabetes, neurologic disorders, vascular insufficiency ulcers, history of smoking
3. Crucial information is the chronicity of the injury
4. The degree of swelling; Presence of fracture blisters (serous or blood filled)
5. Tenting of the skin associated with deformity is important. Do not wait for X rays, traction and reduce and padded Slab and then X rays.
6. Proximal to distal with palpation along the shaft of the fibula [Maisonneuve type of injury].
7. The “squeeze test” a diagnostic test for syndesmosis injury.
8. The external rotation test for syndesmosis stability
9. The Thompson test for the assessment of the continuity of the Achilles tendon
10. The anterior drawer test of the ankle for anterior talofibular ligament injury or an unstable fracture pattern.
11. Feel base of the fifth metatarsal, the anterior process of the calcaneus, lateral process of the calcaneus, as well as the Lisfranc joint.
12. Performing a stress test is the gravity stress view. During the gravity stress view, the patient lies in the lateral decubitus position on the side of the affected ankle with the distal leg, ankle, and foot allowed to hang dependent off the end of the table while a mortise view is obtained. This patient positioning, in effect, acts to impart an external rotational force as in the manual stress view.
13. Circulation check
14. Sensation should be tested. Even minor ankle sprains can be associated with superficial peroneal nerve

The motor examination should focus on the presence of toe motion and ankle motion. It is imperative that a full motor and sensory examination be completed before manipulation of the injured ankle and the findings documented before and immediately following the manipulation. Clearly, a dislocated ankle or a severe ankle injury affords a limited ankle examination; however, any motor function that can be examined should be documented. Normal range of motion of the ankle joint

## Imaging and Diagnostic Modalities

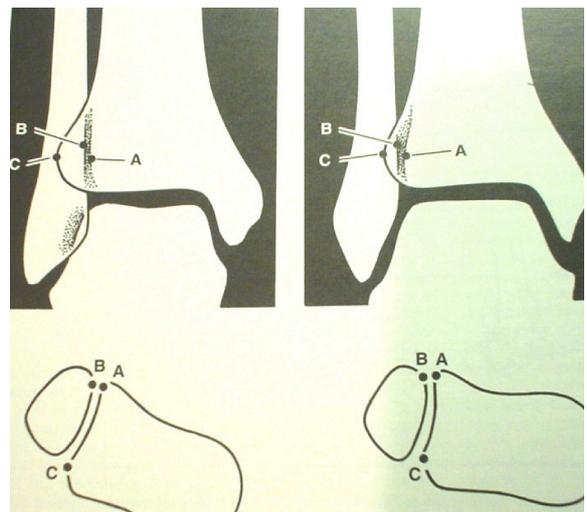
### 1. X ray AP

15-degree internal rotation AP (mortise)

Lateral views

Although the Ottawa **ankle** rules have been validated and found to be both cost effective and reliable (up to 100% sensitivity), their implementation has been inconsistent in general clinical practice.

- Always look for medial and lateral failure in the malleoli
- Look for ankle mortise and talar shift
- Fibular shortening, widening of the joint space, malrotation of the fibula
- Look for Maisonneuve pattern injury: X ray proximal fibular fracture. d. Assess syndesmosis



The degree to which an asymmetry at the mortise is tolerable is controversial, although

1 mm of tibiotalar displacement has been shown in a static cadaveric **ankle** model to decrease the contact area by 42%.

- A. Posterior border of the tibia
- B. Border of the fibula
- C. Ant border of tibia
- In AP: Distance between A and B <5mm
- B and C: overlap 10 mm

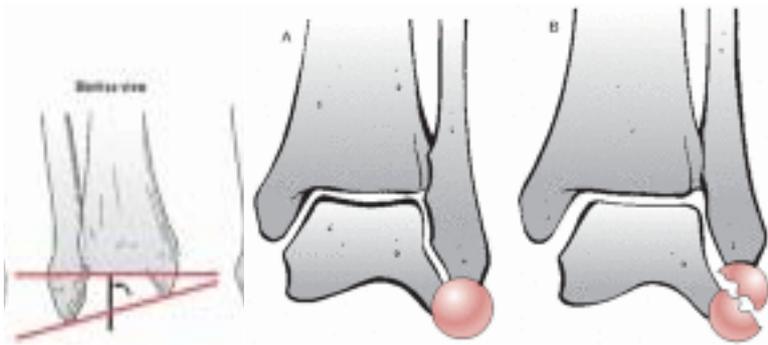
Parameters that suggest unstable fracture patterns include

lateral malleolar displacement greater than 2 mm with resultant talar shift on the AP or lateral

A significant medial malleolar displacement, deltoid ligament disruption defined by greater than 5 mm medial clear space

Syndesmosis injury: tibial-fibular clear space greater than 5 mm or tibial-fibular overlap of less than 10 mm (both on the AP)

Tibial-fibular overlap of less than 1 mm on the mortise view



The talocrural angle is measured between a line perpendicular to the tibial plafond and a line connecting the tips of the medial and lateral malleoli. Normal range is  $83 \pm 4$  degrees or a deviation from the talocrural angle measurement on the contralateral side.

The most useful radiographic signs of fibular length are the talocrural angle and the “ball sign.” The “ball” or “dime sign” is described on the AP view as an unbroken curve connecting the recess in the distal tip of the fibula and the lateral process of the talus when the fibula is out to length. **B.** Fibula malreduced in a shortened position, ball sign is absent.

**2. CT:** The greatest asset of CT scans in the setting of ankle fractures is to diagnose tibial plafond impaction injuries, Lisfranc’s and talar fractures

## **SURGICAL AND APPLIED ANATOMY AND COMMON SURGICAL APPROACHES**

The medial malleolus, which is composed of the anterior and posterior colliculi separated by the intercollicular groove. The anterior colliculus is the narrower and most distal portion of the medial malleolus and serves as the origin of the superficial deltoid ligaments. The intercollicular groove and the posterior colliculus, which is broader than the anterior colliculus, provide the origin of the deep deltoid ligaments.

## The superficial deltoid

Origin Anterior colliculus [3 components]

I The Naviculotibial ligament

II Calcaneotibial ligament [sustentaculum tali]

III Superficial talotibial ligament, which inserts at the medial talar tubercle.

## The deep deltoid

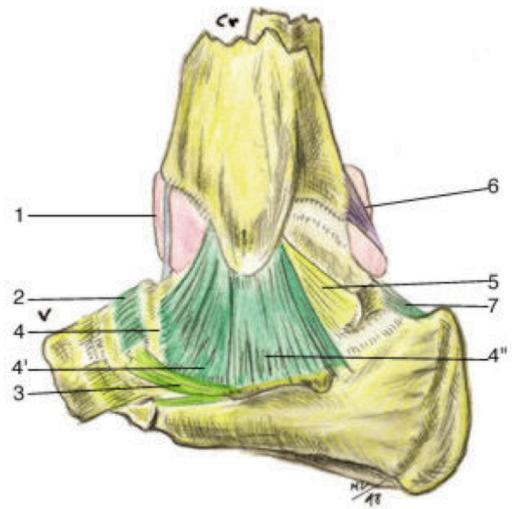
Anterior: Origin: the intercollicular groove

Inserts: on the medial talus.

Posterior: Origin: posterior colliculus

Inserts: on the medial talus.

This ligament is the strongest and thickest ligament of the deltoid complex.



Medial aspect of the joints of the right ankle region - superficial layer

1- anterior oblique capsular reinforcement

2- talonavicular ligament

3- deep portion of spring ligament

4- medial ligament, superficial tibiotalar portion

4' medial ligament, superficial portion attached to spring ligament

4'' medial ligament, superficial tibiocalcaneal portion

5- medial ligament, deep component

## Syndesmosis tibio-fibular joint:

The anterior tubercle (Chaput tubercle) is the origin of the AITFL

Posterior tubercle is the origin of the deep component of the posterior inferior tibiofibular ligament (PITFL).

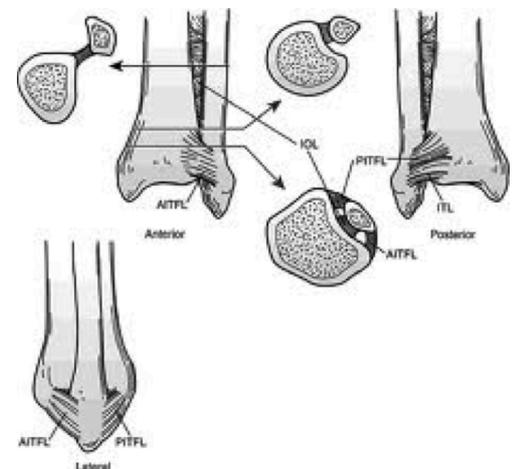
The more superficial fibers of the posterior tibiofibular ligaments are also attached to the posterior tubercle and are typically not injured in trimalleolar **fractures** and indirect reduction of the posterior malleolar fragment with restoration of fibular length.

The posterior malleolus comprises the posterior lip of the tibial plafond. Recent studies that demonstrated no talar instability with posterior malleolus **fractures** involving up to 40% of the articular surface if there was no lateral-sided injury to the fibula or posterior **ankle** ligaments.

AITFL, which runs from Chaput tubercle on the tibia to Wagstaffe tubercle on the fibula;

PITFL, which runs from Volkmann tubercle and attaches to the posterolateral aspect of the fibula. Distal to the PITFL is the inferior transverse tibiofibular ligament (ITL).

The fourth component of the interosseous membrane is the tibiofibular interosseous membrane, which thickens and becomes the tibiofibular interosseous ligament



**Deltoid ligament:** Superficial fibres - prevents eversion

Deep fibres - prevents external rotation.

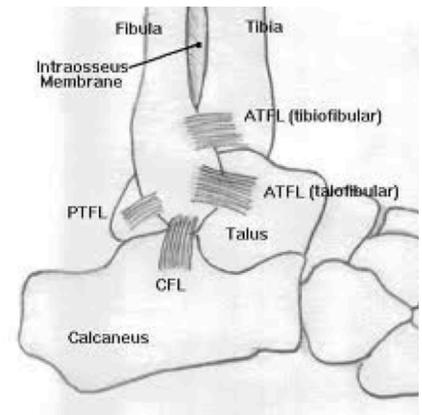
Once the deltoid ligament was sectioned, all ankles showed a significant decrease in tibiotalar contact area. This result was consistent with the observation that the pattern of instability was not a straight lateral translation but rather anterolateral rotation underneath the tibial plafond

**Lateral ankle ligaments:**

The calcaneofibular ligament (CFL) is stronger than the ATFL and originates at the lower segment of the anterior border of the lateral malleolus inserting on the calcaneus deep to the peroneal tendons.

The CFL resists **ankle** inversion in a dorsiflexed **ankle**.

The posterior talofibular ligament (PTFL) is the strongest of the three LCLs.



**Weight borne:** 80-90% weight transmitted through tibial plafond

10% through medial and lateral facet on valgus/varus.

17% through the fibula

**Joint force**

The ankle joint sustains peak loads of almost 3 times body weight, with running 7 times the body weight