

ACUTE SPORTS INJURIES IN CHILDREN

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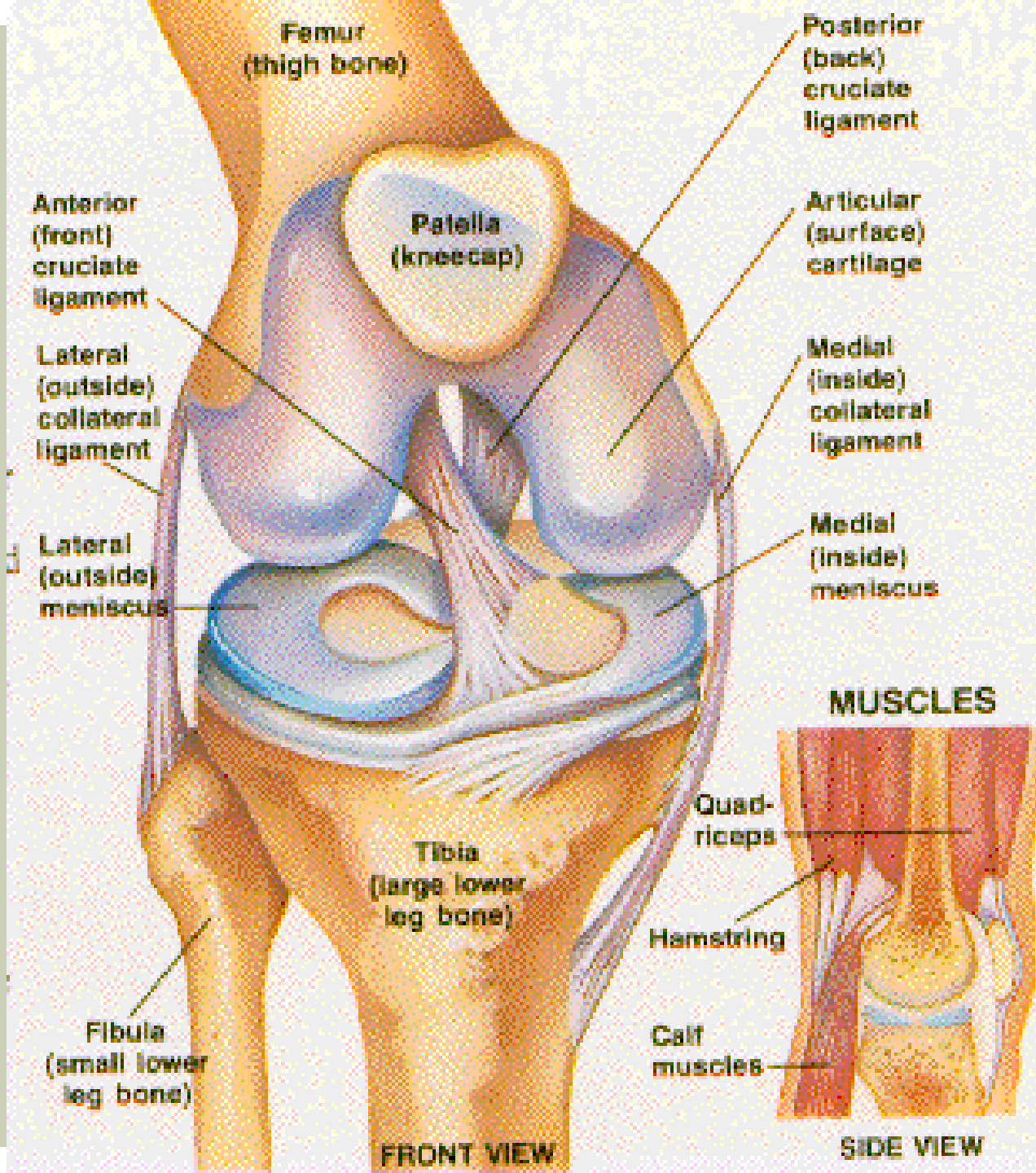
OBJECTIVES

- Understand pearls on the injury history which may lead to the injury diagnosis
- Identify the differential diagnosis in acute knee and ankle injuries.

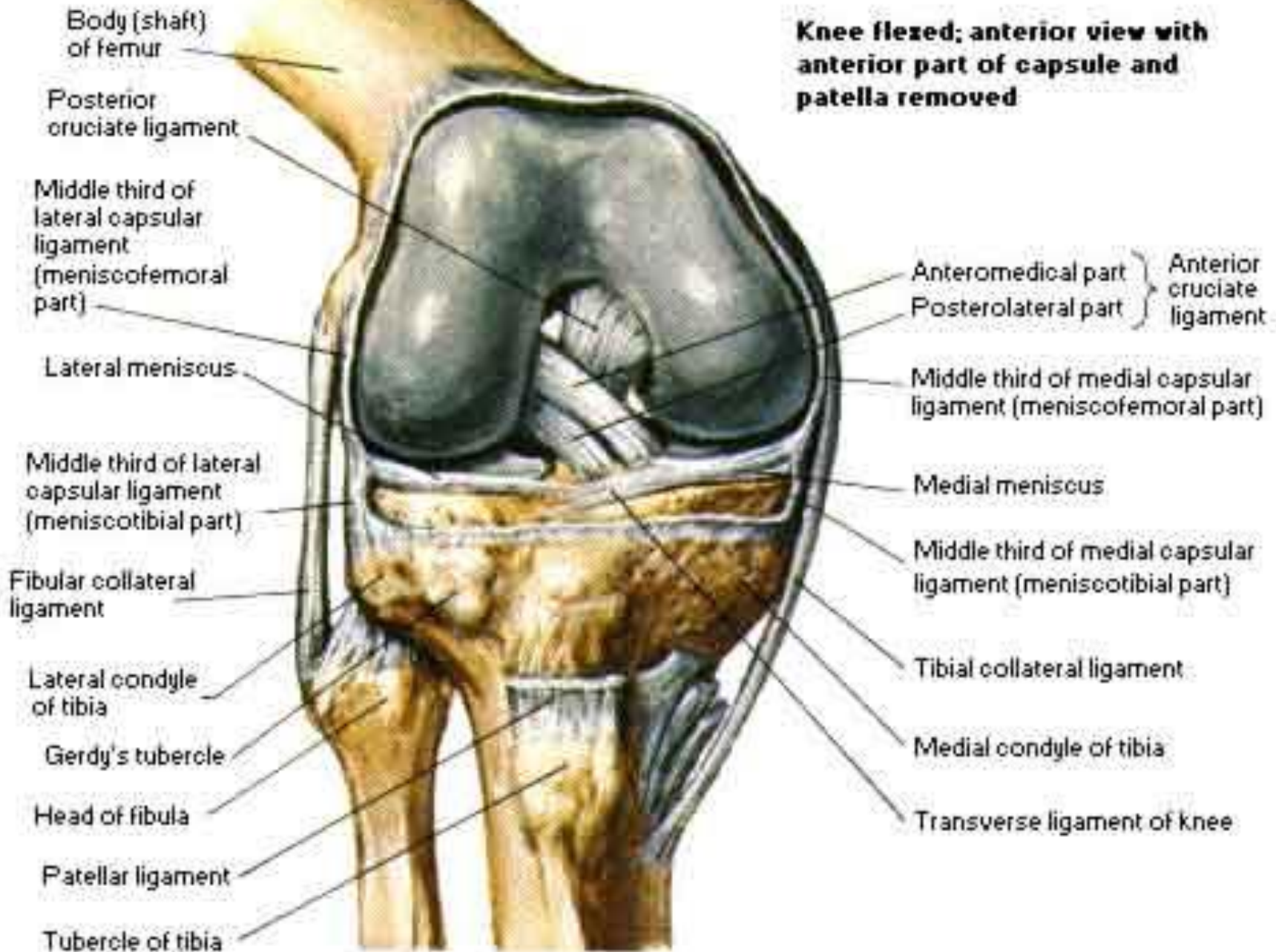
GENERAL PRINCIPLES OF MUSCULOSKELETAL EVALUATION

- Inspection
- Palpation
- Range of Motion Testing
- Provocative Testing
- Functional Testing

ACUTE KNEE INJURIES



Knee flexed; anterior view with anterior part of capsule and patella removed



THE BIG SIX IN ACUTE KNEE PAIN

- ACL
- PCL
- MCL
- Meniscus
- Patellar dislocation
- Fracture

PROVOCATIVE TESTING

- **ACL**
 - Lachman's
 - Anterior Drawer
- **PCL**
 - Posterior Drawer
 - Posterior Sag Test
- **Meniscus**
 - McMurray's test
 - Apley Compression Test
- **MCL**
 - Valgus Stress Test
- **LCL**
 - Varus Stress Test
- **Patella**
 - Patellar Apprehension Test

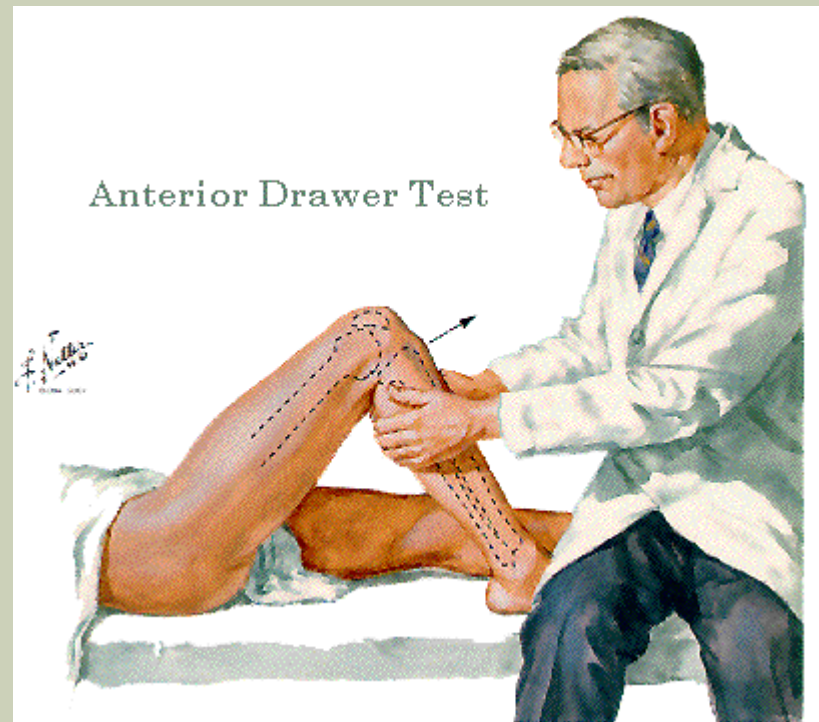
CASE 1

- **17 year old female soccer player who hears a “loud pop” and pain during pivoting**
- **She is unable to continuing competing and must be assisted off the field**
- **A moderate to large knee effusion ensues**
- **She describes her pain as generalized and is unable to ambulate**

CASE 1 – PHYSICAL EXAMINATION

- Large knee effusion
- Very limited knee ROM
- Generalized tenderness to palpation
- Asymmetric Lachman
- Asymmetric Anterior Drawer Testing
- Radiographs normal

Anterior Drawer Test for ACL



Lachman Test for ACL



http://www.sportsdoc.umn.edu/Clinical_Folder/Knee_Folder/knee.htm

ACL RUPTURE

- History: “hyperextension” injury with feeling a “pop” at the time of injury
- Mechanism: Pivoting and or planting motion
- Pearls: Large swelling initially; Triad of O’Donahue (Unhappy Triad) – ACL, MCL, medical meniscus
- Effusion: significant with acute traumatic injury
- Pain: generalized initially; decreases over next few days
- Ambulation: May be difficult in light of effusion
- Treatment: XR; MRI; referral to Sports surgeon

CASE 2

- 19 year old male who was the front passenger in an MVC
- He recalls his knee hitting the dashboard and has experienced knee pain since that time
- Mild to moderate knee effusion was noted the day after the incident
- He was initially unable to ambulate
- However, he presents to your office approximately 10 days after the MVC, he describes walking with a “mild limp”

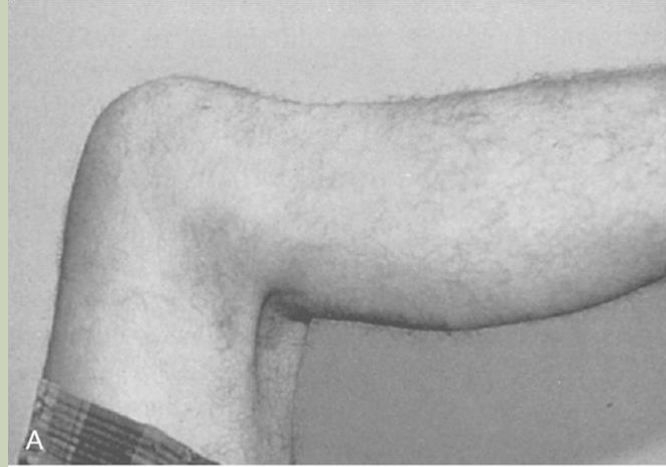
CASE 2 – PHYSICAL EXAMINATION

- Knee flexion to 90 degrees, extension lag of 10 degrees
- Mild to moderate knee effusion
- No specific focal tenderness to palpation
- Asymmetric Posterior Drawer
- Asymmetric Posterior Sag Test
- Negative Dial Test
- Mild Antalgic Gait
- Radiographs Normal

Posterior Drawer Test for PCL



POSTERIOR SAG SIGN



DIAL TEST



PCL INJURY

- History: Trauma (direct fall from height on knee or MVC/hits dashboard)
- Mechanism: high velocity knee injury while in flexed position
- Pearls: Swells initially; improves over a few days; must assess for posterolateral corner injury
- Effusion: can be significant with acute injury
- Pain: generalized initially improves over few days
- Ambulation: May be difficult in light of effusion
- Treatment: XR; MRI; often non-surgical; PT; bracing; rest from sports for up to 12 weeks

CASE 3

- 16yo male playing a pickup game of football with his buddies
- Sustained a blow to the outside of the knee
- Experienced pain on the “inside of his knee” at that time
- No swelling noted
- Able to score the winning touchdown, but with a mild to moderate antalgic gait

CASE 3 – PHYSICAL EXAMINATION

- Full active range of motion of the knee
- No knee effusion
- Tenderness to palpation in the medial knee
- 1+ Laxity to Valgus Stress Testing at 30 degrees of knee flexion
- No Laxity to Valgus Stress at 0 degrees of knee flexion
- Mild Antalgic Gait
- Radiographs Normal



Valgus Testing for MCL



Varus Testing for LCL

<http://ahn.mnsu.edu/athletictraining/spata/kneemodule/specialtests.html/>

MCL INJURY

- **History: Trauma**
- **Mechanism: Most commonly sprained from a direct blow to the outside of the knee or an excessive outward twist when the foot is planted on the ground. More common on surfaces that have increased friction (turf and courts)**
- **Pearls: Swells initially; improves over a few days**
- **Effusion: can be significant with acute injury**
- **Pain: generalized initially improves over few days**
- **Ambulation: May be difficult in light of effusion**

CASE 4

- **18 year old who sustained a pivot injury when playing soccer a few months ago**
- **Describes initial swelling and intermittent swelling with current activity**
- **Describes knee locking and “giving way”**

CASE 4 – PHYSICAL EXAMINATION

- Slightly decreased active range of motion of the knee secondary to pain (loss of full extension)
- Mild to moderate knee effusion
- Tenderness to palpation at the medial joint line
- Positive McMurray's → medial knee pain
- Mild Antalgic Gait
- Radiographs Normal

McMurray's Test for Meniscus



MENISCUS TEAR

- **History:** Pain with squatting, twisting limitation of movement; +/- locking
- **Mechanism:** Pivoting motion
- **Pearls:** Swells initially; Triad of O'Donahue (Unhappy Triad) – ACL, MCL, medial meniscus
- **Effusion:** significant with acute traumatic injury
- **Pain:** Localized to joint line; generalized
- **Ambulation:** May be difficult in light of effusion

CASE 5

- 14 year old female who was coming down from a rebound while playing basketball and felt an acute pop in her knee
- Describes a sensation that “something moved”
- She fell to the ground and was unable to continue competing
- She had to be carried off the court
- She notes an immediate knee effusion and pain

CASE 5 – PHYSICAL EXAMINATION

- Large knee effusion
- Very limited knee ROM
- Generalized tenderness to palpation, but maximal ttp at medial patella and adductor tubercle
- 3+ Patellar glide
- Positive patella apprehension testing
- Radiographs normal

Patellar Apprehension Test



PATELLA DISLOCATION

- History: “knee went out” laterally
- Mechanism: Flexion and pivot
- Pearls: Hypermobility very common
- Effusion: moderate to significant from retinacular tearing
- Pain: Generalized initially; medially later
- Ambulation: May be limited secondary to swelling
- Treatment: PT with **VMO Strengthening**; patella stabilization brace; rest from PE/Sports 6 weeks

ACUTE ANKLE INJURIES

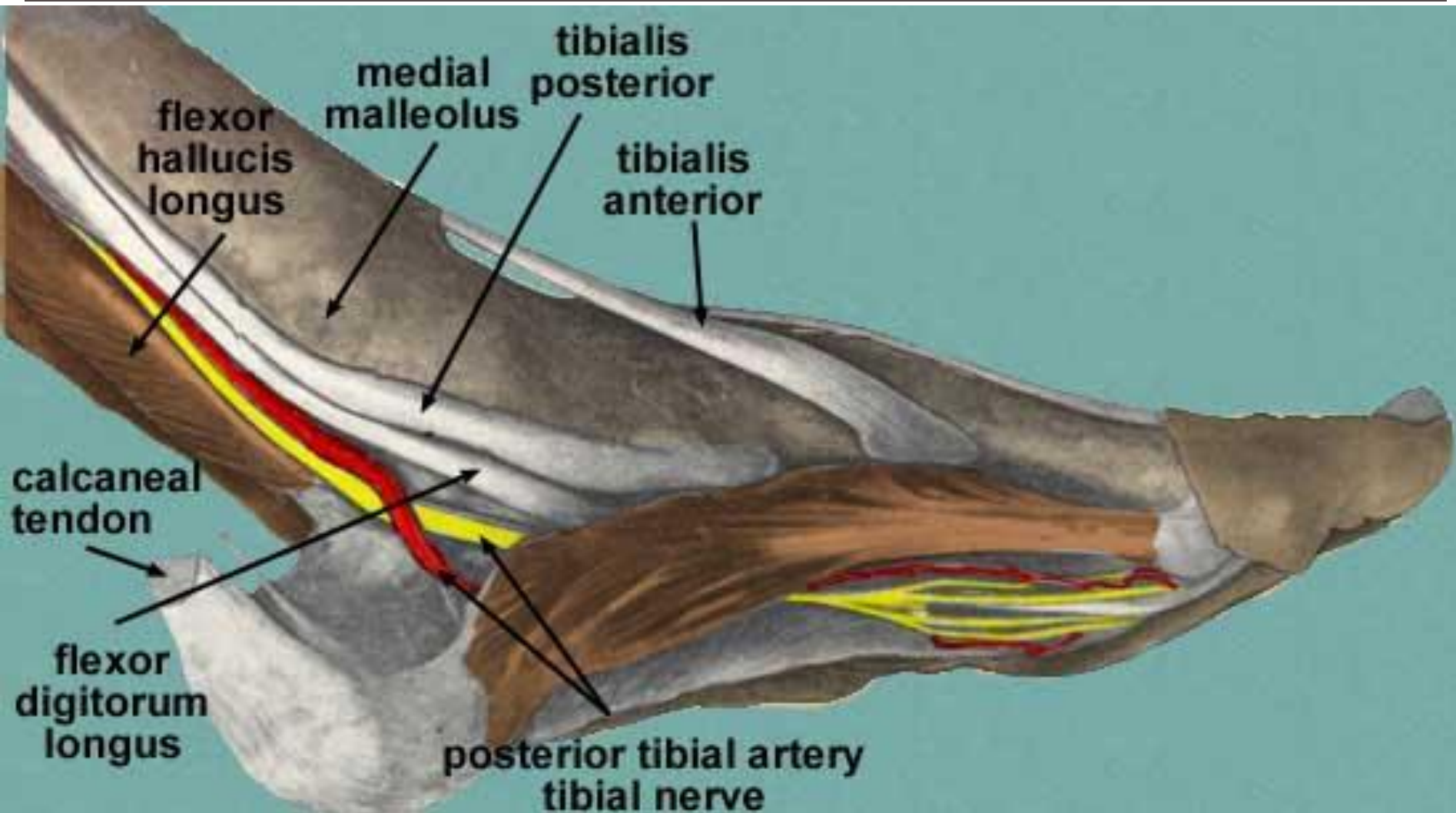
PALPATION – 13 LANDMARKS

- 1) Entire Course of the Fibula (Maisonneuve's fracture)
- 2) Medial Joint Line
- 3) Anterior Joint Line
- 4) Lateral Joint Line
- 5) Medial Malleolus
- 6) Lateral Malleolus
- 7) Navicular
- 8) Base of 5th Metatarsal – insertion of peroneus brevis
- 9) ATFL
- 10) Calcaneofibular ligament
- 11) PTFL
- 12) Deltoid Ligament
- 13) Achilles Tendon

TENDONS OF MEDIAL ANKLE

- **Posterior to M malleolus (in order)**
 - **Tibialis Posterior tendon**
 - **Flexor Digitorum Longus tendon**
 - **Posterior tibialis artery, vein and nerve**
 - **Flexor hallucis longus tendon**
- **“Tom, Dick, and a Very Nervous Harry”**

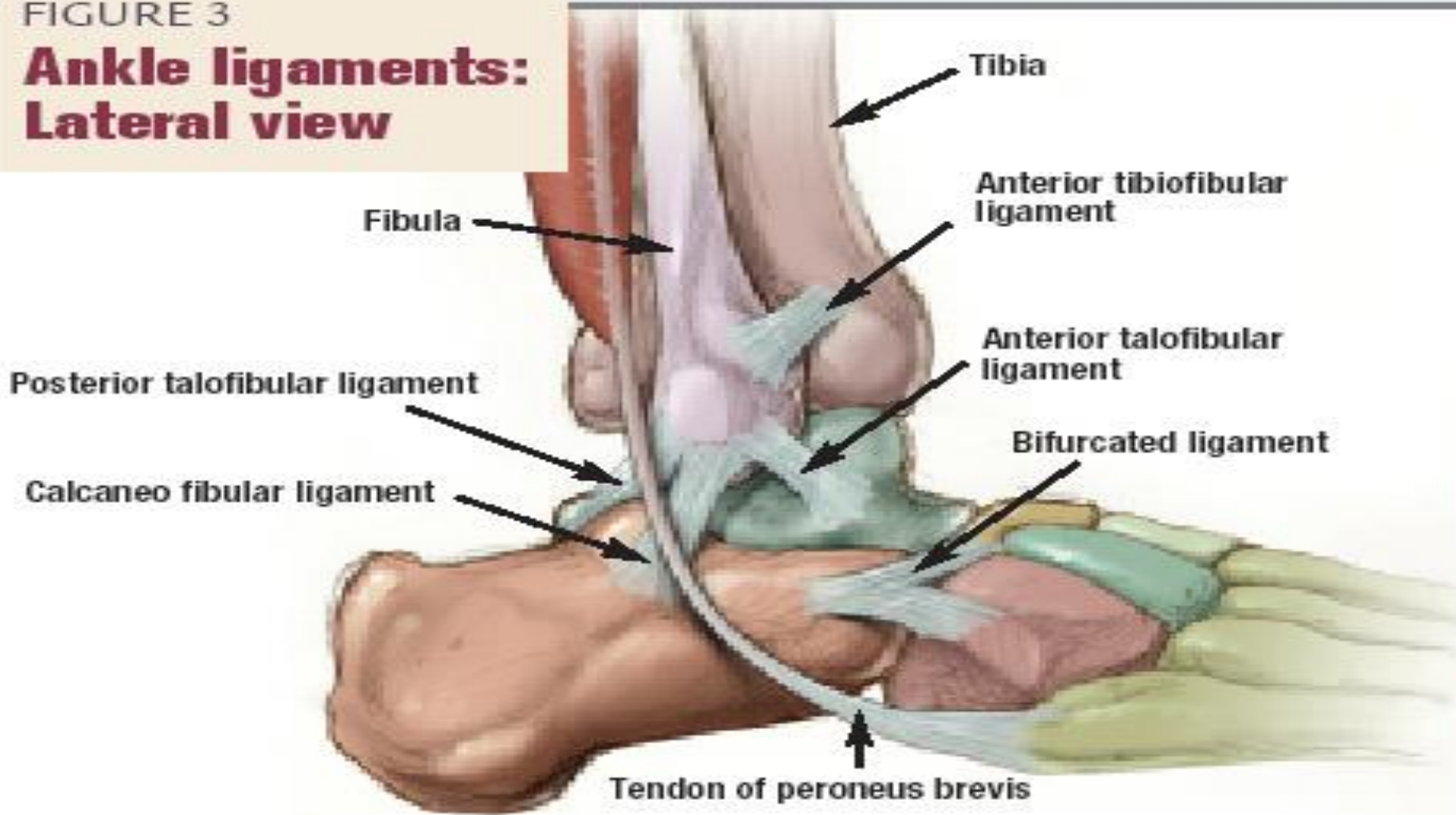
TENDONS OF MEDIAL ANKLE



LATERAL ANKLE ANATOMY

FIGURE 3

Ankle ligaments: Lateral view



The lateral ligament complex consists of the anterior talofibular ligament (ATFL), calcaneofibular ligament (CFL), and the posterior talofibular ligament (PTFL). The ATFL restrains anterior displacement of the talus and is the ligament that is sprained most often.

ANTERIOR ANKLE ANATOMY

FIGURE 4

Tibiofibular syndesmosis



Anterior view of the tibiofibular syndesmosis, above left, shows the anterior inferior tibiofibular ligament and interosseous ligament, which connect the distal tibia and fibula, and the interosseous membrane, which connects the tibia and fibula for their entire length. Also shown is the anterior aspect of the deltoid (medial) ligament, which has both superficial and deep components. The posterior view, above right, shows the posterior inferior tibiofibular ligament, connecting the distal tibia and fibula.

FIGURE 8

Squeeze test



With the patient seated on the exam table and the knees flexed at 90° , gently squeeze the affected leg at midcalf. Pain in the ankle joint indicates injury to the tibiofibular syndesmosis (high ankle sprain).

CASE 1

- 18 yo basketball player who sustained an inversion injury to his right ankle while rebounding
- His injury resulted in ankle effusion and significant ecchymosis on the lateral aspect of the ankle
- He is unable to bear weight on the right ankle at the time of injury and in your clinic

PHYSICAL EXAMINATION – CASE 1



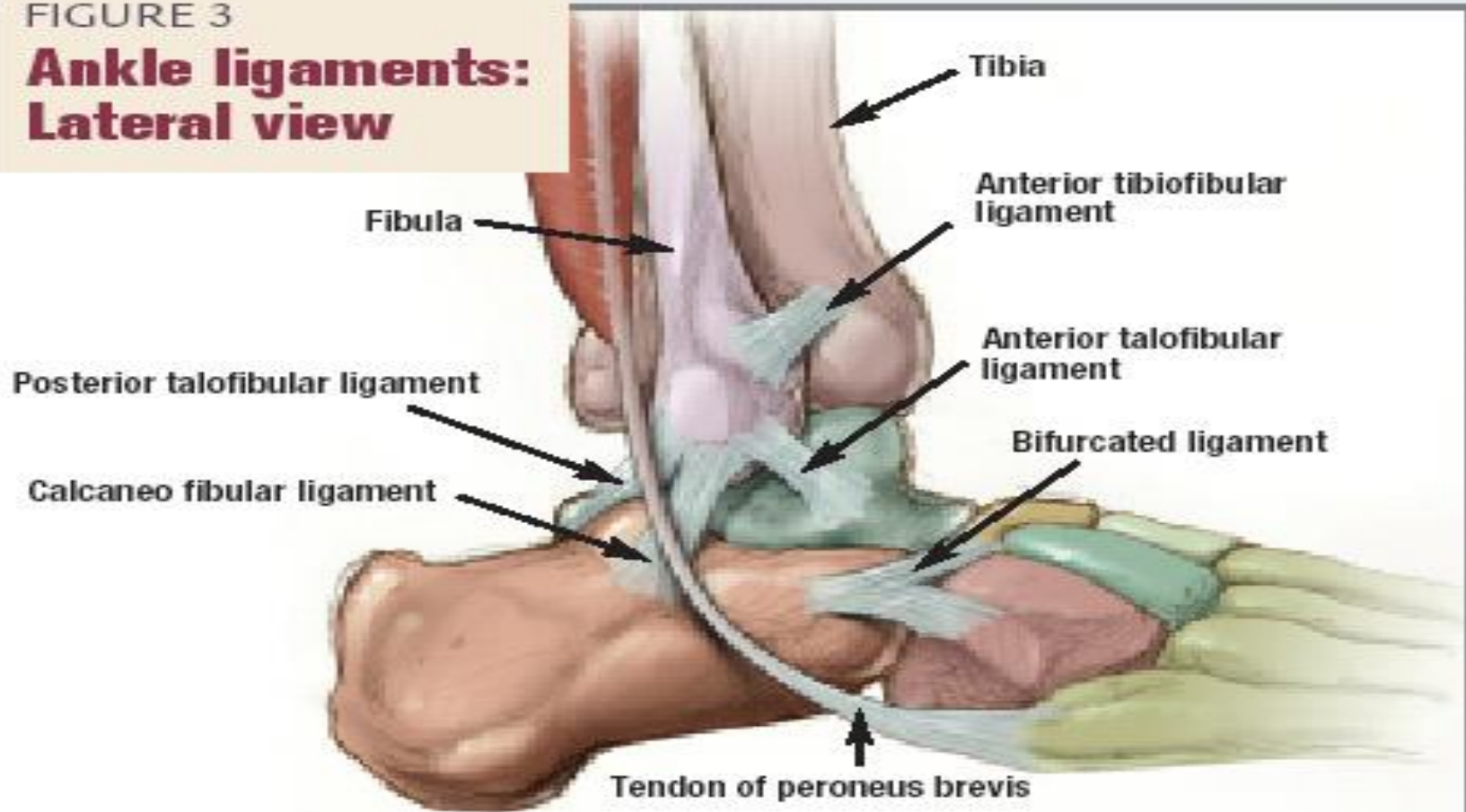
CASE 1 PHYSICAL EXAMINATION

- **INSPECTION:** Ecchymosis and effusion of the lateral aspect of the ankle
- **ROM:** Decreased range of motion of the ankle
- **PALPATION:** ttp along the ATFL, Calcaneofibular ligament, and PTFL
- No ttp along tibia, fibula, medial or lateral malleolus, navicular, base of 5th metatarsal, or Achilles tendon
- **PROVOCATIVE TESTING:** Positive anterior drawer and inversion stress test
- Syndesmosis squeeze testing was negative
- Thompson testing reproduced ankle plantarflexion
- **FUNCTIONAL TESTING:** Unable to bear weight

DIAGNOSIS

FIGURE 3

Ankle ligaments: Lateral view



The lateral ligament complex consists of the anterior talofibular ligament (ATFL), calcaneofibular ligament (CFL), and the posterior talofibular ligament (PTFL). The ATFL restrains anterior displacement of the talus and is the ligament that is sprained most often.

ANKLE SPRAIN

- 80% of ankle sprains are inversion injuries
- Inversion typically results in medial injury (in order from A → P)
 - ATFL
 - Calcaneofibular ligament
 - PTFL
- Eversion injury more rare secondary to position of fibula
- Eversion typically results in lateral injury to deltoid ligament

Ankle sprain



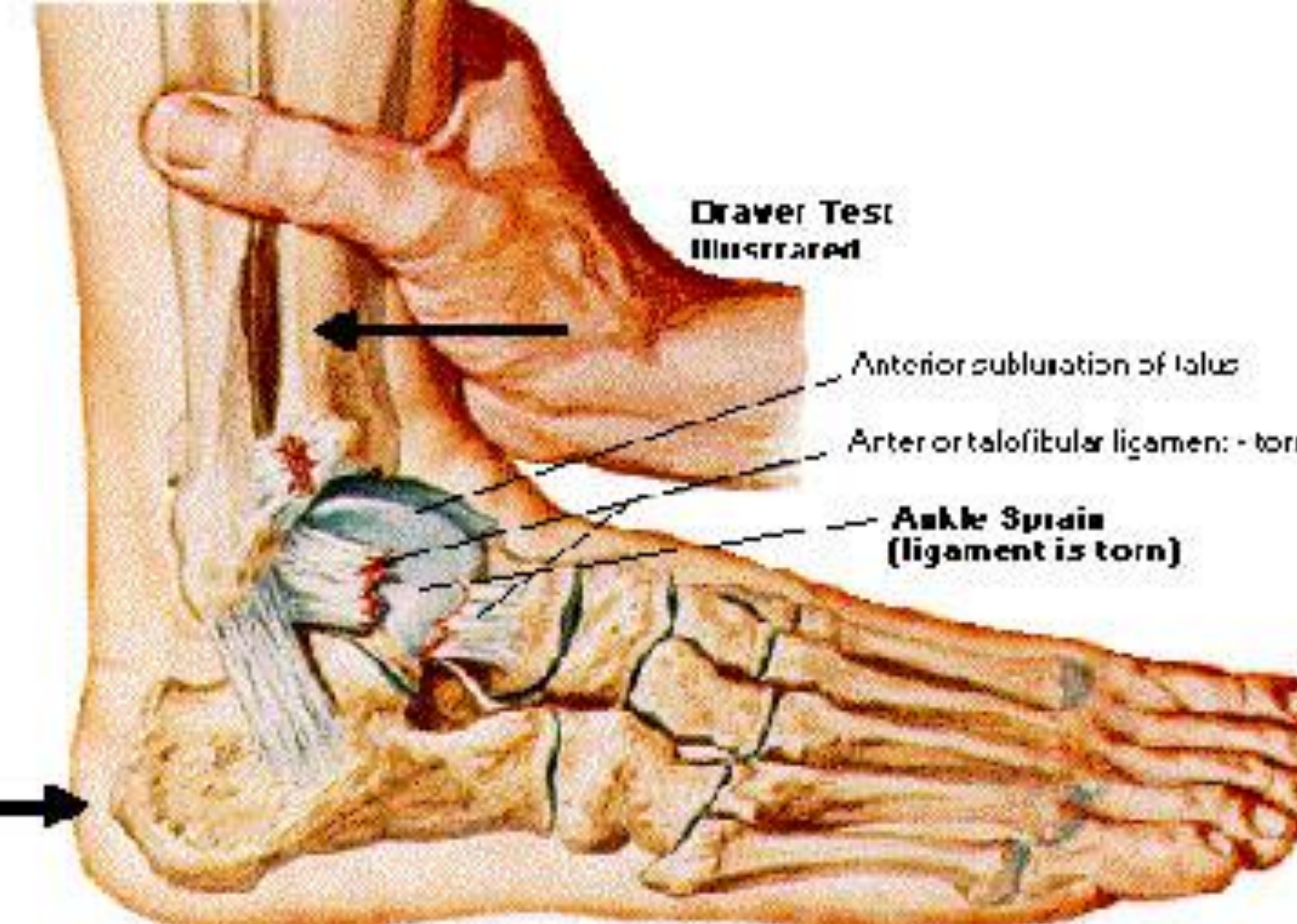
Swelling, inflammation and bruising of ankle



Damage to ligaments of the ankle



Drawer Test Illustrated

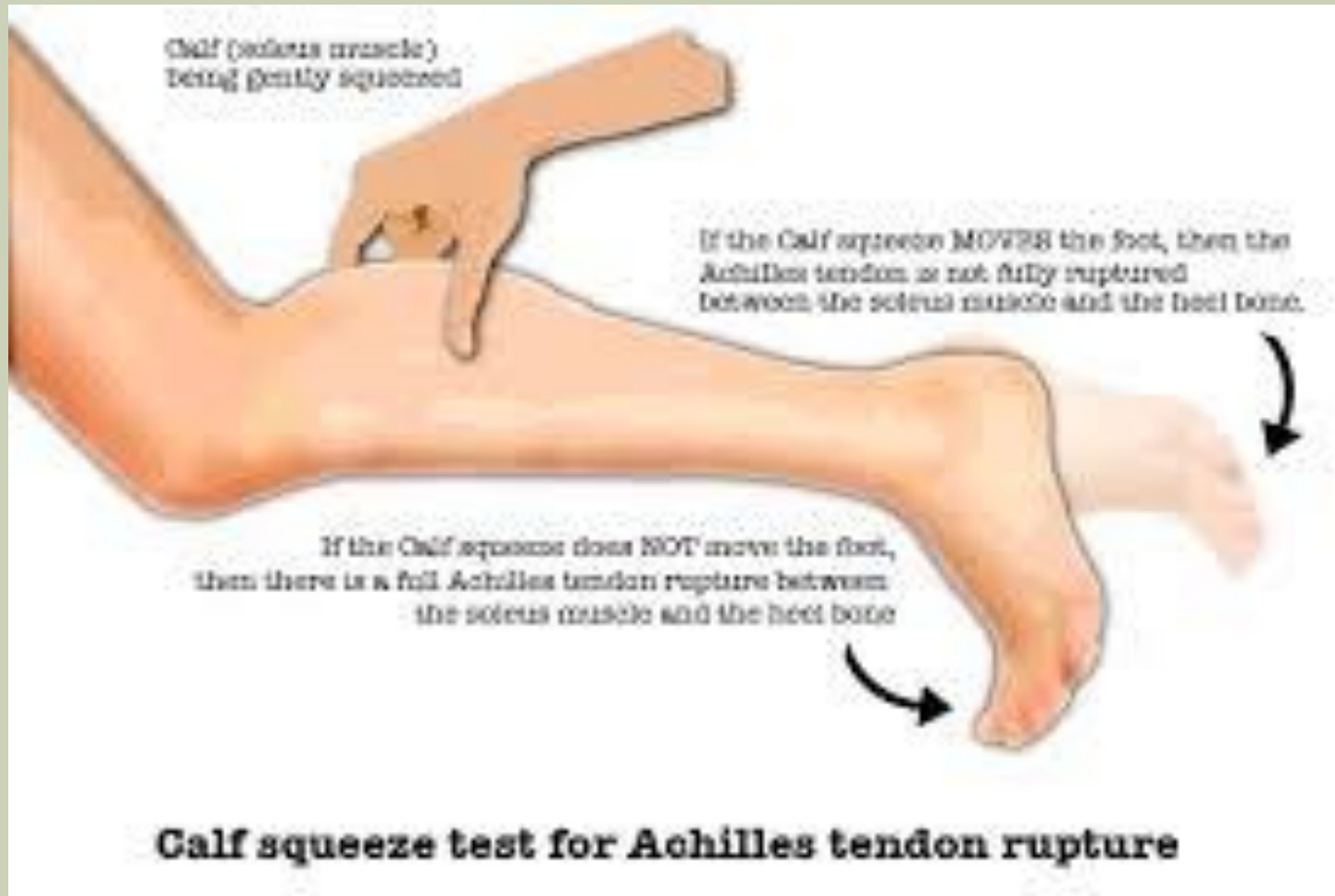


Anterior subluxation of talus

Anterior talofibular ligament: - torn

**Ankle Sprain
(ligament is torn)**

THOMPSON TESTING



CASE 2

- 18 yo basketball player who sustained an eversion injury to his right ankle while rebounding
- His injury resulted in generalized ankle effusion and significant generalized ecchymosis of the ankle and foot
- He was unable to bear weight on the right ankle at the time of injury and in your clinic

CASE 2 – PHYSICAL EXAMINATION

- **INSPECTION:** Generalized ecchymosis and effusion
- **ROM:** Decreased range of motion of the ankle
- **PALPATION:** No ttp along the ATFL, Calcaneofibular ligament, and PTFL
- No ttp along tibia, fibula, medial or lateral malleolus, navicular, or base of 5th metatarsal
- ttp deltoid ligament
- **PROVOCATIVE TESTING:** Negative anterior drawer and inversion stress test
- Positive Syndesmosis squeeze testing
- Thompson testing reproduced ankle plantarflexion
- **FUNCTIONAL TESTING:** Unable to bear weight on right foot

CASE 2 RADIOGRAPHS



SYNDESMOTIC INJURY

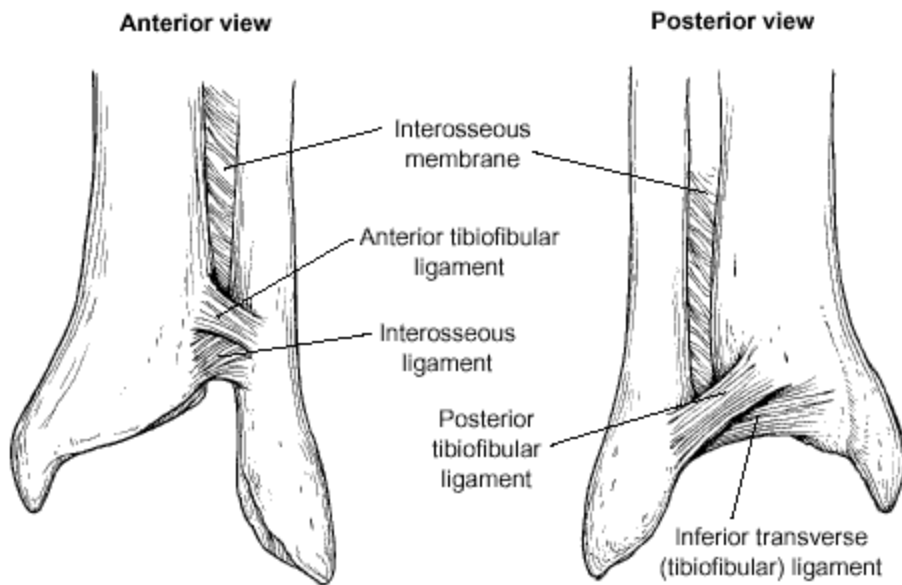
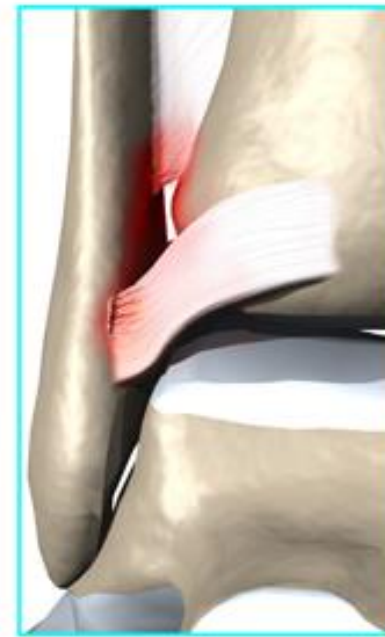


Fig. 1 The components of the DLES.



Ankle Syndesmosis Injury



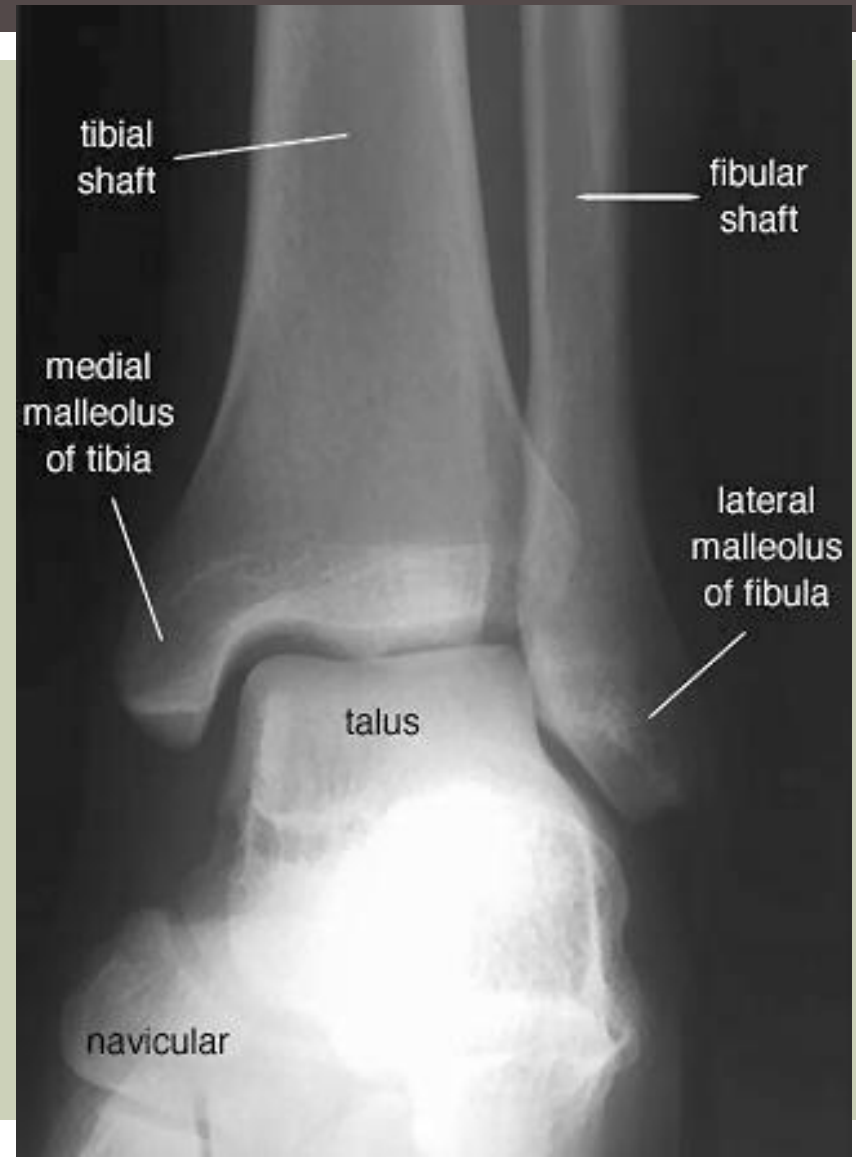
DELTOID LIGAMENT



COMPARISON - NORMAL RADIOGRAPHS



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DIAGNOSIS

- **Deltoid Sprain and Syndesmotic Disruption**
- **Mechanism: Eversion Ankle Injury**
- **Disruption of A and P tibiofibular ligaments and syndesmosis**
- **Ankle Mortise is disrupted**
- **Often requires surgical intervention**

CASE 3

- 6 yo who jumped out of his treehouse and sustained an injury to his left ankle
- His injury resulted in ankle effusion and significant ecchymosis on the lateral aspect of the ankle
- He was unable to bear weight on the right ankle at the time of injury and in your clinic

CASE 3 – PHYSICAL EXAMINATION

- **INSPECTION:** Ecchymosis and effusion of the lateral aspect of the ankle
- **ROM:** Decreased range of motion of the ankle
- **PALPATION:** No ttp along the ATFL, Calcaneofibular ligament, and PTFL
- No ttp along tibia, A/M/L joint lines, medial or lateral malleolus, deltoid, navicular, base of 5th metatarsal, or Achilles tendon
- ttp physis of the distal fibula
- **PROVOCATIVE TESTING:** Negative anterior drawer and inversion stress test
- Negative syndesmosis squeeze testing
- Thompson testing reproduced ankle plantarflexion
- **FUNCTIONAL TESTING:** Unable to bear weight on right foot

CASE 3 DIAGNOSIS

- **Salter Harris I fracture of the distal fibula**
- **The growth plate (physis) is composed of cartilaginous material which is weaker than the surrounding ligaments, making it vulnerable to disruption**
 - Growth plate cartilage is less resistant to stress than adult articular cartilage
 - It is less resistant to shear and tension forces than adjacent bone
 - The physis may be 2–5 times weaker than the surrounding fibrous tissue

SH 1 FRACTURE DISTAL FIBULA

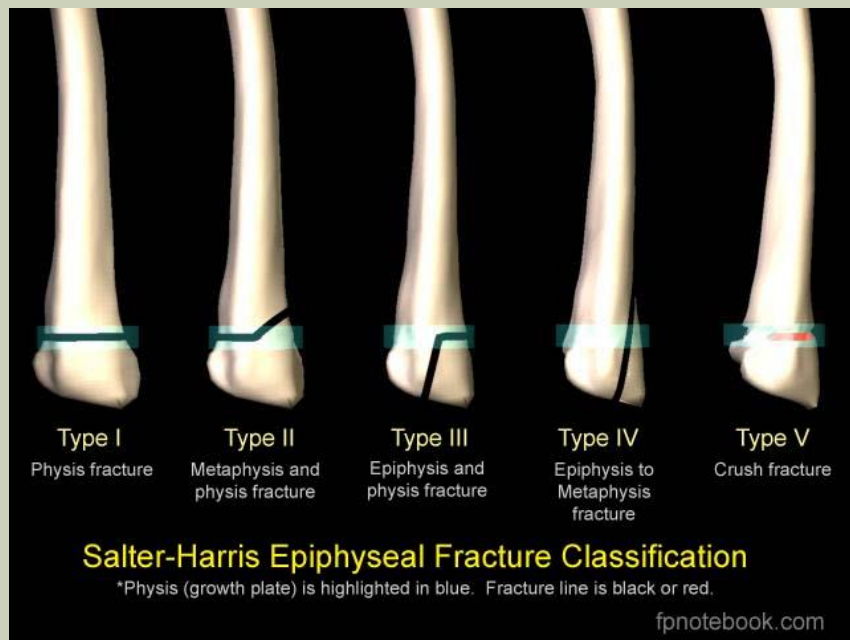


5 days post injury



2 weeks post injury

SALTER-HARRIS FRACTURES



- Acute physeal injuries may account for up to 30% of injuries (in Cannes)
- Physeal injury may result in:
 - Limb length discrepancy
 - Angular deformity
 - Altered joint mechanics
 - Significant long term disability

THANK YOU



Maypop (Chinese Crested)



Coco (Yorkshire Terrier)

REFERENCES

- Available on request