Learning Objectives:

1. Present cases of acute injuries showing PE, Imaging, and treatment.
2. Improve diagnostic skills of acute ankle injuries.

I have nothing to disclose.
565 Biomechanics of Gait

489 Functional Anatomy of the Knee and Leg

490 Examination and Imaging of the Knee and Leg

491 Acute Knee Ligament Injuries in Athletes
Surgery of the Foot
Roger A Mann Editor
CV Mosby
5th Edition 1986

Biomechanics of the Foot and Ankle by Roger A Mann
Chapter 1
Function

- Propulsion
- Support
- Flexibility
- Rigidity
- Gait mechanics: ankle and foot motions
Walking Cycle

- Stance phase (60%); Swing phase (40%)
- Double limb support (10%): both feet on ground
### Normal Gait is a Controlled Fall
What happens to the Joints with Foot On Ground

<table>
<thead>
<tr>
<th>Foot</th>
<th>Tibia</th>
<th>Talus</th>
<th>Foot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dorsiflexion</td>
<td>Internally Rotates</td>
<td>Everts</td>
<td>Pronation</td>
</tr>
<tr>
<td>Plantarflexion</td>
<td>Externally Rotates</td>
<td>Inverts</td>
<td>Supination</td>
</tr>
<tr>
<td>P</td>
<td>ER</td>
<td>I</td>
<td>S</td>
</tr>
</tbody>
</table>
Gait analysis posterior view
Ankle: Modified Hinge Joint

- Bony configuration
  - Mortise
  - Circular Pretzel

- Ligamentous stability
  - ATF and CF laterally
  - Deltoid superficial and deep medially
  - Syndesmosis superiorly
Figs. 20, 21. Palpation of the lateral edge of the dome of the talus (anterolateral portion). Plantar flexion of the foot exposes a larger surface of the talar dome.

Fig. 61. The anterior draw sign test to evaluate the intactness of the anterior talofibular ligament.

Fig. 62. A positive anterior draw sign.
EUA Gross instability, right ankle
Dense fibrous structure maintaining ankle mortise (tibiofibular articulation)

Source of “high ankle sprain”

Prolonged morbidity!

Injury occurs from eversion, especially with the foot dorsiflexed

1 mm lateral shift of talus within mortise reduces contact area 42%
Medial (Deltoid) Ligament

- Superficial & deep component; functions as single structure
- Primary resistance to eversion
Medial (Deltoid) Ligament

- Superficial deltoid fans out from the medial malleolus to insert on the:
  - Talus posteriorly
  - Calcaneus medially
  - Navicular anteriorly

- Deep deltoid ligament
  - Anterior fibers insert on the neck of the talus
  - Posterior fibers insert on the posterior medial tubercle of the talus
# Summary of Findings From the National Collegiate Athletic Association Injury Surveillance System on Foot and Ankle Injury.*

<table>
<thead>
<tr>
<th>Sport</th>
<th>Game Injuries Relating to the Ankle (%)</th>
<th>Game Injuries Relating to the Foot (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men’s baseball</td>
<td>7.4</td>
<td>0</td>
</tr>
<tr>
<td>Women’s softball</td>
<td>10.3</td>
<td>0</td>
</tr>
<tr>
<td>Men’s basketball</td>
<td>26.2</td>
<td>2.6</td>
</tr>
<tr>
<td>Women’s basketball</td>
<td>24.6</td>
<td>2.4</td>
</tr>
<tr>
<td>Men’s football</td>
<td>15.6</td>
<td>1.1</td>
</tr>
<tr>
<td>Men’s lacrosse</td>
<td>11.3</td>
<td>0</td>
</tr>
<tr>
<td>Women’s lacrosse</td>
<td>22.6</td>
<td>1.3</td>
</tr>
<tr>
<td>Men’s soccer</td>
<td>18.8</td>
<td>4.2</td>
</tr>
<tr>
<td>Women’s soccer</td>
<td>19.4</td>
<td>2.7</td>
</tr>
</tbody>
</table>

How I Treat . . .

- Control swelling
- Brace
- Acutely and during the entire season
- Proprioception
- Core
- Prevent recurrent sprains
- ? Ankle sprain preventable ?
Can we prevent ankle sprain? Even this simple question – Unknown by evidence-based studies.

Prevent – not proven, but we can lessen severity . . . Maybe!

Key Messages

• The preventive effects of taping and bracing have been clearly documented, although the evidence is more convincing for players with previous ankle injury than for healthy athletes.

Key Messages

• The efficacy of wearing high-top shoes is unclear.

• There is some evidence that balance training reduces the risk of ankle sprains in athletes with previous injury.

<table>
<thead>
<tr>
<th>LATERAL ANKLE PAIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Sprain ATF and/or CF</td>
</tr>
<tr>
<td>• Sinus Tarsi Syndrome</td>
</tr>
<tr>
<td>• Subtalar Joint</td>
</tr>
<tr>
<td>• Arthrosis Fracture</td>
</tr>
<tr>
<td>• Cuboid Subluxation</td>
</tr>
<tr>
<td>• Peroneal Dysfunction</td>
</tr>
</tbody>
</table>
FIG. 11-61. Osteology of the lateral side of the foot and ankle.
Physical Exam of the Foot and Ankle
Fig. 19-25. Lateral (left) and anteroposterior (right) drawings of the foot indicating the location of the commonly found accessory bones (circles with numbers) and forefoot sesamoids (shaded circles). (1) Os tibiale externum, (2) processus uncatus, (3) os intercuneiforme, (4) pars peronea metatarsalia 1, (5) cuboides secundarium, (6) os peroneum, (7) os vesalianum, (8) os intermetatarsae, (9) os supratalare, (10) talus accessories, (11) os sustentaculum, (12) os trigonum, (13) calcaneus secundarium, (14) os subcalcis, (15) os supranaviculare, (16) os talotibiale. (Keats, T. E., An Atlas of Normal Roentgen Variants That May Simulate Disease, 2nd ed., p. 371. Chicago, Year Book Medical Publishers, 1979.)
19 YO basketball player Os vesalianum bilateral feet.
Think About Peroneal Tendon Involvement If:

- Recurrent Ankle Complaints
- Sprain Not Getting Better
- Pain, Swelling Higher in Peroneal Tendon Sheath
In Acute Ankle Sprain, Assess Peroneal Function
Physical Exam of the Foot and Ankle

Peroneal Tendons

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17 YO WM

High school Baseball/Football Player

C/O Repeated Inversion Ankle Sprains
18 YO Female Gymnast

- Right ankle injury
- Landed awkwardly doing a back tuck
- Immediate pain and swelling, right ankle
Initial X-rays
Dx lateral talus fracture displaced
Severe lateral ankle sprain
Surgery
Anterior Ankle Pain

- **DX**
  - Tibiotalar Impingement
  - Loose Body

- **PE**
  - Pain on Palpation Anteriorly
  - Palpable Osteophytes

- **Radiographs**
  - Forced Dorsiflexion Lateral View
  - Document Loss of Dorsiflexion
  - Amount Bone Causing Impingement
Anterior Tibiotalar Impingement Syndrome

"Footballers" Ankle

McMurray, TT: Footballers Ankle, JBJS, 323:68, 1950
Anterior Ankle Pain

‘Footballers Ankle’

Australian Football

McMurray, TT: Footballers Ankle, JBJS, 323:68, 1950
Who is the real footballer?
Posterior Ankle Pain

- Differential Diagnosis
  - FHL Tendinitis
  - Posterior Impingement
    - Os Trigonum
  - Posterior Process Talus Fracture (Shepherds 1982)

“Dancers” Tendinitis
Posterior Ankle Pain

- **Differential Diagnosis**
  - Posterior Process Talus Fracture – Shepherd’s Fracture
  - Os trigonum large process versus fracture
  - Tarsal Coalition
  - Osteoid Osteoma
  - Flexor Hallucis Longus Tendinitis—intrinsinc versus compressive due to bony impingement
<table>
<thead>
<tr>
<th>Location</th>
<th>FHL Tendinitis Impingement</th>
<th>Posterior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posteromedial</td>
<td>Posteromedial</td>
<td>Posterolateral</td>
</tr>
<tr>
<td>Tenderness</td>
<td>FHL</td>
<td>Behind Fibula/ Posterior Ankle</td>
</tr>
<tr>
<td>Pain</td>
<td>Motion Great Toe</td>
<td>Plantar Flexion</td>
</tr>
<tr>
<td>Misdiagnosed</td>
<td>Posterior Tibialis Tendinitis</td>
<td>Peroneal Tendinitis Os Trigonum</td>
</tr>
<tr>
<td>as</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiographs</td>
<td>Normal</td>
<td>Present or Fracture</td>
</tr>
</tbody>
</table>
A

B

C

Large posterior tubercle

Os trigonum

Os trigonum
## Bony Impingement of the Ankle

<table>
<thead>
<tr>
<th>MOTION</th>
<th>CONTACT AREAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dorsiflexion</td>
<td>Anteromedial Talus</td>
</tr>
<tr>
<td></td>
<td>Tibial</td>
</tr>
<tr>
<td>Plantar Flexion</td>
<td>Posterolateral Tibia</td>
</tr>
<tr>
<td></td>
<td>Os Calcis</td>
</tr>
</tbody>
</table>

Medial Ankle Pain

• Differential Diagnosis
  • Deltoid Sprain
  • Medial Malleolus Fracture
  • Tendinitis
    • Posterior Tibialis
    • Flexor Hallucis Longus
  • Osteochondral Talus Fracture
  • Osteochondritis Dissecans
Medial (Deltoid) Ligament

- Superficial & deep component; functions as single structure
- Primary resistance to eversion
Posterior Tibial Tendon Dysfunction

<table>
<thead>
<tr>
<th>Stages</th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tendon Length</td>
<td>Normal</td>
<td>Elongated</td>
<td>Elongated</td>
</tr>
<tr>
<td>Hindfoot</td>
<td>Normal</td>
<td>Mobile</td>
<td>Fixed Valgus</td>
</tr>
<tr>
<td>Deformity</td>
<td>None</td>
<td>Mild</td>
<td>Mod –</td>
</tr>
<tr>
<td>Severe</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment</td>
<td>Non-Op</td>
<td>Transfer</td>
<td>Subtalar</td>
</tr>
<tr>
<td>Op</td>
<td>Synovectomy</td>
<td>FDL</td>
<td>Arthrodesis</td>
</tr>
</tbody>
</table>
Fig. 4-2. “Too-many-toes” sign signifying lateral forefoot rotation. Two and one-half toes seen on the left foot, four toes on the abnormal right foot.
14 YO Female

- Soccer athlete
- Left ankle
- Acute lateral talar dome fracture
- Documented by plain films and bone
- Edema on MRI
Initial X-Rays
Talar Dome Fracture-45YO Golfer
Osteochondral Talar Lesions


- Osteochondritis Dissecans
  - Male 3 : 1 Female
  - Medial 2 : 1 Lateral

- Etiologies
  - Trauma
  - Vascular
  - Repetitive Loading
Medial Malleolus

- Left ankle:
  18 yo went up for jump shot & felt pop & sudden onset of pain over medial aspect of ankle
Conclusion

- Think about the compartment injured and anatomy to make the correct diagnosis
- Ankle is a modified hinge and exam is easy
- Plain Radiographs are the initial images
- Order MRI scan if patient is not improving