X-Ray Rounds:
(Plain) Radiographic Evaluation of the Ankle

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Anatomy

- Complex hinge joint
- Articulations among:
  - Fibula
  - Tibia
  - Talus
- Tibial “plafond”
  - Distal tibial articular surface
- Complex ligamentous system
Anatomy

- Medial malleolus
  - Distal tibia
  - Medial support
- Lateral malleolus
  - Distal fibula
  - Lateral support
- Talus
  - Trapezoid-shaped

- Mortise (tibial plafond, medial & lateral malleoli)
  - Constrained articulation with the talar dome
Anatomy

- Syndesmotic ligament complex
  - Axial, rotational, & translational stability
  - Four ligaments:
    - Anterior tibiofibular ligament
    - Posterior tibiofibular ligament
    - Transverse tibiofibular ligament
    - Interosseous ligament

FIGURE 2. Posterior view of the major ligaments of the ankle. Any of these ligaments may be injured in conjunction with a syndesmotic injury.
Anatomy

- **Deltoid (medial) ligament complex**
  - Superficial (contributes little to stability)
    - Tibionavicular ligament
    - Tibiocalcaneal ligament
    - Superficial Tibiotalar ligament
  - Deep (primary medial stabilizer)
    - Intraarticular:
    - Deep tibiotalar ligament
Anatomy

- Lateral (fibular collateral) ligament complex
  - Anterior talofibular ligament (weakest)
  - Posterior talofibular ligament (strongest)
  - Calcaneofibular ligament
Indications for Ankle Radiographs

- Ottawa Ankle Rules
  - Age 55 years or older

Ankle x ray series is required only if there is any pain in malleolar zone and any of these findings:
- Bone tenderness at A
- Bone tenderness at B
- Inability to bear weight both immediately and in emergency department

Foot x ray series is required only if there is any pain in midfoot zone and any of these findings:
- Bone tenderness at C
- Bone tenderness at D
- Inability to bear weight both immediately and in emergency department
Indications for Ankle Radiographs

How good are the Ottawa Rules?
- When originally published:
  - 100% sensitivity & 40% specificity for detecting malleolar fractures
- Subsequent studies:
  - Lower sensitivity (93% to 95%) and specificity (6% to 11%) than originally thought
  - Not perfect, but still a good tool

Other indications
- The patient cannot communicate (altered mental status, alcohol intoxication, or other)
- Pain and swelling do not resolve within 7-10 days after injury
- Anytime your history and physical don’t give you enough information
AP View of the Ankle

DE: Talar Tilt: < 2 degrees of angulation is NI

AB: Tibiofibular Clear Space: NI < 5 mm
BC: Tibio-Fibular Overlap: NI > 10 mm
AP View of the Ankle

Talar Tilt: > 2 degrees angulation may indicate medial or lateral disruption

Tib-fib Clear Space > 5mm or Tib-fib Overlap < 10mm may indicate syndesmotic injury
Lateral View of the Ankle

Dome of the talus: centered under and congruous with tibial plafond

Posterior tibial tuberosity fractures & direction of fibular injuries can be identified

Avulsion fractures of the talus by the anterior capsule can be identified

Any deformity to the talus, calcaneus or subtalar joint
Calcaneal Fractures

Bohler’s Angle
30-35 degrees is normal

Others:
- Critical Angle of Gissane
- Broden’s Views
Mortise View of the Ankle

- AP view taken with the foot in 15-20 degrees of internal rotation to offset the intermalleolar axis

- Medial clear space
  - > 4mm may indicate lateral talar shift

- Talar tilt, Tib-fib Overlap, Tib-fib clear space (see AP view)

- Talocrural angle (angle b/w plafond parallel and intermalleolar line)
  - Normal is 8-15 degrees (where the lines intersect)
  - Smaller angle may indicate fibular shortening
Mortise View of the Ankle

A: Normal
B: Talocural angle (83° ± 4°)
C: Medial clear space
D: <4 mm
E: Talar subluxation
F: Talar tilt (<2 mm)
G: Short fibula Mismatched subchondral surfaces
Normal AP & lateral right ankle X Ray
AP View:
Widened medial clear space

Mortise View:
Open mortise (decreased tib-fib overlap)

= Syndesmotic injury

= Surgical referral ("needs a screw")
28 y/o M who “twisted” his left ankle 1 day ago.

Danis-Weber Type B fibular ankle fracture
Ankle Fracture Classification

Danis-Weber Classification
- Defined by location of the fracture line
  - *Type A*: below the tibiotalar joint
  - *Type B*: at the level of the tibiotalar joint
  - *Type C*: above the tibiotalar joint
    - Syndesmotic ligament compromise

Lauge-Hansen Classification
- Infrequently used, clinically; mostly academic
Mortise view:
Weber C fracture with open mortise and widened medial clear space

= deltoid & syndesmotic ligament tears, with fracture

= surgical referral

mm
25 y/o volleyball player “landed wrong" on the right foot, “hurting” the ankle

Exam with positive talar tilt

Lateral ligament tears
-ATFL
-CFL

mm
Radiographic Stress Tests of the Ankle

- **Talar Tilt Stress Test**
  - Stabilize the leg with one hand while inverting plantar flexed heel with the other
  - Contralateral ankle used for comparison
  - Line is drawn across the talar dome and tibial vault
    - Degree of lateral opening angle is measured
    - Normal tilt is less than 5 deg
  - **Standing Talar Tilt Stress Test:**
    - may be more sensitive
    - Patient stands on an inversion stress platform with the foot and ankle in 40 deg of plantar flexion and 50 deg of inversion
25 y/o male tennis player “torqued” his right ankle

Exam with positive anterior drawer sign

Grade III ATFL ankle sprain
Radiographic Stress Tests of the Ankle

Anterior Drawer Test
- Abnormal anterior translation is between 5 to 10 mm, or 3 mm more than other side

External Rotation Stress Test
- Evaluates syndesmotic & deep Deltoid ligaments
- Difference in width of superior clear space between medial and lateral side of the joint should be < 2 mm
AP View:
Widened medial clear space

Decreased tib-fib overlap

= Medial & syndesmotic ligament compromise

= surgical referral
Normal AP & lateral views

Open mortise
= “needs a screw”
Weber Type A lateral malleolar fracture

Treat conservatively
Open mortise with high fibular fracture

Name?

Maisonneurve fracture

= surgical referral
Salter-Harris fracture, type II

= Refer for ORIF
Figure 6. The Salter-Harris Classification of Growth-Plate Fractures

1. Straight
2. Above
3. Below
4. Through
5. Rush
Lateral ligamentous injury

Medial malleolar avulsion fracture

Surgical referral
Nondisplaced spiral fibular fracture

= CR & immobilization
Posterior malleolar avulsion fracture
Abnormal Bohler’s angle = Calcaneal Fx

“Surgerize!”
Medial malleolar fracture

= refer for screw fixation
Medial malleolar Fx

Widened medial clear space: talar dislocation

Open mortise: syndesmotic injury

*Maisonneuve Fx*

= Surgery
Bimalleolar fractures
Osteopenic appearing bone

Surgical referral
Tx osteoporosis prn
Diagnosis?

Charcot’s foot
Anterolateral tibial epiphyseal fracture

aka: Tillaux fracture
Tillaux Fracture

- Fracture of the anterolateral tibial epiphysis
- Mechanism
  - Avulsion of epiphyseal fragment due to the strong anterior tibiofibular ligament
  - External rotational force across the ankle
- Commonly seen in adolescents
- Treatment: ORIF
Calcaneal osteomyelitis

= IV Abx
= Surgical I & D if chronic
Calcaneal fracture = ORIF
Mortise view

Pilon fracture (Comminuted tibial plafond compression fracture)

Management?
Positive talar tilt stress test

Surgery
s/p Fall while rockclimbing

Treatment?
Conclusion

- Plain radiographic anatomy of the ankle
- Indications for plain radiographs of the ankle
- Direct and indirect signs of injury on plain radiographs