Radiographic Evaluation of Blunt Ankle Trauma

Jack Casey, HMS IV
Gillian Lieberman, MD
Overview

• Importance of ankle injuries
• Imaging—when, how, and what to look for
• Anatomy review
• Common ankle injuries
  – Patient cases to illustrate mechanisms of injury and radiologic classification

Focus on radiology
Historical Context

Early writings on fractures and dislocations of the ankle stressed the seriousness of these injuries. The authors reported only a rare cure, often permanent disability, and not infrequently amputation or death as a consequence. Dupuytren (1778–1835) noted that, even under favorable conditions, fractures of the ankle almost always resulted in deformity and lameness.
Blunt Ankle Trauma
– Still A Major Problem

• Most common MSK injury
• Less that 15% of patients have clinically significant fractures
• Ankle films are 3rd most common radiologic study ordered in many hospitals
• > $500 million spent annually on ankle radiographs in North America
• Clinical guidelines can help guide management

Indications for Imaging  

*The Ottawa Ankle Rules*

- Set of clinical guidelines, designed to have sensitivity of 100% for detecting fractures s/p blunt ankle trauma.  
  - willing to accept trade-off of lower specificity

- Expected benefits: Limit radiation exposure, health care costs, ED waiting time.

- Designed to be easy to use
Ankle x-ray series is only necessary if there is pain near the malleoli and any of these findings:

1. Inability to bear weight both immediately and in the ED (four steps)
2. Bone tenderness at posterior edge or tip of medial or lateral malleoli.

www.aafp.org/afp/20020901/785.html
Ottawa Ankle Rules  
- The basics

Foot x-ray series is only necessary if there is pain in the **mid-foot** and any of these findings:

- Inability to bear weight both immediately and in the ED (four steps)

2. Bone tenderness at base of **fifth metatarsal** or the **navicular**.

www.aafp.org/afp/20020901/785.html
Ottawa Ankle Rules
- How good are they?

• Systemic review of 27 studies (15,581 patients)
  – Sensitivity 96.4 - 99.6 %
  – Specificity varied widely (10-79%)
  – Less than 2% of patients who were negative for fx according to ankle rules actually had a fracture.
  – Missed fractures were almost always minor, did not affect long term outcomes.

• 28% reduction in use of ankle radiography
• No decrease in patient satisfaction

Ottawa Ankle Rules

- A few limitations

• Not applicable to:
  – <18 y/o
  – Altered mental status
  – Multi-system trauma
  – Chronic/ subacute injuries

• Always trust clinical judgment
Implementing the OAR

• Thorough (but brief) H+P
  ➢ Evaluate skin/soft tissue. Assess for open fx.
  ➢ Check and document neurovascular status
  ➢ Palpate entire distal 6 cm of both malleoli before asking patient to bear weight
  ➢ Palpate over 5th metatarsal and navicular for tenderness
  ➢ Palpate for tenderness over proximal fibula to exclude potential Maisonneuve fracture

• Think about underlying anatomy and mechanism of injury
Basic Anatomy 1 - Bones

Interactive Foot and Ankle. Primal Pictures, Ltc.
Basic Anatomy 2- Ligaments

THREE principal sets of ligaments support the ankle, all of which are essential to its stability.
Basic Anatomy 3 - Tendons

Greenspan, Orthopedic Radiology
Bones and connective tissue give rise to ring-like structure surrounding the talus.

Ankle Injuries-Inversion

Remember Ring-Like Structure in Conceptualizing Injury.

www.emedicinehealth.com
Ankle Injuries- Eversion

Remember Ring-Like Structure in Conceptualizing Injury.

Greenspan, Orthopedic Radiology

www.x-strap.com
Appropriate Views

• **Must always include:**
  1) AP
  2) Mortise (ankle in 10 - 25 degrees of internal rotation)
  3) Lateral

• **May add additional views in questionable cases** (i.e. stress views, comparison views with uninjured ankle)
Regions of Interest

- Bones of ankle joint
- The fifth metatarsal tuberosity should be seen in at least one projection.
- Important to visualize anterior process of the calcaneus.
Normal AP Radiograph

www.rad.washington.edu
Foot internally rotated 10-35 degrees to allow for improved visualization of the mortise.
AP vs. Mortise Views

Images from Greenspan, Orthopedic Radiology
Normal Lateral Radiograph

Note: ROI not fully included (5th metatarsal absent)
Classifying Fractures

• Anatomic
• Weber (AO)
• Other
Anatomic Classification of Fx

Identifying additional sites of fracture is not just an academic exercise— as bi/tri malleolar fx usually require orthopedics eval, surgical management.

Greenspan, Orthopedic Radiology
Unimalleolar Fx

Patient 1 – s/p eversion injury, fall from 10 feet

Small fx, medial malleolus

Also note dislocation talus

Image from BIDMC PACS
Patient 2-
“Fall with ankle inversion. Please r/o fracture”

Bimalleolar Fx

Mortise View

Images from BIDMC PACS

AP view
Trimalleolar Fx

"Eversion injury. r/o fx" (ED films)

Images from BIDMC PACS
Trimalleolar Fx ORIF

Images from BIDMC PACS

Patient 3 (Intra-op)
Weber Classification of Fx

- Based on the level of fibular fracture
- Used to determine extent of syndesmotic injury. A<B<C
Patient 4- s/p fall with ankle inversion. r/o fx.

Avulsion fx below joint line
Weber B

Spiral fibular fx: assoc. with partial disruption of tibiofibular ligament

www.wheelessonline.com
How would you classify anatomically?

Bimalleolar (comminuted)
Recap of Classifications

• Anatomic- Uni/ Bi/ Tri Malleolar

• Weber- A/ B/ C
Fracture 5th Metatarsal

Patient 7—“s/p ankle inversion injury. r/o fx”
Fracture 5th Metatarsal

Mechanism of Injury
Beyond Simple Radiographs

If pain persists in 6-8 weeks, consider other imaging modalities:

- MRI (for evaluation of ligaments/ tendons)
- CT
Summary

• Indications for Radiographs
  ➔ Ottawa Ankle Rules:
    o 4 sites for bony tenderness, 4 steps
    o Save time, money, and avoid radiation exposure, without sacrificing quality

• Appropriate views, ROI

• Think about anatomy

• Always look for additional fx
Acknowledgements

- Gillian Lieberman, MD
- Pamela Lepkowski
- Mary Hochman, MD
- Larry Barbaras
References

• American College of Radiology. ACR appropriateness criteria. Imaging evaluation of suspected ankle fractures. www.acr.org
• www.aafp.org/afp/20020901/785.html
• www.rad.washington.edu
• www.x-strap.com/pix/eversion.jpg