Anatomy

Fractures and Dislocation

Stress related injuries and AVN

Congenital Impingement

The Talus
Anatomy

Congenital

Stress related injuries and AVN

Impingement

The Talus
Anatomy

Congenital

Fractures

Stress related injury

The Talus
Anatomy

Congenital

Fractures

Stress related injury

AVN

The Talus
Mortise and Tenon

The Talus
The Talus

- **Talus** definition is - a slope formed especially by an accumulation of rock debris
- **Talus also called** - Astragalus /əˈstræɡələs
- Derived from the Latin word **taxillus**, which refers to the ankle bone of a horse
The Talus

- **Shagai**: Bones collected and used for traditional games and fortune-telling throughout central Asia

![Images of camel, horse, sheep, and goat bones](https://en.wikipedia.org/wiki/Shagai)
Anatomy

Fractures and Dislocations

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Congenital Impingement

The Talus
The Talus: Anatomy

- Second largest of the tarsal bones
- Only bone articulating with the leg bones
- No muscle or tendon attachment
- Predominantly extrasosseous vascular supply
- 60% covered by cartilage
- 3 parts:
  - Head
  - Neck
  - Body
The Talus: Anatomy

• The talus consists of:
  A. Two facets, one subtalar joint, and two processes
  B. Two facets, two subtalar joints, and three processes
  C. Three facets, two subtalar joints, and three processes
  D. Three facets, two subtalar joints, and two processes
  E. Three facets, three subtalar joints, and three processes
The Talus: Anatomy

• Embryology
  – Tarsal bones mesenchymal differentiation and segmentation sometime around the 8th week of gestation
  – Ossification of the talus originates from a single primary center
  – Elongation occur in an anteroposterior direction
  – In the newborn talus up to 24% of the talus already consists of bony tissue

The Talus: Anatomy

- **Talar Head:**
  - Covered with hyaline cartilage
  - Convex
- **Articulation:**
  - Navicular anteriorly
  - Calcaneus inferiorly and medially
The Talus: Anatomy

- **Talar neck:**
  - Directed plantar-medially
  - 150 degrees angle with the body
  - Inferior surface of the talar neck forms the tarsal canal
    - Opening into the sinus tarsi laterally
  - Tarsal canal is devoid of cartilage and is extra-articular
- **Sulcus tali:**
  - Deep groove which separates middle and posterior talocalcaneal articular surfaces

Anatomy of the talus, Dr Matt Skalski, radiopedia

https://slideplayer.com/slide/6198238/
The Talus: Anatomy

- Talar body:
  - Superior convex articular surface trochlea with shallow central groove (saddle shape)
  - Inferiorly:
    - Articulates with the calcaneus:
      - Posterior facet: larger and located posteriorly and laterally.
      - Middle facet: smaller and more medial, articulating with the calcaneal sustentaculum tali.
The Talus: Anatomy

- **Talar body:**
  - **Posterior Process:**
    - **Lateral tubercle:** posterior talofibular ligament
      - Stieda process
      - Os trigonium: 1.7% to 50%
    - **Medial tubercle:** posterior fibers of the deltoid
    - Groove in between: FHL
  - **Lateral Process:**
    - Broad-based triangular lateral process:
      - Articulate with the fibula superiorly
      - Forms the **posterior facet** of the posterior subtalar joint

https://slideplayer.com/slide/6198238/
The Talus: Anatomy

Melenevsky, RadioGraphics 2015
The Talus: Anatomy

Anatomy of the talus, Dr Matt Skalski, radiopedia
The Talus: Anatomy

Talar ridges, osteophytes, and beaks: a radiologic commentary, D. Resnick, 1984, Radiology
The Talus: Anatomy

• Vascular supply:
  – Posterior tibial artery- 36%
  – Dorsalis pedis artery- 47%
  – Perforating peroneal artery- 16%

https://boneandspine.com/blood-supply-of-talus/
The Talus: Anatomy

• Posterior tibial artery:
  – The posterior tubercle branches supply:
    • Both the medial and lateral tubercles
  – The tarsal canal artery:
    • Origin: 1 cm proximal to the bifurcation into the medial and lateral plantar arteries
    • Deltoid branches
    • Courses through the tarsal canal into the sinus tarsi
    • At the sinus tarsi, it forms an anastomosis with the tarsal sinus artery

• Tarsal sinus artery:
  • Branches from an anastomotic loop between the perforating peroneal artery and the lateral tarsal artery
The Talus: Anatomy

- Anterior Tibial Artery (continues as Dorsalis Pedis)
- Peroneal Artery
- Lateral Tarsal Artery
- Posterior Tibial Artery
- Artery of the Tarsal Sinus
- Medial Tarsal Branches
- Artery of the Tarsal Sling
- Inferior Talar Neck Branches
- Vascular plexus from Calcaneal branches of the Posterior Tibial Artery
- Artery of the Tarsal Canal
- Deltoid Branch

Melenevsky, RadioGraphics 2015
The Talus: Anatomy

• Talar body blood supply:
  – Tarsal canal artery:
    • Supplies the central and lateral two-thirds of the talar body
    • The remaining medial third of the talar body receives deltoid branches, arising from the tarsal canal artery
The Talus: Anatomy

• Talar neck blood supply:
  – The superomedial half of the talar neck and head is supplied by branches of the anterior tibial artery
  – The inferolateral half may be supplied:
    • Tarsal sinus artery
    • Branches of anastomosis of the tarsal sinus artery and the tarsal canal artery
    • Lateral tarsal artery, which arises from the dorsalis pedis artery
The Talus: Anatomy

Dorsalis pedis artery branches

BODY

Posterior tubercle branches

HEAD

Tarsal sinus branches

Artery of the tarsal canal
The Talus: Anatomy

Pearce, RadioGraphics 2005
The Talus

• Rady Children’s Hospital 3D Printing Lab

Special thanks to:
Dr. John Naheedy
Dr. Jerry Dewek
Dr. Daniel Vincour
Anatomy

Congenital

Stress related injuries and AVN

Impingement

The Talus
The Talus: Congenital Anomalies

- Congenital Vertical Talus (CVT)
- Clubfoot
- Talar coalition
- Accessory anterolateral talar facet (AALTF)
The Talus: Congenital Anomalies

- **Congenital Vertical Talus**
  - **Rocker bottom foot**
  - Prominent calcaneus/heel and a convexly rounded sole
  - Irreducible dorsal dislocation of the navicular on the talus producing a rigid flatfoot deformity present at birth

https://www.orthobullets.com/pediatrics/4066/congenital-vertical-talus

Khoshnaw et al, Radiopaedia
The Talus: Congenital Anomalies

• Congenital Vertical Talus

HAVESON, et al Congenital Flatfoot Due to Talonavicular Dislocation (Vertical Talus)
The Talus: Congenital Anomalies

• **Congenital Vertical Talus**
  – Epidemiology:
    • Rare, 1:150,000 births
    • 50% associated with neuromuscular disease
      chromosomal aberrations
  – 50% bilateral
  – M:F ratio of 2:1
The Talus: Congenital Anomalies

- **Congenital Vertical Talus**
  - Association:
    - Trisomy 13, 18
    - Myelomeningocele
    - Arthrogryposis
    - Diastematomyelia
    - Congenital dislocation of the hip
    - Cerebral palsy
    - Spinal muscular atrophy
The Talus: Congenital Anomalies

- **Congenital Vertical Talus**
  - Radiologic features:
    - Fixed equinus: plantarflexion of the calcaneus
    - Vertical talus: plantarflexion of the talus
    - Irreducible dorsal navicular dislocation
    - Forefoot valgus: divergence of the metatarsal bases (AP) and superimposition of the metatarsal bones (lateral)
    - Long axis of the talus passes plantar to the metatarsal axis (lateral) and medial to the first metatarsal (AP)

Khoshnaw et al, Radiopaedia
The Talus: Congenital Anomalies

- Congenital Talipes equinovarus:
  - ClubFoot
  - Idiopathic deformity of the foot of unclear etiology
The Talus: Congenital Anomalies

- Clubfoot (congenital talipes equinovarus):

![Diagram of talus anomalies](image)
The Talus: Congenital Anomalies

• Clubfoot (congenital talipes equinovarus):
  – Most common musculoskeletal birth defect
  – Overall incidence 1:1,000, though some populations 1:250 (Hawaiians and Maoris)
  – Male:female ratio 2:1
  – 50% bilateral
  – May be idiopathic, neurogenic, or syndrome-associated
  – 80% isolated
The Talus: Congenital Anomalies

- **Clubfoot (congenital talipes equinovarus):**
- **Pathophysiology**
  - Muscle contractures contribute to the characteristic deformity that includes *(CAVE)*
    - **Cavus** (tight intrinsics, FHL, FDL)
    - **Adductus of forefoot** (tight tibialis posterior)
    - **Varus** (tight tendoachilles, tibialis posterior, tibialis anterior)
    - **Equinus** (tight tendoachilles)
The Talus: Congenital Anomalies

- **Clubfoot (congenital talipes equinovarus):**
  - **Pathophysiology**
    - Genetics
      - Genetic component is strongly suggested
      - Unaffected parents with affected child have 2.5% - 6.5% chance of having another child with a clubfoot
      - Familial occurrence in 25%
      - Recent link to *PITX1*, transcription factor critical for limb development
      - Common genetic pathway may exist with congenital vertical talus
The Talus: Congenital Anomalies

- **Clubfoot (congenital talipes equinovarus):**
- **Pathophysiology**
  - Associated conditions
    - Arthrogryposis
    - Diastrophic dysplasia
    - Myelodysplasia
    - Tibial hemimelia
    - Amniotic band syndrome (streeter dysplasia)
      - Upper extremity and hand anomalies common in this population
    - Pierre robin syndrome
    - Opitz syndrome
    - Larsen syndrome
    - Prune-belly syndrome
    - Anterior tibial artery hypoplasia or absence is common, regardless of etiology of clubfoot
The Talus: Congenital Anomalies

- Clubfoot (congenital talipes equinovarus):
  - Radiologic features:
    - Hindfoot equinus: lateral talocalcaneal angle less than 35º
    - Hindfoot varus: talocalcaneal angle less than 20º
    - Metatarsus adductus
    - Talonavicular subluxation: medial subluxation of the navicular on the talus

Donnelly, Pediatric Imaging: The Fundamentals
Goel et al, Radiopaedia
The Talus: Congenital Anomalies

- **Clubfoot (congenital talipes equinovarus):**

Frontal talocalcaneal angle

Lateral talocalcaneal angle
The Talus: Coalition

- **Tarsal Coalition:**
  - Abnormal union between two tarsal bone:
    - Osseous (synostosis)
    - Cartilaginous (synchondrosis)
    - Fibrous (syndesmosis)
  - Any age:
    - Hindfoot and midfoot pain
    - Frequent ankle sprains
    - Rigid flatfoot
  - Incidence of 1–2%
The Talus: Congenital Anomalies

- Talus coalition:
  - Talonavicular coalition
  - Anterior facet talocalcaneal coalition
  - Posterior facet talocalcaneal coalition
  - Extra-articular posteromedial talocalcaneal coalition
  - Middle facet talocalcaneal coalition
The Talus: Congenital Anomalies

- Talus Coalition:
  - Anterior facet TCC
  - Middle facet TCC
  - Posterior facet TCC
  - Extraarticular TCC
  - Extraarticular TCC with os sustentaculum

Yun, et al, AJR:205, December 2015
The Talus: Congenital Anomalies

- Talus Coalition:
  - Anterior facet talocalcaneal coalition
The Talus: Congenital Anomalies

• Anterior facet talocalcaneal coalition
  – Rare
  – Anterior process of the calcaneus and anterior facet of the talus
Anterior facet talocalcaneal coalition

30 year old male. Left ankle pain. Multiple sprains previously. Painful medial, lateral talus, and anterior process of the calcaneus.
The Talus: Congenital Anomalies

- Talus Coalition:
The Talus: Congenital Anomalies

• Middle facet talocalcaneal coalition
  – Most common TCC
  – C-sign
  – Talar beak
  – Typical downward medial sloping seen on coronal MR
  – Hypoplastic or aplastic sustentaculum tali may also be present
Middle facet talocalcaneal coalition

13 y/o male. Ankle pain.
Middle facet talocalcaneal coalition

61 y/o male. Ankle pain.
The Talus: Congenital Anomalies

- Talus Coalition:

  - Posterior facet talocalcaneal coalition
Posterior facet talocalcaneal coalition

12 yo female presents with a history of medial pain
Posterior facet talocalcaneal coalition

48-year-old female with 3 months of worsening left heel pain. No preceding accident or injury.

Moe et al. AJR:186, January 2006

Normal (For Comparison)
Posterior facet talocalcaneal coalition

48-year-old female with 3 months of worsening left heel pain. No preceding accident or injury.
Posterior facet talocalcaneal coalition

48-year-old female with 3 months of worsening left heel pain. No preceding accident or injury.
The Talus: Congenital Anomalies

• Talus Coalition:

Extra-articular posteromedial talocalcaneal coalition
The Talus: Congenital Anomalies

• Extra-articular posteromedial talocalcaneal coalition:
  – Described by Harris in 1955
  – Linklater et. al. suggested that EATCC is usually a fibrous coalition
  – Asymptomatic or minimally symptomatic adult patients
  – Accompanied by various bony deformities or relatively normal subtalar joint

The posterior sustentaculum tali is a ridge of bone posterior to the middle subtalar joint and medial to the posterior subtalar joint.
Extra-articular posteromedial talocalcaneal coalition

52 y/o male ankle pain. No injury
The Talus: Congenital Anomalies

• Extra-articular posteromedial talocalcaneal coalition:

<table>
<thead>
<tr>
<th>Type of coalition</th>
<th># of coalitions (%)</th>
<th># of osseous coalitions (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle facet</td>
<td>97 (70.2)</td>
<td>33 (34)</td>
</tr>
<tr>
<td>Posterior facet</td>
<td>2 (1.4)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Posteromedial subtalar</td>
<td>39 (28.2)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Total</td>
<td>138 (100)</td>
<td>33 (23.9)</td>
</tr>
</tbody>
</table>
The Talus: Congenital Anomalies

- Extra-articular posteromedial talocalcaneal coalition:
  - EATCC can result in tarsal tunnel syndrome:
    - Direct pressure by the bony protrusion on the tarsal tunnel structures
    - Secondary to ganglion cysts arising from the coalition and decompressing into the tarsal tunnel
Extra-articular posteromedial talocalcaneal coalition

25 y/o female. Medial ankle mass status post injury 1 year ago causing pain and numbness.
Extra-articular posteromedial talocalcaneal coalition

25 y/o female. Medial ankle mass status post injury 1 year ago causing pain and numbness.
Extra-articular posteromedial talocalcaneal coalition

25 y/o female. Medial ankle mass status post injury 1 year ago causing pain and numbness.
Petchprapa, et al
17 year old man with bilateral ankle pain

Middle subtalar coalition (MSC)

Middle subtalar coalition + PMEAC

Petchprapa, et al
The Talus: Congenital Anomalies

• Os sustentaculum:
  – First described by Pfitzner in 1896
  – Small accessory bone lodged at the medial and posterosuperior aspects of the sustentaculum tali
    inferomedial aspect of the medial talar tubercle
  – Rare: 0.3–0.4%
  – Component of a type of extraarticular talocalcaneal coalition
Os sustentaculum

30 year old male. Left ankle pain. Multiple sprains previously. Painful medial, lateral talus, and anterior process of the calcaneus.
Os sustentaculum

30 year old male. Left ankle pain. Multiple sprains previously. Painful medial, lateral talus, and anterior process of the calcaneus.
Os sustentaculum

68 year old male. Recent fleck from France. Left leg pain since then.
The Talus: Congenital Anomalies

- Talus Coalition:
  - Talonavicular coalition
The Talus: Congenital Anomalies

• Talonavicular coalition:
  – Rare
  – Uni or bilateral
  – Associations:
    • Symphalangism
    • Clinodactyly
    • Great toe that is shorter than the second toe
    • Pes cavus
    • Calcaneonavicular coalition
    • Talocalcaneal coalition
  – Mushroom sign (AP)
  – Loss of the talar-scaphoid joint line at the level of Chopart's joint (Lateral)
Talonavicular coalition

35-year-old male. Bilateral ankle pain. No preceding accident or injury.
Talonavicular coalition

Case courtesy of Karine Morche, Radiopaedia.org, rID: 68160
The Talus: Congenital Anomalies

• Accessory Anterolateral Talar Facet
  – First described by Sewell in 1904
  – Previously known as “facies externa accessoria corporis tali”
  – Squaring or broadening of the apex of the lateral aspect of the talus
The Talus: Congenital Anomalies

• Accessory Anterolateral Talar Facet
  – One of the causes of a painful rigid flat foot
  – Other more recognized and established causes of flat foot:
    • Tarsal coalition
    • Hindfoot valgus
    • Infectious
    • Inflammatory
    • Degenerative arthritides
    • Neoplastic or neurologic processes
    • Osteochondral fractures
The Talus: Congenital Anomalies

- Accessory Anterolateral Talar Facet

The Talus: Congenital Anomalies

• Accessory Anterolateral Talar Facet
The Talus: Congenital Anomalies

• Accessory Anterolateral Talar Facet

AJR:207, October 2016
AALTF Osseous Findings
AALTF Osseous Findings
AALTF Soft Tissues Findings
The Talus: Congenital Anomalies

• Accessory Anterolateral Talar Facet:
  – Prevalence initially reported by Sewell: only 10.2%
  – MR imaging prevalence of the AALTF:
    • 32.7% of symptomatic patients
    • 26.0% of asymptomatic volunteers
  – Two cadaveric studies by Martus et al. and Sarrafian in which an AALTF was seen in 34% of specimens in both studies
The Talus: Congenital Anomalies

• Alqahtani et al, reported AALTF in **31.55%** of 187 patients with sinus tarsi syndrome and/or tarsal coalition
**Table 1** Demographics and Imaging Characteristics of AALTF

<table>
<thead>
<tr>
<th></th>
<th>Total n (%)</th>
<th>AALTF n (%)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td>187 (100.00)</td>
<td>59 (31.55)</td>
<td></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>88 (47.10)</td>
<td>36 (40.91)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>99 (52.90)</td>
<td>23 (23.23)</td>
<td></td>
</tr>
<tr>
<td><strong>Side</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>95 (50.80)</td>
<td>31 (32.63)</td>
<td>&gt;0.1</td>
</tr>
<tr>
<td>Left</td>
<td>92 (49.20)</td>
<td>28 (30.43)</td>
<td>&gt;0.1</td>
</tr>
<tr>
<td><strong>Modality</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MRI +/- CT</td>
<td>165 (88.24)</td>
<td>52 (31.15)</td>
<td>&gt;0.1</td>
</tr>
<tr>
<td>CT only</td>
<td>22 (11.76)</td>
<td>7 (31.82)</td>
<td></td>
</tr>
<tr>
<td><strong>Osseous changes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcaneal bone marrow edema*</td>
<td>45 (27.27)</td>
<td>36 (80.00)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Talar bone marrow edema*</td>
<td>39 (23.64)</td>
<td>35 (89.74)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Cortical thickening</td>
<td>36 (19.25)</td>
<td>34 (94.44)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Cystic changes</td>
<td>35 (18.72)</td>
<td>24 (68.57)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Subfibular soft tissue edema*</td>
<td>37 (22.42)</td>
<td>29 (78.38)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Sinus tarsi edema*</td>
<td>117 (70.91)</td>
<td>45 (38.46)</td>
<td>0.014</td>
</tr>
</tbody>
</table>

*Bone marrow and soft tissue edema was only evaluated on 165 patients who had MR imaging.
The Talus: Congenital Anomalies

Table 2 Frequency of Coalition and AALTF

<table>
<thead>
<tr>
<th>Tarsal coalition</th>
<th>Total n (%)</th>
<th></th>
<th>AALTF n (%)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td></td>
<td>n (%)</td>
<td></td>
</tr>
<tr>
<td>Any coalition</td>
<td>70 (37.43%)</td>
<td>31 (44.29%)</td>
<td>0.005</td>
<td></td>
</tr>
<tr>
<td>CNC</td>
<td>37 (19.79%)</td>
<td>11 (29.73%)</td>
<td>0.478</td>
<td></td>
</tr>
<tr>
<td>MFTCC</td>
<td>9 (4.81%)</td>
<td>7 (77.78%)</td>
<td>0.005</td>
<td></td>
</tr>
<tr>
<td>PFTCC</td>
<td>5 (2.67%)</td>
<td>1 (20.00%)</td>
<td>&gt;0.1</td>
<td></td>
</tr>
<tr>
<td>EATCC</td>
<td>25 (13.37%)</td>
<td>19 (76.00%)</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>6 (3.21%)</td>
<td>1 (16.67%)</td>
<td>0.901</td>
<td></td>
</tr>
</tbody>
</table>

* CNC= Calcaneonavicuaular coalition, MFTCC= Middle facet talocalcaneal coalition, PFTCC= Posterior facet talocalcaneal coalition, EATCC= Extra-articular talocalcaneal coalition
Accessory Anterolateral Talar Facet
Accessory Anterolateral Talar Facet
Accessory Anterolateral Talar Facet
• 31 patients (aged 19-75 years) with persistent sinus tarsi pain
• Subjects underwent accessory facet resection with balancing reconstruction
• Arthroscopically,
  – 66% focal defect on the AALTF cartilage surface
  – 83% attenuation of the posterior capsular ligament
Accessory Talar Facet Impingement in Pathologic Conditions of the Peritalar Region in Adults

Hisateru Niki, MD, PhD, Takaaki Hirano, MD, PhD, Yui Akiyama, MD, PhD, and Moroe Beppu, MD, PhD

• All x-ray parameters showed significant improvement postoperatively (P < .001)
• Mean objective scores improved from 54.0 preoperatively to 91.0 postoperatively (P < .001)
• Sinus tarsi pain and FABME were absent in all cases at the final follow-up
Accessory Talar Facet Impingement in Pathologic Conditions of the Peritalar Region in Adults

Hisateru Niki, MD, PhD¹, Takaaki Hirano, MD, PhD¹,
Yui Akiyama, MD, PhD¹, and Moroe Beppu, MD, PhD¹

A. Preoperative
B. Postoperative

32 year old male. Ankle pain
32 year old male. Ankle pain
AALTF Acquired vs Congenital
The Talus

• Rady Children’s Hospital 3D Printing Lab

Special thanks to:
Dr. John Naheedy
Dr. Jerry Dewek
Dr. Daniel Vincour
Anatomy

Congenital

Impingement

The Talus

Fractures
The Talus: Fractures

- Talar fractures represent *less than 1%* of all fractures in the human body
- 3% and 6% of fractures in the foot
- High-energy trauma
  - Talar head (5%), neck (50%), and body (23%) fractures
    - Posterior process fracture
    - Lateral process fracture
    - Talar dome injuries
The Talus: Fractures

- **Talar Head Fractures:**
  - Articular surface of the talus at the talonavicular articulation
  - Accompanied by dislocation or subluxation and adjacent bone fractures
  - 5%–10% of all talar fractures
  - Pain at the dorsal midfoot, swelling and focal tenderness to palpation over the talar head, and painful range of motion

**Mechanism:**
- Crush injury to the articular surface
- Significant comminution
- Shear fracture
Talar head fracture

20 years old male, status post MVA
Talar head fracture

20 years old male, status post MVA
The Talus: Fractures

• **Talar Head Fractures**:
  - Imaging:
    • AP, oblique, and lateral radiographs of the foot
    • CT
  - Management:
    • Nondisplaced talar head fractures are treated conservatively
    • Displaced fractures require surgical intervention
  - Goal:
    • Maintain congruity of the talonavicular joint
    • Reduce the incidence of subsequent osteoarthritis and avascular necrosis
Talar head fracture

20 years old male, status post MVA
The Talus: Fractures

• **Talar Neck Fractures**:  
  – Traditionally considered the most common talar fracture  
  – *Anterior or inferior to the lateral process* of the talus and the talar dome cartilage  
  – High incidence:  
    • Small cross-sectional area  
    • Vascular ingrowth, which increases the neck’s porosity

*Melenevsky, RadioGraphics 2015*
The Talus: Fractures

• Talar Neck Fractures:
  – Mechanism of injury:
    • First described in airplane pilots during World War I and termed *aviator astragalus*
    • Motor vehicle or motorcycle collisions and high-level falls
    • Majority extended from the talar body or head

Mechanism:
• Combination of axial and dorsiflexion
The Talus: Fractures

- **Talar Neck Fractures**:

<table>
<thead>
<tr>
<th>Fracture Type</th>
<th>Description</th>
<th>Risk of Osteonecrosis (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Nondisplaced talar neck fracture</td>
<td>0–15</td>
</tr>
<tr>
<td>II</td>
<td>Talar neck fracture and talocalcaneal dislocation</td>
<td>20–50</td>
</tr>
<tr>
<td>III</td>
<td>Talar neck fracture, talocalcaneal dislocation, and tibiotalar dislocation</td>
<td>100</td>
</tr>
<tr>
<td>IV</td>
<td>Talar neck fracture and disruption of all talar articulations</td>
<td>100</td>
</tr>
</tbody>
</table>
The Talus: Fractures

- Talar Neck Fractures:
  - Type I fracture: all three major sources of blood supply remain intact
  - Type II fractures: may lead to disruption of the artery of the tarsal canal
  - Type III fractures: disrupt both the artery of the tarsal canal and the deltoid and calcaneal branches
  - Type IV fractures: all three major sources of blood supply to the talus are likely compromised
The Talus: Fractures

35 years old male, fall from car

Hawkins-Canale type I talar neck fracture
The Talus: Fractures

35 years old male, fall from car

Hawkins-Canale type I talar neck fracture
The Talus: Fractures

67 years old female, head on motor vehicle collision

Hawkins-Canale type II talar neck fracture
The Talus: Fractures

29 years old male, status post fall from 25 feet

Hawkins-Canale type III talar neck fracture
The Talus: Fractures

Hawkins-Canale type IV talar neck fracture

Melenevsky, RadioGraphics 2015
The Talus: Fractures

• Talar Neck Fractures:
  – Type I: Nonoperative management
  – Most type II fractures are treated with surgical reduction
  – Type III and IV fractures:
    • Closed reduction
    • Open reduction and internal fixation
The Talus: Fractures

- **Talar Body Fractures**:  
  - 13% to 61%  
  - Simple, two-fragment fractures or extensively comminuted injuries  
  - Majority of talar body fractures are displaced and will require operative treatment  
  - Complications such as osteonecrosis and posttraumatic osteoarthritis are commonly encountered

**Mechanism:**  
- High energy  
- Shear and crush fractures  
- Axial load on a dorsiflexed foot
The Talus: Fractures

- Talar Body Fractures:

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Compression or osteochondral dome fracture</td>
</tr>
<tr>
<td>B</td>
<td>Coronal shear fracture</td>
</tr>
<tr>
<td>C</td>
<td>Sagittal shear fracture</td>
</tr>
<tr>
<td>D</td>
<td>Posterior tubercle fracture</td>
</tr>
<tr>
<td>E</td>
<td>Lateral tubercle fracture</td>
</tr>
<tr>
<td>F</td>
<td>Crush comminuted fracture</td>
</tr>
</tbody>
</table>

*Melenevsky, RadioGraphics 2015*
Talar body fracture

38 years old female, jumped off a cemented wall
Talar body fracture

20 years old male, status post trauma
The Talus: Fractures

• Osteochondral Fractures of the Talar Dome:
  – Impaction injury, which damages the articular cartilage and subchondral bone
  – 31% of talar dome compression fractures are occult on radiographs
  – *Lesion* and *fracture* have often been used interchangeably to describe osteochondral defects (OCDs).
  – OCD lesions account for about 1% of all talar fractures
  – The most commonly used system for classifying OCD lesions was presented by Berndt and Harty in 1959
The Talus: Fractures

- **Osteochondral Fractures of the Talar Dome:**
  - Additional staging described by Scranton and McDermott in 2001
    - Stage 1 is subchondral bone compression
    - Stage 2 is a partially detached osteochondral fragment
    - Stage 3 is a completely detached but nondisplaced osteochondral fragment
    - Stage 4 is a completely detached and displaced osteochondral fragment
    - Stage 5 is a large cyst below the articular surface.
The Talus: Fractures

• Osteochondral Fractures of the Talar Dome:
  – Lateral lesions:
    • Shallow
    • Wafer-shaped
    • Dorsiflexion and inversion injuries
  – Medial lesions:
    • Less symptomatic
    • Deep and cup-shaped
    • Plantar flexion and inversion (Fig 12).
  – Stable and nondisplaced OCD fragments: heal
  – Displaced unstable fragments: AVN
Osteochondral Fractures
Osteochondral Fractures
The Talus: Fractures

• **Posterior Process Fractures:**
  
  • Lateral tubercle (Shepherd fracture)
  
  • Medial tubercle (Cedell fracture) → posteromedial fragment
    
    – *Positive nutcracker sign:* Pain and crepitation on forced plantar flexion of the ankle

• Treatment: Immobilization or excision of the fragment

**Mechanism:**

• Direct trauma or forced plantar flexion

• Dorsiflexion and pronation → avulsion of PTAF
Posterior Process Fractures

20 years old, status post injury
Posterior Process Fractures

Melenevsky, RadioGraphics 2015
The Talus: Fractures

- **Lateral Process Fractures:**
  - Occult on initial radiographs → best on AP view
  - 2.3% of all snowboarding injuries
  - 15% of all ankle injuries
  - 19% of talar fractures in patients injured in motor vehicle accidents and falls from a height

**Mechanism:**
- Dorsiflexed
- Eversion
- Axial loading
The Talus: Fractures

- **Lateral Process Fractures:**
  - **Classification (Hawkins criteria):**
    - **Simple (type I):** Most common
      - Single fracture line extending from the talofibular articular surface to the subtalar joint

*Melenevsky, RadioGraphics 2015*
The Talus: Fractures

• Lateral Process Fractures:
  – Classification (Hawkins criteria):
    • Comminuted (type II)
      – Involving the entire lateral process and both articular surfaces

Melenovsky, RadioGraphics 2015
The Talus: Fractures

- Lateral Process Fractures:
  - Classification (Hawkins criteria):
    - Chip (type III)
      - Region of the sinus tarsi and are usually visualized only on lateral radiograph

Melenevsky, RadioGraphics 2015
Anatomy

Congenital

Fractures

Stress related injury

The Talus
The Talus: Stress fractures

- Talus is a relatively uncommon site of a stress fracture
- First report by McGlone in 1965
- Athletes, military recruits, and sports enthusiasts
- Talar head stress fracture is the most common

http://radsource.us/stress-fractions-foot-ankle/
The Talus: Stress fractures

56-year-old female status post fall November 2018 with persistent ankle pain and edema. No additional history of trauma.
56-year-old female status post fall November 2018 with persistent ankle pain and edema. No additional history of trauma.
The Talus: Stress fractures

56-year-old female status post fall November 2018 with persistent ankle pain and edema. No additional history of trauma.
Anatomy
Congenital
Fracture
Stress related injury
AVN
The Talus
The Talus: Avascular Necrosis

• Anatomic consideration:
  – 60% of its surface is covered by articular cartilage
  – No muscular or tendinous attachments
  – Only a limited area of penetrable bone is available for vascular perforation
  – Small nutrient vessels
  – Variations in intraosseous anastomoses
  – Lack of collateral circulation
The Talus: Avascular Necrosis

• AVN (osteonecrosis) of the talus:
  – Interruption in any part of the vascular network:
    • Arteries, capillaries, sinusoids, and veins
  – This interruption can be classified as:
    • Obstruction
    • Compression
    • Physical disruption

• The body’s response to AVN is an attempt at repair by means of reossification, revascularization and resorption of necrotic bone → radiographic appearance of AVN
The Talus: Avascular Necrosis

• AVN (osteonecrosis) classification:
  – Traumatic
    • Fracture and dislocation of the talar neck
  – Atraumatic
    • Corticosteroids
    • Alcoholism
    • Systemic lupus erythematosus
    • Renal transplants
    • Sickle cell anemia
    • Hyperlipidemia
    • Irradiation
    • Inherited thrombophilias
The Talus: Avascular Necrosis

• Hawkins sign:
  – Thin subchondral radiolucent line along all or part of the talar dome
  – 6–8 weeks after injury
  – AP radiographs
  – Adequate blood supply

• Partial Hawkins: incomplete (partial) AVN → lateral > medical
The Talus: Avascular Necrosis

38 year old male, history of fall from fence.
The Talus: Avascular Necrosis

24 year old male, history of SLE. No Trauma.
The Talus: Avascular Necrosis

68 year old female, bilateral ankle pain. Obesity. No other risk factors.
The Talus: Avascular Necrosis
68 year old female, bilateral ankle pain. No Trauma.
The Talus: Avascular Necrosis

68 year old female, bilateral ankle pain. No Trauma.
"I, Talus of the House Tarsus, First of my Name, King of the Andals and the First Men, and Lord of the Seven Tarsal Kingdoms, protector of the realm END THIS PRESENTATION."
Talus Bone Shower Curtain

by Science Picture Co

$90.00
ADD TO CART

IMAGE SIZE

DESCRIPTION
Our shower curtains are made from 100% polyester fabric and include 12 holes at the top of the curtain for simple hanging from your own shower curtain rings. The total dimensions of each shower curtain are 71" wide x 74" tall.

SHIPS WITHIN
2 - 3 business days
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Thank you