Easily Missed Fractures
of the Ankle & Foot

Search for on EVERY Ankle view:
1) MM & LM (Weber)
2) OLT (OCD)
3) 5th MT (Jones, Avulsion)
4) LPT

Search for on EVERY Foot view:
5) APC
6) MT
7) Lisfranc

Anatomy: Tarsal Bones & Joints

Talus
- Latin: “Ankle”
- Center of Ankle Joint

Ankle Joint
- Dome

Mortise: Woodworking Term
- Plafond [fr. plat flat + fond bottom]
- ceiling formed by the underside of a floor

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Easily Missed Fractures of the Ankle & Foot

Anatomy: Tarsal Bones & Joints

Talus
→ Tibia
← Navicular
Calcaneus

Talos-Navicular Joint
Navicular sits on Head like a hat

Talo-Navicular subluxation
→ Posterior Tibial Tendon (PTT) Dysfunction

Navicular
Head of Talus

Anatomy: Tarsal Bones & Joints

Sub-Talar Joint
Talus
Calcaneus

Calcaneus
Sub-Talar Joint
3 Facets

*Sustentaculum*Tali
Anterior
Middle
Posterior
Calcaneus

* Latin: “a supporting structure”

Anatomy: Tarsal Bones & Joints

Sub-Talar Joint
Calcaneus

Cuboid
→ Talus
Easily Missed Fractures of the Ankle & Foot

Anatomy: Tarsal Bones & Joints
- Calcaneo-Cuboid Joint
  - Cuboid
  - Calcaneus

Anatomy: Tarsal Bones & Joints
- Chopart Joint
  - Lateral Process Talus
  - Anterior Process Calcaneus

The Navicular **DOES NOT** articulate with the Calcaneus

Anatomic Divisions
- META-TARSALS
- LISFRANC
- CHOPART
- TARSALS
- FORE-FOOT
- MID-FOOT
- HIND-FOOT

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Anatomy: Cross-Sectional
CT: Axial Plane

Syndesmosis

Ti

Anatomy: Cross-Sectional
CT: Axial Plane

Anatomy: Cross-Sectional
CT: Axial Plane

TNJ
P-STJ

M-STJ

Anatomy: Cross-Sectional
CT: Axial Plane

GOOD FOR:

- Syndesmosis
- Talonavicular Joint
- Calcaneocuboid Joint
- Navicular-cuneiform Joints
- Tarsal-metatarsal Joints

NOT GOOD FOR:

- Ankle Joint
- Subtalar Joint

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Anatomy: Cross-Sectional
CT: Sagittal Plane
Reformatted off Axial reference image
Medial Slice
TNJ
M-STJ

Anatomy: Cross-Sectional
CT: Sagittal Plane
Reformatted off Axial reference image
Middle Slice
TNJ
P-STJ
M-STJ

Anatomy: Cross-Sectional
CT: Sagittal Plane
Reformatted off Axial reference image
Lateral Slice
AJ
P-STJ
LPT
APC
Cu
CCJ

SECONDARY PLANE FOR:
- Ankle Joint
- Sub-Talar Joint
- Talo-Navicular Joint
- Calcaneo-Cuboid Joint
- Navicular-Cuneiform Joints
- Tarsal-Metatarsal Joints
NOT GOOD FOR:
- Syndesmosis

Anatomy: Cross-Sectional
CT: Coronal Plane (2 schemes)
1) Mortise Coronal: Reformatted off Axial
Aligned between Malleoli
GOOD FOR:
- Distal Tibial Fractures
  - Malleoli
  - Tillaux, Triplane
  - Pilon
- Talar Dome Fxs (OLT)
(Mortise Sagittal, perpendicular to this)

Anatomy: Cross-Sectional
CT: Coronal Plane (2 schemes)
2) Oblique Coronal: Reformatted Sagittal
Perpendicular to P-STJ
GOOD FOR:
- Hindfoot Fxs
  - Sub-Talar Joint
  - Talus
  - Calcaneus
- Tarsal Coalitions

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Easily Missed Fractures of the Ankle & Foot

Anatomy: Cross-Sectional
CT: Oblique Coronal Plane
- Sagittal ref image perpendicular to P-STJ

GOOD FOR:
- Sub-Talar Joint
- Ankle Joint

NOT GOOD FOR:
- Talo-Navicular Joint
- Calcaneo-Cuboid Joint
- Navicular-Cuneiform Joints
- Tarsal-Metatarsal Joints
Easily Missed Fractures of the Ankle & Foot

Easily Missed Fractures
Search for on EVERY Ankle view:
1) MM & LM (Weber, Adolescent)
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3) 5th MT (Jones & Avulsion)
4) LPT

Lateral Process Talus

Lateral Process Talus Fracture
17 yo F gymnast, landed wrong after vault
Lateral View

Lateral Process Talus Fracture
29 yo F, s/p MVA
Lateral View

Lateral Process Talus Fracture
40 yo M, s/p motorcycle accident
Lateral View

Lateral Process Talus Fracture
24 yo M, construction worker fell 15 feet
Lateral View

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Easily Missed Fractures of the Ankle & Foot

Fracture of the lateral process of the talus is a common, yet frequently missed, injury. It is the second most common fracture of the talar body, accounting for 24% of these injuries, yet it has been documented that 40% of fractures of the lateral process of the talus are missed at initial presentation.

Mechanism of foot/ankle injuries related to snowboarding

<table>
<thead>
<tr>
<th>Injury Type</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Falling</td>
<td>75%</td>
</tr>
<tr>
<td>Twisting</td>
<td>12%</td>
</tr>
<tr>
<td>Collision with tree</td>
<td>8%</td>
</tr>
<tr>
<td>Getting off lift</td>
<td>4%</td>
</tr>
<tr>
<td>Collision with skier</td>
<td>3%</td>
</tr>
<tr>
<td>Getting on lift</td>
<td>1%</td>
</tr>
</tbody>
</table>

Ankle Injuries
- 5-6% of all alpine skiing injuries
- 12-38% of all snowboarding injuries

LPT Fractures
- 15% of snowboarding ankle injuries
- 2% of all snowboarding injuries
Easily Missed Fractures of the Ankle & Foot

**Anterior Process Calcaneus**

Easily Missed Fractures
Search for on *EVERY Ankle* view:
1) MM & LM (Weber)
2) OLT (OCD)
3) 5th MT (Jones, Avulsion)
4) LPT
Search for on *EVERY Foot* view:
5) APC

Anterior Process Calcaneus Fx

APC Fx: Search for on every foot view
29 yo F, tripped down some steps
CT day of injury
6 months later...

APC Fx: Best seen on CT
29 yo F, tripped down some steps
CT day of injury
CT 6 months after injury

APC Fx: May require fixation
29 yo F, tripped down some steps
9-months post-surgery

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Easily Missed Fractures of the Ankle & Foot

Elongated APC: “Anteater sign”
Unlike the normal triangular APC. Elongated APC has blunt tip like an anteater’s snout.

Elongated APC: “Anteater sign”
1) More easily fractured
Even from minor trauma

Elongated APC: “Anteater sign”
2) Tarsal Coalition
   i) Calcaneo-Navicular

Tarsal Coalitions
Cause of foot pain in adolescent
“Rigid (peroneal) flat foot”
Abnormal hindfoot biomechanics ⇒
“Talar Beak”, seen on lateral

Tarsal Coalitions
Occur at 2 sites
   i) Calcaneo-Navicular
   Can be seen on oblique view

Tarsal Coalitions
Occur at 2 sites
   ii) Middle Facet Sub-Talar Joint
   Best seen on Oblique Coronal CT
Easily Missed Fractures of the Ankle & Foot

FIG 7.403: The calcaneus secondarius should not be mistaken for a fracture of the anterior process of the calcaneus.

11 yo F with R foot pain
Easily Missed Fractures of the Ankle & Foot

Easily Missed Fractures
Search for on **EVERY Ankle** view:
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4) LPT
Search for on **EVERY Foot** view:
5) APC
6) MT

Metatarsal Fractures
CAN BE VERY SUBTLE
- Need AP & Oblique Views
- Magnification Helps
FATIGUE FRACTURES ARE COMMON
- “March Fracture”
- 2nd/3rd/4th MTs
- Look Closely for Periosteal Reaction
- Suggest Follow-Up Radiographs

“March Fracture”
40 yo F  3 weeks later

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Easily Missed Fractures of the Ankle & Foot

**Metatarsal Fractures**

**CAN BE VERY SUBTLE**
- Need AP & Oblique Views
- Magnification Helps

**FATIGUE FRACTURES ARE COMMON**
- “March Fracture”
- 2nd/3rd/4th MTs
- Look Closely for Periosteal Reaction
- Suggest Follow-Up Radiographs

**CHRONIC PAIN w/NEG RADIOGRAPHS...**
- ...MRI

**Metatarsal Fractures - Occult**

14 yo M

6 weeks later

**Metatarsal Fractures**

14 yo M

6 weeks later

**Metatarsal Stress Fracture**

22 yo F, pain during 1 week vacation wearing sandals

**Metatarsal Stress Fracture**

22 yo F, pain during 1 week vacation wearing sandals
Easily Missed Fractures of the Ankle & Foot

Metatarsal-Phalangeal Joint Dislocation

47 yo M, in ER with “Pain”

Parallelism: Parallel Articular Surfaces

Lack of Parallelism

Easily Missed Fractures
Search for on EVERY Ankle view:
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3) 5th MT (Jones & Avulsion)
4) LPT
Search for on EVERY Foot view:
5) APC
6) MT
7) Lisfranc

Lisfranc Fx/Dislocation

Metatarsals

Lisfranc Tarsal Bones

Lack of Parallelism
Easily Missed Fractures of the Ankle & Foot

Lisfranc Fx/Dislocation

AP

Obl

Oblateral

Homolateral

Divergent

Lisfranc Fx/Dislocation

Lisfranc Joint

Lisfranc Ligament

Lisfranc Fx/Dislocation

Lisfranc Joint

Lisfranc Ligament

Lisfranc Fx/Dislocation

Lisfranc Joint

Lisfranc Ligament

Lisfranc Fx/Dislocation: Diabetes

Normal Lisfranc joint

Neuropathic destruction of the Lisfranc joint

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Easily Missed Fractures of the Ankle & Foot

**Listrac: The Man**
- Very Aggressive Surgeon
- Wrote Extensively
- Described New Procedures
  - Disarticulation of the Shoulder
  - Excision of the Rectum
  - Amputation of the Cervix
- Never Described T-MT Frx/Dislocation

**Timeline: 19th Century**
- Very Aggressive Surgeon
- Never Described T-MT Frx/Dislocation
- Described T-MT Amputation
  - 1815: 50 pages to describe
  - only 1 minute to perform!
- 23yo Joined Napoleon’s Army

**Timeline: 19th Century**
- Described T-MT Amputation
  “Military surgeons were not given the calm and unhurried atmosphere necessary for the task of laboriously picking out bone splinters and bits of clothing from gaping wounds.”

**Timeline: 19th Century**
- Described T-MT Amputation
  “Although some wounds did not themselves dictate amputation, it often had to be done because the patient could not otherwise survive the rigors of transport to the rear.”

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Easily Missed Fractures of the Ankle & Foot

Timeline: 19th Century

- Described TMT Amputation

```
"The mind did not have time to reason. Experience and coldbloodedness counted for more than talent. Everything had to be done with prompt and decisive action."
```

Jacques Lisfranc
1790-1847

Timeline: 19th Century

Percy, surgeon-in-chief, complained of having too many "pseudosurgeons who counted their battle actions only by the number of arms and legs they had cut off."

Jacques Lisfranc
1790-1847

Timeline: 19th Century

Dr. Oliver Wendell Holmes (US physician, poet, humorist, Dean of Harvard Medical School):

"As for Lisfranc, I can say little more of him than he was a great drawer of blood... ordering a wholesale bleeding of his patients, right and left, whatever might be the matter with them."

Guillaume Dupuytren: A Surgeon in His Place and Time

Jacques Lisfranc
1790-1847

Timeline: 19th & 20th Centuries

- Born 1857, N. Wales
- Died 1933, age 76
- 1887 (age 30) Apprenticed w/uncle, Hugh Owen Thomas
- 1888 – Appointed chief surgeon for the Manchester Ship Canal

Sir Robert Jones
1824-1900

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Easily Missed Fractures of the Ankle & Foot

Timeline: 19th & 20th Centuries

- Jacques Lisfranc 1790-1847
- Sir Robert Jones 1857-1933

1895: Roentgen Rays
1900:

During WWI, revolutionized the care of wounded soldiers
- Established network of field hospitals
- Rehab hospitals
- Mortality rate for open fractures was reduced from 80% to 20%

1925: "To him and his practical teaching and influence we owe it that our streets today show relatively so few war cripples"

Sir Robert Jones 1857-1933

1914-1919: WW I
1796-1815: Napoleonic Wars
1800: Ether

Jones: Early X-Ray Proponent

Dec 28 1895: Röntgen publishes "On a New Kind of Rays"
Feb 22 1896: Jones publishes in Lancet, "The Discovery of a Bullet Lost in the Wrist by Mean of the Roentgen Ray"

Arguably the first published case history in which x-rays were used as a diagnostic tool

"...in all branches of medicine, is an essential aid to diagnosis. No matter how experienced we may be, we cannot afford to dispens with it, even in the apparently simple and obvious case. Not only should we insist upon procuring a film, but it is equally important that we should welcome the radiologist’s reading of it. Some surgeons resent this and say, ‘Give me the film so that I can read it myself,’ but this is an arrogant and stupid attitude, and not the patient’s advantage.”

Frederick Watson: “The Life of Sir Robert Jones” p98, 1934


Jones: The Inspiration

Memorial Tablet:
"Great surgeon; greater man"

Obituary:
“As a teacher he was pre-eminent, not in the role of didactic pedagogue, but in the role of leader able to enthuse men, and through them he advanced the art and science of his specialty”

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