Anatomy of an Ankle Injury: Pearls for Evaluation and Management

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I have no relevant financial relationships to disclose
Topics to discuss

- Paradigm shift
- Anatomy review
- Mechanisms of injury
- Grading scales and Classifications
- Assessment of Stability – Physical Exam
- Role of MRI
- Associated injuries
- Treatment protocols
- Chronic Instability and Treatment
We must start to consider ankle sprains to be comparable in severity to ankle fractures. They occur with the same force, torque, and rotation. If undertreated, they result in the same outcome: CHRONIC PAIN, INSTABILITY, AND OSTEOARTHRITIS.
DO WE UNDERTREAT ANKLE SPRAINS?

- 2017 Clinical Journal of Sports Medicine
- National database of health insurance records – 825,718 ankle sprains – 735,927 LAS included in study
- Outcome measurements were how many received imaging, DME, and PT in first 30 days after injury

DO WE UNDERTREAT ANKLE SPRAINS?

- In first 30 days after diagnosis
  - Only 2/3 received initial x-rays
  - 9% brace
  - 8.1 walking boot
  - 6.5% splinted
  - Only 6.8% received physical therapy
DO WE UNDERTREAT ANKLE SPRAINS?

- Long term outcomes following LAS are well documented
  - 40% develop chronic ankle instability (CAI)
  - Decreased orthopedic quality of life
  - Patients with LAS become less physically active
  - CAI associated with increased rate of OA

- Does not spare the young athletes either
  - 90% return to full sport after 10 days
  - 25% report pain and instability
  - 45% report no recovery after 3 years
Evidence shows most providers offer limited acute treatment
  - i.e. “WALK IT OFF”

Proper rehabilitation necessary for
  - Restoration of proprioception
  - Normalization of joint mechanics and gait

CAI is usually avoidable!
We must adopt appropriate treatment protocols for ankle sprains in the ED and Urgent Care.

Immobilize appropriately.
Stress follow up within 2 weeks.
Anatomy Review
Lateral Ankle Anatomy¹
Medial Ankle Anatomy
Posterior Ankle Anatomy
Ankle Fractures

Mechanism of Injury and Classification
Mechanism of Injury

Ankle fractures are rotational injuries – “A Clockwork Injury”²,³

Syndesmotic ligament and deltoid sprains occur with these patterns

Lauge Hansen Classification System aids in prediction of what structures are injured
Supination
External Rotation

Stage I – AITFL rupture or avulsion fracture
Stage II – Distal spiral oblique fibula fracture
  - Most common type of fibula fracture
  - Begins at level of joint
Stage III – Posterior malleolar fracture or PITFL rupture
Stage IV – Transverse medial malleolar fracture or deltoid rupture
Note: Wagstaffe Fracture May Be Seen at Stage #2 vs #1
Pronation
External Rotation

Stage I – Transverse medial malleolus fracture or deltoid rupture
Stage II – AITFL rupture
Stage III – Interosseous membrane rupture and high fibula fracture
  - Can be near joint or up to fibular neck below the knee
Stage IV – Posterior malleolus fracture or PITFL rupture
Lauge Hansen continued

Pronation Abduction

• Medial malleolus transverse fracture or disruption of deltoid ligament
• Anterior tibiofibular ligament sprain
• Transverse comminuted fracture of the fibula above the level of the syndesmosis

Supination Adduction

• ATFL sprain or distal fibular avulsion
• Vertical medial malleolus and impaction of anteromedial distal tibia
Lateral Ankle Sprains

Mechanism of Injury and Classification
Mechanism of Injury

Low ankle sprains are inversion injuries

Anterior talofibular ligament sprains in plantarflexion/inversion

Calcaneofibular ligament sprains in dorsiflexion/inversion

Ankle can move from plantarflexion to dorsiflexion while inverted and both ligaments can rupture

Most common in hard court sports requiring quick lateral movements and jumping
<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade I</td>
<td>No ligament tear</td>
</tr>
<tr>
<td></td>
<td>Mild ecchymosis and edema</td>
</tr>
<tr>
<td></td>
<td>Ambulatory</td>
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<tr>
<td>Grade II</td>
<td>Partial tear or attenuation</td>
</tr>
<tr>
<td></td>
<td>Moderate ecchymosis and edema</td>
</tr>
<tr>
<td></td>
<td>Difficulty with ambulation</td>
</tr>
<tr>
<td>Grade III</td>
<td>Complete tear with instability</td>
</tr>
<tr>
<td></td>
<td>Severe ecchymosis and edema</td>
</tr>
<tr>
<td></td>
<td>Severe pain with weight bearing activity</td>
</tr>
</tbody>
</table>
High Ankle ( Syndesmosis ) Sprains  

- Syndesmosis maintains stability of ankle mortise  
  - Prevents separation of fibula from tibia  
- AITFL most commonly injured ligament of syndesmosis  
- May involve interosseous membrane rupture  
- Associated with external rotation injuries  
- Disruption increases tibiotalar contact pressure and leads to early DJD
Deltoid Ligament Sprains

- Superficial fibers resist external rotation
- Deep fibers resist lateral translation of the talus
- Superficial and deep fibers resist eversion force at the ankle
- Most commonly caused by forced eversion/external rotation movement
- Most commonly associated with other injuries like malleolar fractures and high ankle sprains
- Isolated injuries have good prognosis
Physical Exam

- Pain on palpation of each ligament
- Anterior drawer
- Talar tilt
- Ankle eversion
- Ankle abduction stability
- Fibular instability
- Squeeze test of syndesmosis
- Difficult to assess in acute injuries
Ligament Stress Testing
Ligament Stress Testing
Ligament Stress Testing
Role of MRI \(^8,11\)

- Very sensitive and specific for ligament and osseous injury
- Often underreports severity of tendon injuries (opinion)
- Image is static with foot held in neutral position – may miss attenuation or rupture in post-acute setting
- Always rely on physical exam findings for treatment decisions
- Reserved for patients who do not respond to treatment or when other pathology suspected
Concomitant Injuries

- Peroneal tendon tear or strain
- Talar or tibial osteochondral injury
- 5th metatarsal fracture
- Anterior process fracture of calcaneus
- Lateral process fracture of talus
- Os trigonum syndrome or posterior talar process fracture
My Treatment Protocols
Ankle Fractures

- Displaced
  - ORIF most common
  - Closed reduction
  - External fixation
  - Non-weightbearing

- Non-displaced
  - Non-weightbearing
  - Cast or CAM boot immobilization
  - ORIF optional for faster healing
Examples of ORIF
Risks of Fracture and Surgery

- Non-union
  - Vit D deficiency
  - Tobacco
  - Early ambulation
  - Comminuted or severe gaps/displacement

- Malunion
  - Usually non-treatment or non-compliance

- Failure of hardware
- Osteomyelitis
- Chronic wounds
- Traumatic osteoarthritis
Syndesmotic (High) Ankle Sprain

**ORIF recommended if no contraindications**

- Bear weight in boot 2 weeks post-op

**If surgery contraindicated**

- NWB x 6 weeks with boot immobilization

**Transition to brace and PT at 2-6 weeks**
Deltoid Ankle Sprain

Usually treat conservatively
Most commonly associated with ankle fractures
Assess stability intraoperatively
NWB x 2 weeks if isolated injury, boot or cast immobilization
Transition to ankle brace and PT at 2 weeks
Lateral Ankle Sprain

- Usually treat conservatively
- Only treat surgically in acute setting for high level athletes
- Assess grade to determine treatment
Grade I

- Boot immobilization only to reduce swelling/pain if needed
- Otherwise WBAT in normal shoe gear
- Home proprioception and balance/strength exercises

Grade II/III

- Boot immobilization in neutral position for 2 weeks or until instability resolves
- Start PT around 2 weeks once edema resolves
- If continued instability on anterior drawer longer than 6 weeks after immobilization, likely to have developed CAI
- Transition to ankle brace once clinically stable
When Can I Let My Patient Walk?

- Transverse fibula fracture below the joint line
  - Okay to walk in CAM boot with minimal activity levels
- Low ankle sprain without mechanical instability
  - Normal activity ok after acute swelling subsides
- Only use CAM boots in acute grade II/III injury for ambulation
  - Stirrup and gauntlet braces should be reserved for post-acute support
When Should I NOT Let My Patient Walk??

- Bimalleolar or Trimalleolar fractures
- Syndesmotic widening or shifting of the talus laterally
- Medial malleolar fractures
  - High rate of non-union
  - Often associated with syndesmotic injury not evident radiographically
- Fibular fracture at or above the level of the joint
  - The most common fibula fractures
- Grade II and III ankle sprains with moderate to severe ecchymosis and edema
  - Difficult to assess instability acutely due to swelling
<table>
<thead>
<tr>
<th>Choice of DME</th>
<th>Unstable Ankle Sprain</th>
<th>Stable Ankle Sprain</th>
<th>Ankle fracture</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Posterior splint or CAM boot until instability resolved</td>
<td>• No need for DME if tolerating ambulation</td>
<td>• Low Fibula fracture – CAM boot x 4 weeks then ankle brace</td>
</tr>
<tr>
<td></td>
<td>• OK to bear weight protected with boot</td>
<td></td>
<td>• Bimalleolar or Trimalleolar posterior splint with Jones compression dressing until ORIF</td>
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<tr>
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<td>• Transition to figure of 8 Velcro brace once ligaments stable</td>
<td></td>
<td>• Then CAM boot like a cast NWB</td>
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Why use CAM boots?

- Controlled Ankle Motion
  - Reduces inflammation and edema through immobilization
  - Holds foot in neutral position to leg for healing
  - Easily removable for ROM and therapy
  - Can use for ambulation when ready to walk
Why Not Stirrup Braces?

• Most common instability is anterior/posterior
• Does not provide enough mechanical support IMO
• Figure of 8 brace much better support in all directions, including dorsiflexion and plantarflexion motion
Chronic Ankle Instability
Mechanical instability = positive stress tests

- Ruptured ligaments cause instability
- Abnormal tibiotalar motion and pressure
- Surgical repair most successful treatment
- Regenerative medicine (PRP, amnion, BMA) optional

Functional instability = lack of proprioception

- Feeling that ankle is going to give out
- Intact ankle ligaments by stress examination
- Loss of joint proprioception and peroneal weakness
- Cannot be treated surgically

Mechanical versus Functional Instability


Thank you!

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