

# Tip of the Iceberg Fractures

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No Conflicts of Interest

# Missed Fractures

- Leading cause of malpractice claims in ED
- 10-20 % of all malpractice claims
- 2nd in claim amount and number of cases established against ED physicians

# Diagnostic Pitfalls

- Inadequate History (ie. Trauma, R/O fracture)
- Incomplete Physical Exam (ie. Maisonneuve fracture)
- Wrong Body Part Requisition (ie. Foot / ankle)
- Suboptimal Views (ie. C-Spine)
- Incorrect Interpretation
- Misunderstanding of X-Ray Sensitivity
- Failure to Pursue with Other Imaging Modalities
- Satisfaction of Search Error (2nd fracture)

# Missed fracture Stats

As a % of all missed fractures in the extremities

- Foot and ankle: 9.5%
- Knee: 6.5%
- Elbow: 6.0%
- Hand and wrist: 9.5%
- Overall percentage for all missed fractures: 3.7%

Wei (Taipei, Acta Radiol 2006)

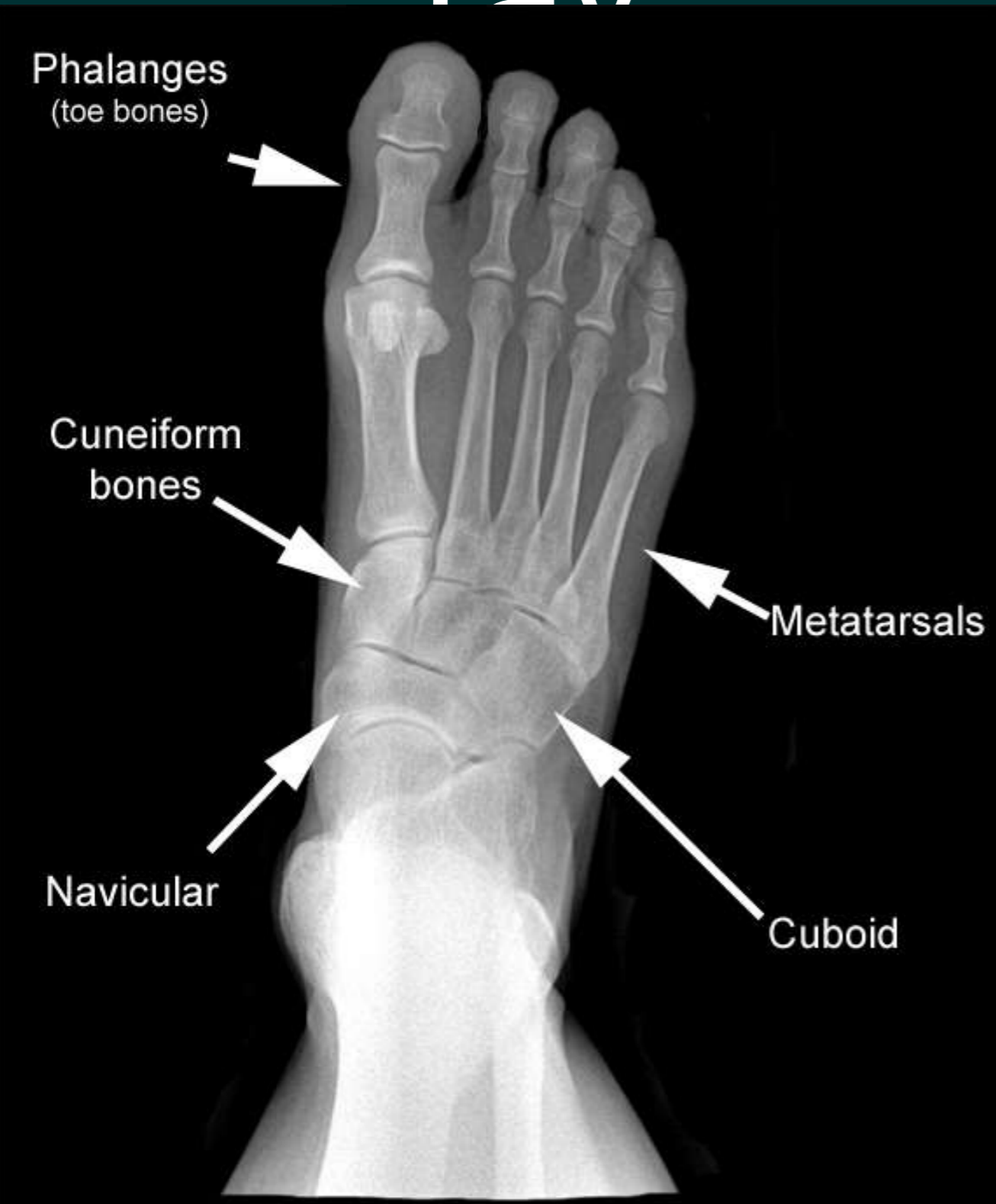
# Follow-Up

- Ligamentous Injuries Can Be Debilitating
- Clear Follow-Up Plan
- Well Established X-Ray Abnormal Recall System

# Fractures Discussed

- Lisfranc
- Talar
- Segond
- Tibial Plateau
- Coronoid
- Radial Head and Neck
- Carpal bones
- Hip

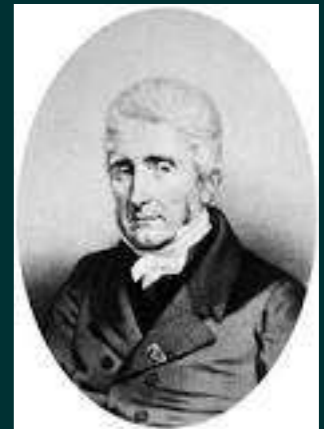
# Foot X-ray





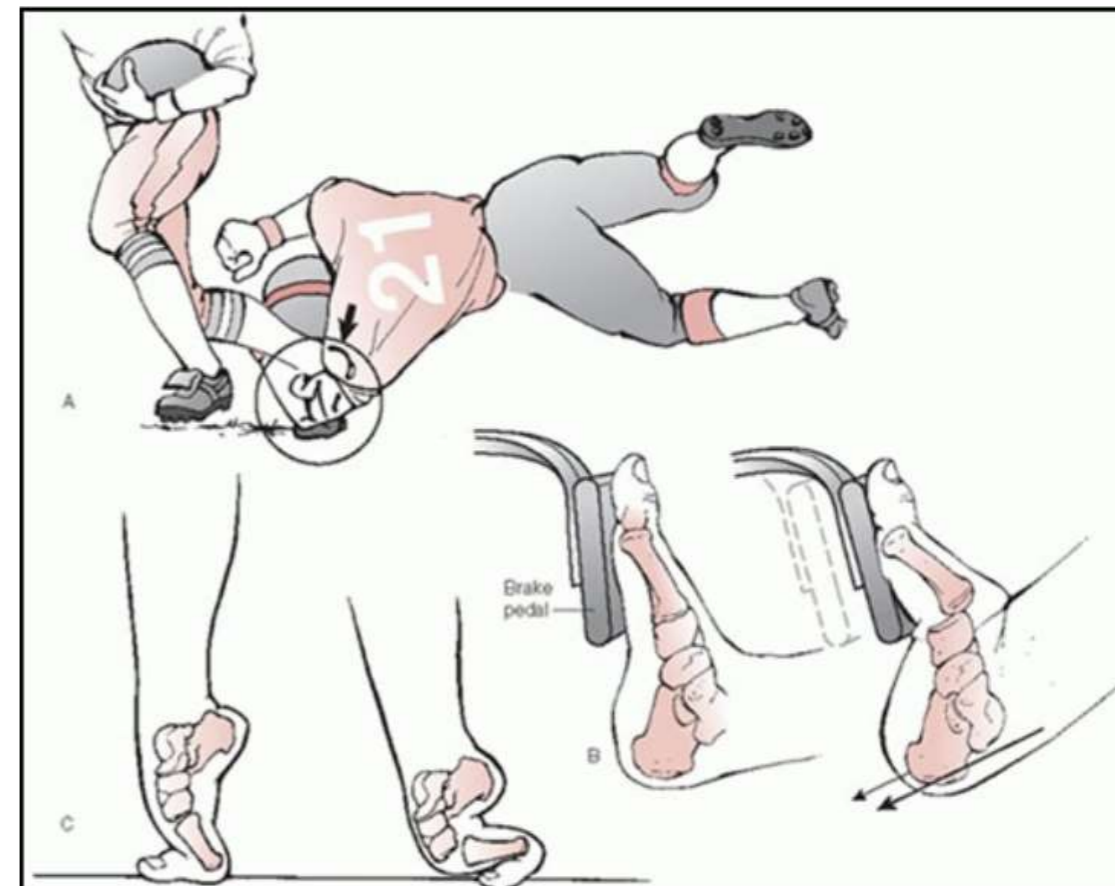
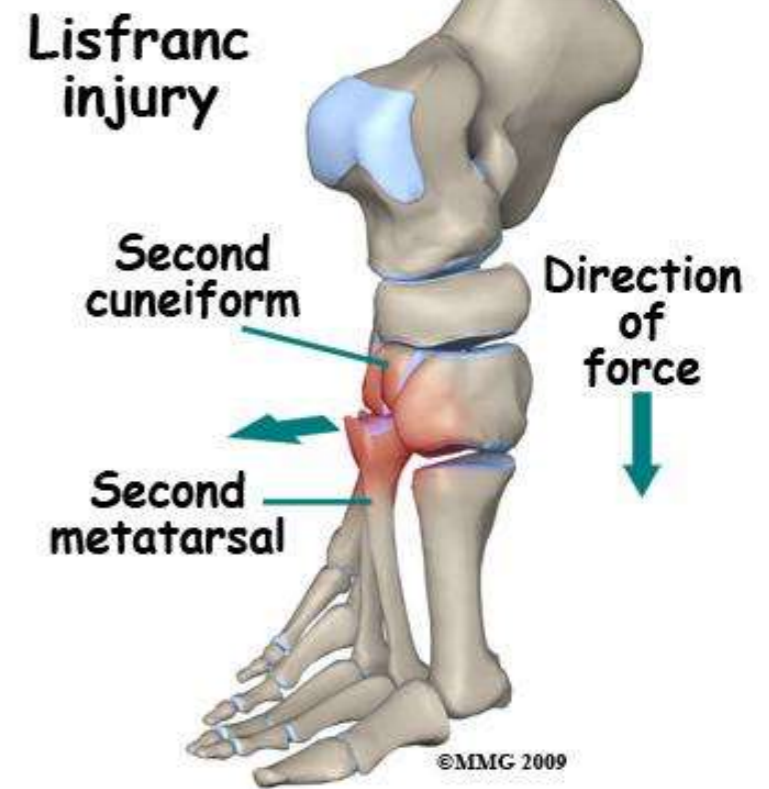
# LISFRANC

- Jacques LISFRANC de St. Martin



# Lisfranc

- Fracture dislocation at the Tarsal Metatarsal Joint
- Crush Injury
- Rotational Force
- Axial load on a plantarflexed foot



# Lisfranc Fractures

- 1/55,000/year
- 20% are missed initially esp. in Polytrauma
  - 43% MVA
  - 24% falls
  - 13% crush injuries
  - 10% sports injuries
  - 2nd MC foot injury in collegiate football players

# LISFRANC Fractures

- Types:
  - Homolateral (associated with cuboidal fractures)
  - Isolated
  - Divergent (associated with navicular fractures)



Sound Note Info

### Dorsal Tarsometatarsal Ligaments (Right)

*(Ligamentum tarsometatarsea dorsalia)*

The dorsal tarsometatarsal ligaments connect the dorsal surfaces of the tarsals to the metatarsals.

# LISFRANC Sprain STAGING

- **I.** Ligamentous Sprain (diagnosed on bone scan as increased uptake)
- **II.** 1st to 2nd interMT diastasis of 1-5 mm due to Rupture of Lisfranc Ligament. No loss of arch height
- **III.** 1st to 2nd InterMT diastasis and loss of arch height

- Type A injuries: Displacement of all five metatarsals with or without fracture of the base of the second metatarsal.

The usual displacement is lateral or dorsolateral, and the metatarsals move as a unit. These injuries are referred to as homolateral.

- Type B injuries: One or more articulations remain intact.
  - Type B1 injuries are medially displaced, sometimes involving the intercuneiform or naviculocuneiform joint.

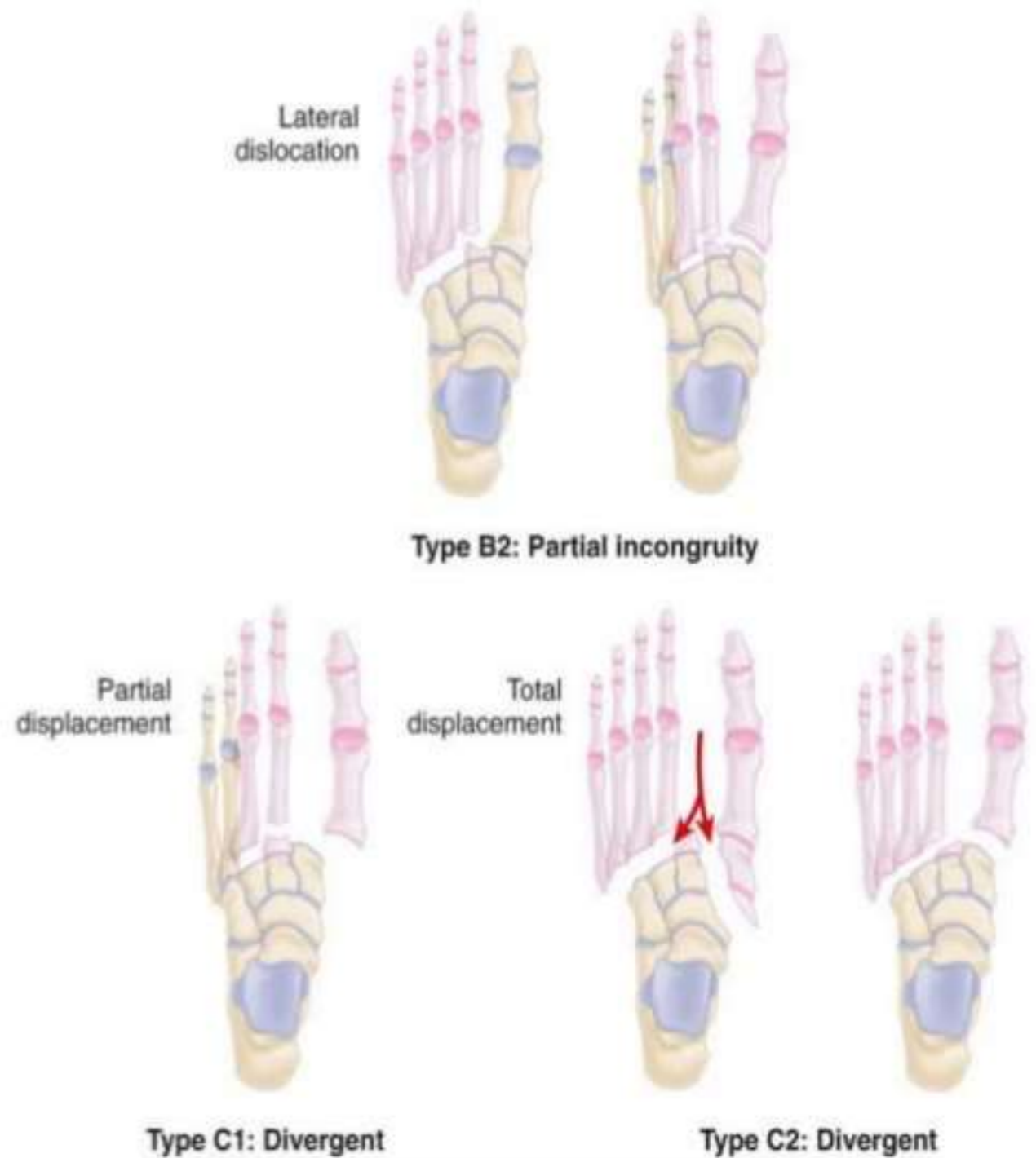


**Type A: Total incongruity**



**Type B1: Partial incongruity**

- Type B2 injuries are laterally displaced and may involve the first metatarsal-cuneiform joint.
- Type C injuries: Divergent injuries that can be partial (C1) or complete (C2) displacement.







Diastasis between 2nd MT  
and the median cuneiform





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# Lisfranc Fracture Dislocation



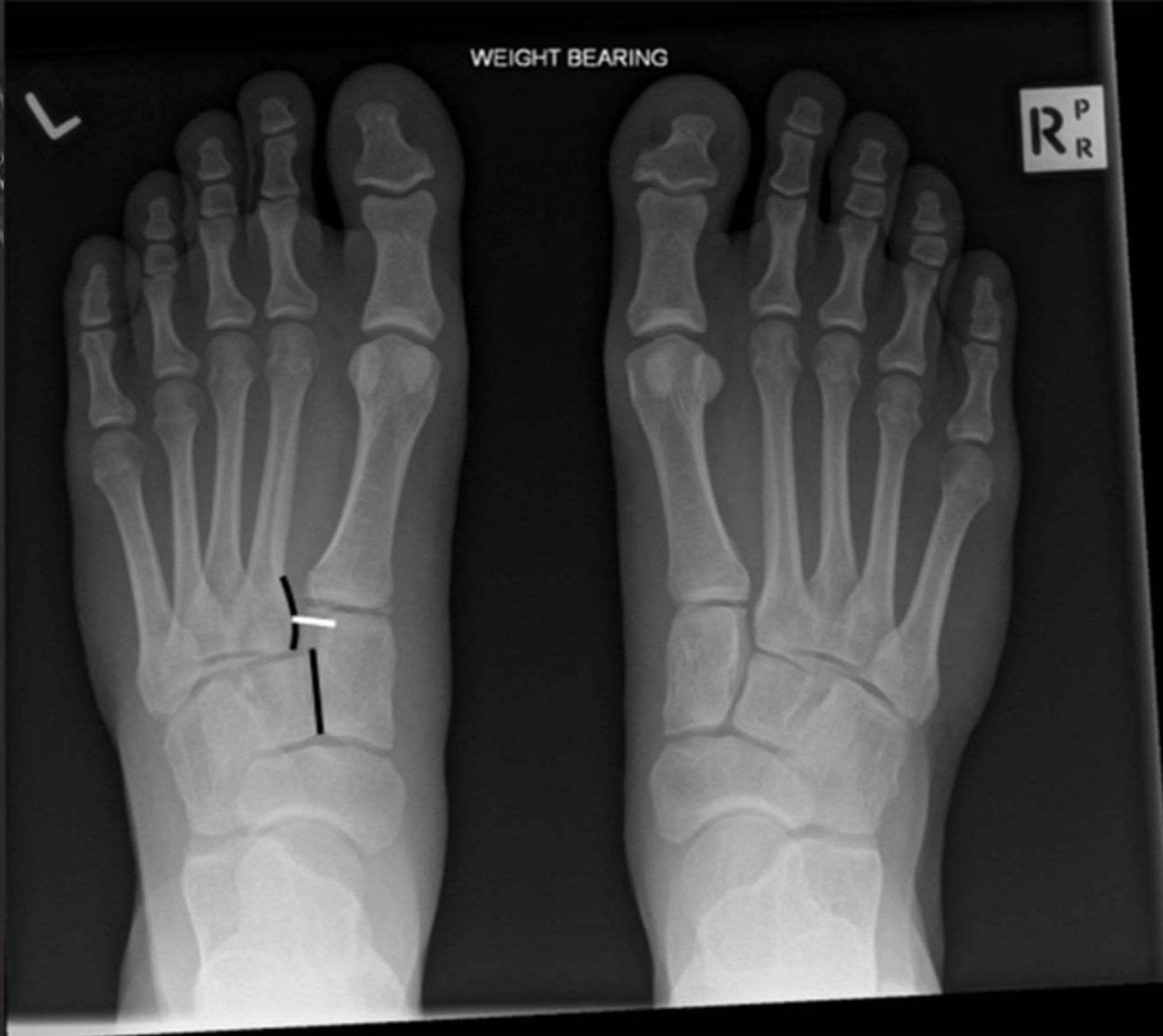
Normal Lisfranc joint



Displaced Lisfranc Joint Injury



# Lisfranc





# Take Home

- Subtle radiologic findings in mild cases,
- Get Obliques if suspicious
- Check gap between bases of 1st and 2nd MT
- Check alignment of 2nd MT and med. cuneiform
- Check alignment of MT's with Tarsal bones (lat. view)
- Weight bearing X-Rays
- CT/MRI liberally

# Not only mesothelioma....

## Minnesota Lisfranc Fracture Lawyer

If you have suffered a Lisfranc fracture due to the negligence of another, [contact a Minnesota Lisfranc Fracture Lawyer](#) or call **612-362-0000**. We have years of experience with these cases and have recovered significant amounts for the Lisfranc fracture victims we have represented. We want to help you and will pursue every angle to maximize your compensation.





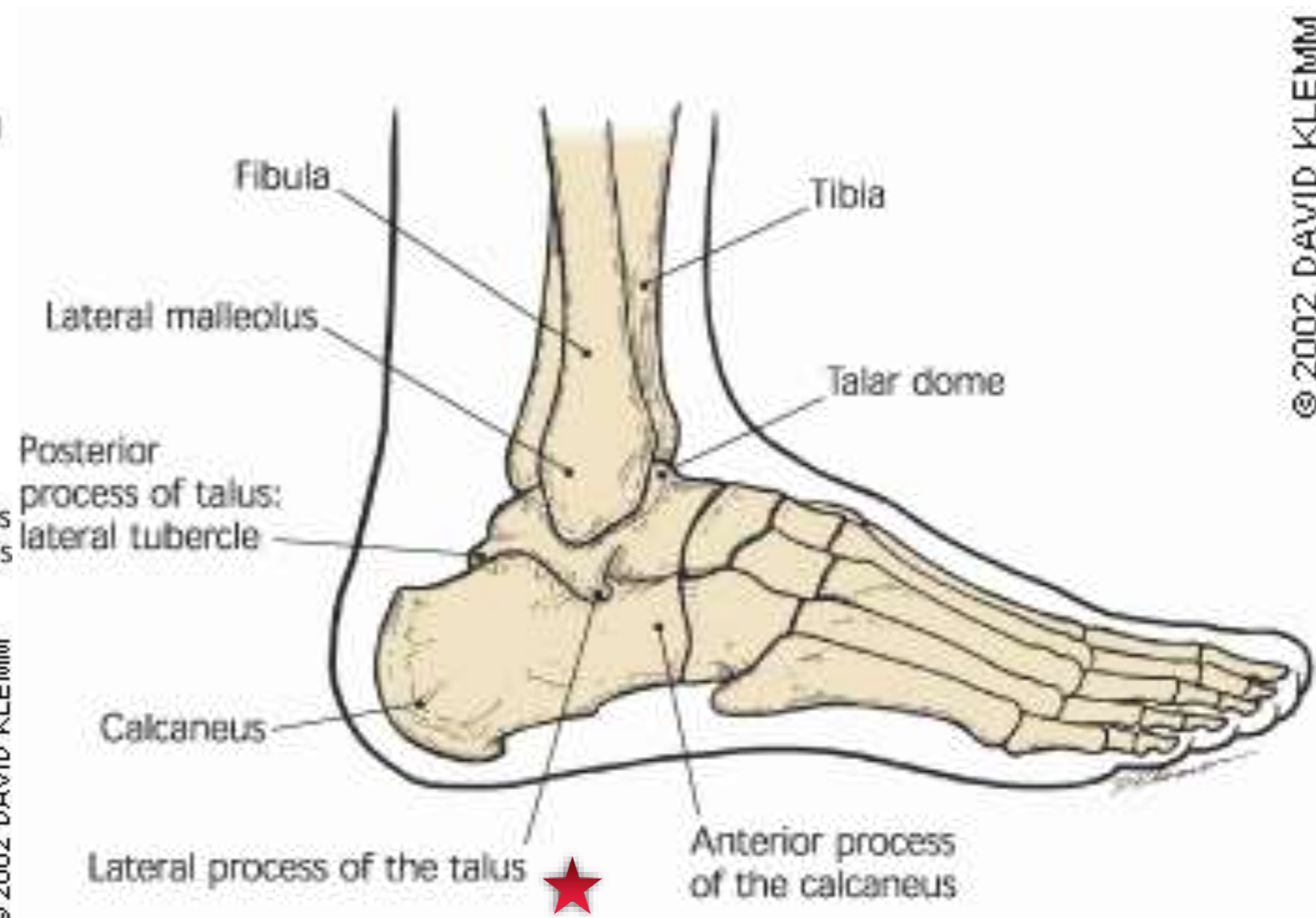
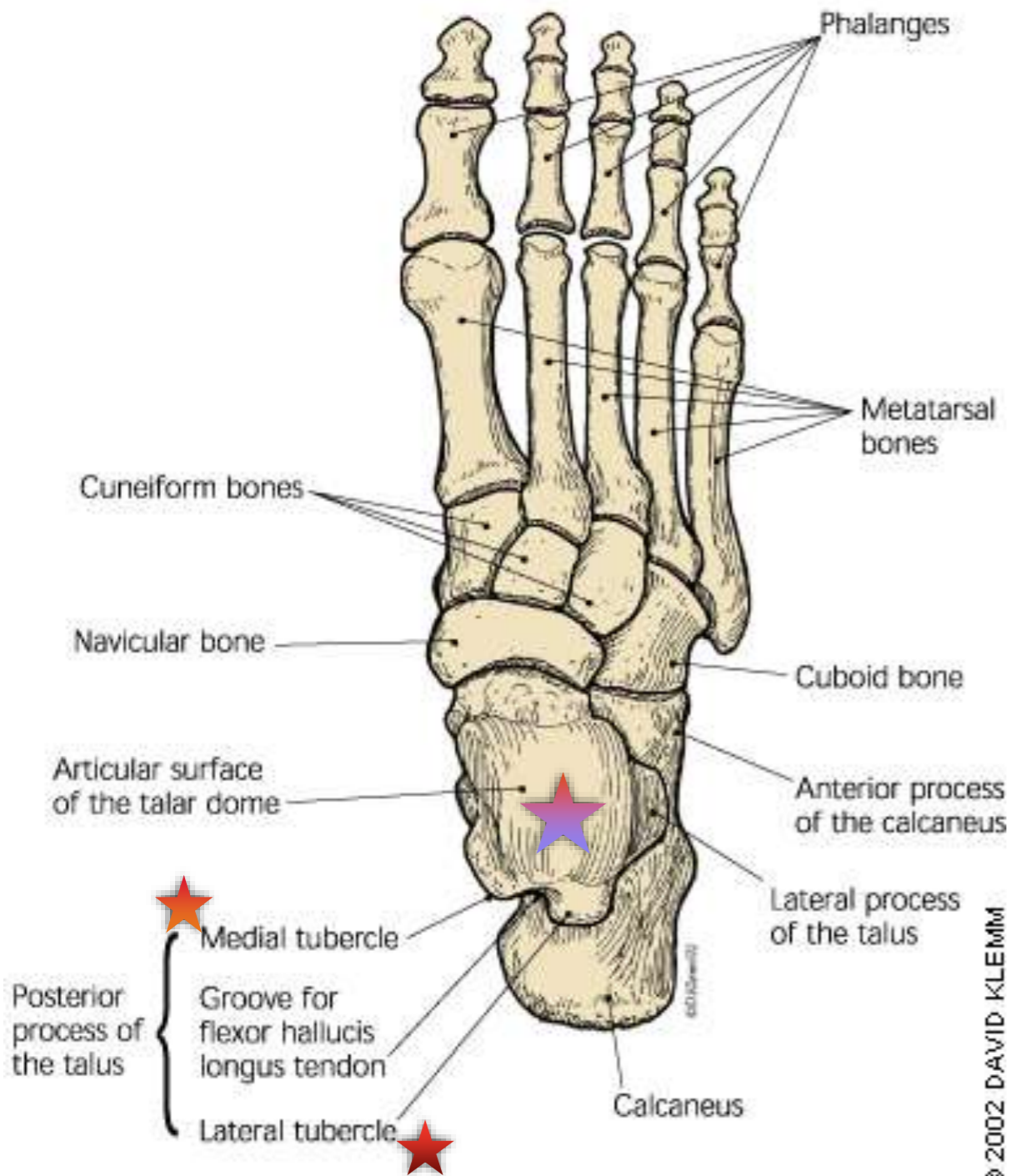
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- Segond
- Tibial Plateau
- Coronoid
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- Carpal bones
- Hip

# Talar Fractures

- Talar Dome
- Lateral Talar Process
- Posterior Talar Process Lateral and Medial Tubercle
- Anterior Process of the Calcaneus

# Talar Fractures



# Talar Dome Fractures

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# Talar Dome

Inversion with plantiflexion for medial fracture

Inversion with dorsiflexion for lateral fracture



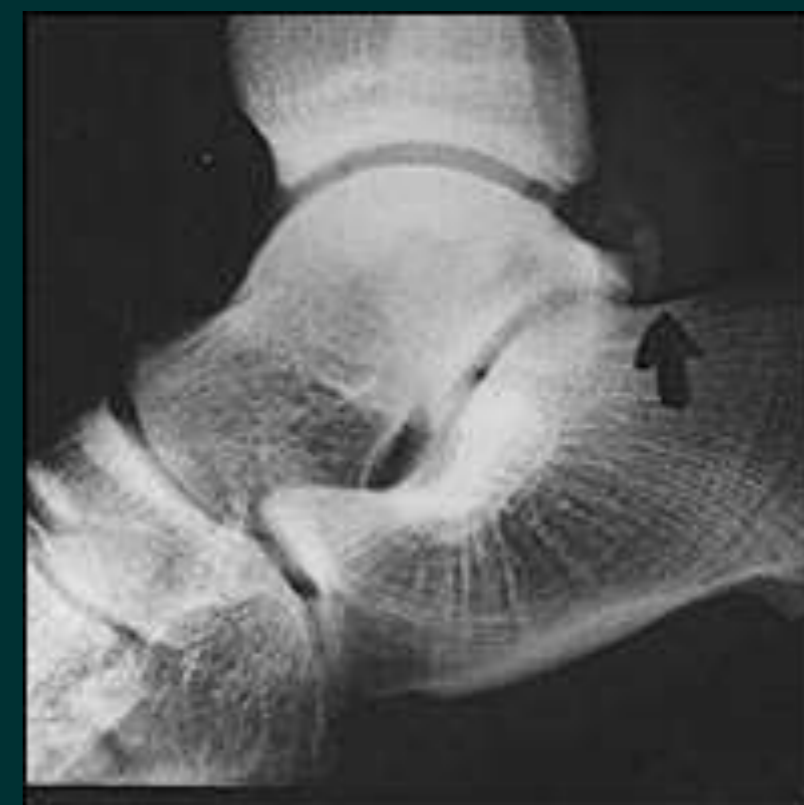
# Lateral Talar Process

- Rapid inversion & dorsiflexion
- Tender over the lateral process



# Posterior process fracture

- Medial Tubercle - Dorsiflexion with pronation
  - Tender to deep palpation bt Achilles and med. Malleolus
- Lateral Tubercle - Hyperplantar flexion
  - Tender bt Achilles and lat. Malleolus



oblique ankle radiograph taken with the foot placed in 40 degrees of external rotation.

# Anterior Process of Calcaneum

- Signs of lateral ankle sprain
- Pain on walking
- Point tenderness over the calcaneo-cuboid joint - 1cm inferior and 3-4 cm anterior to the lat. Malleolus





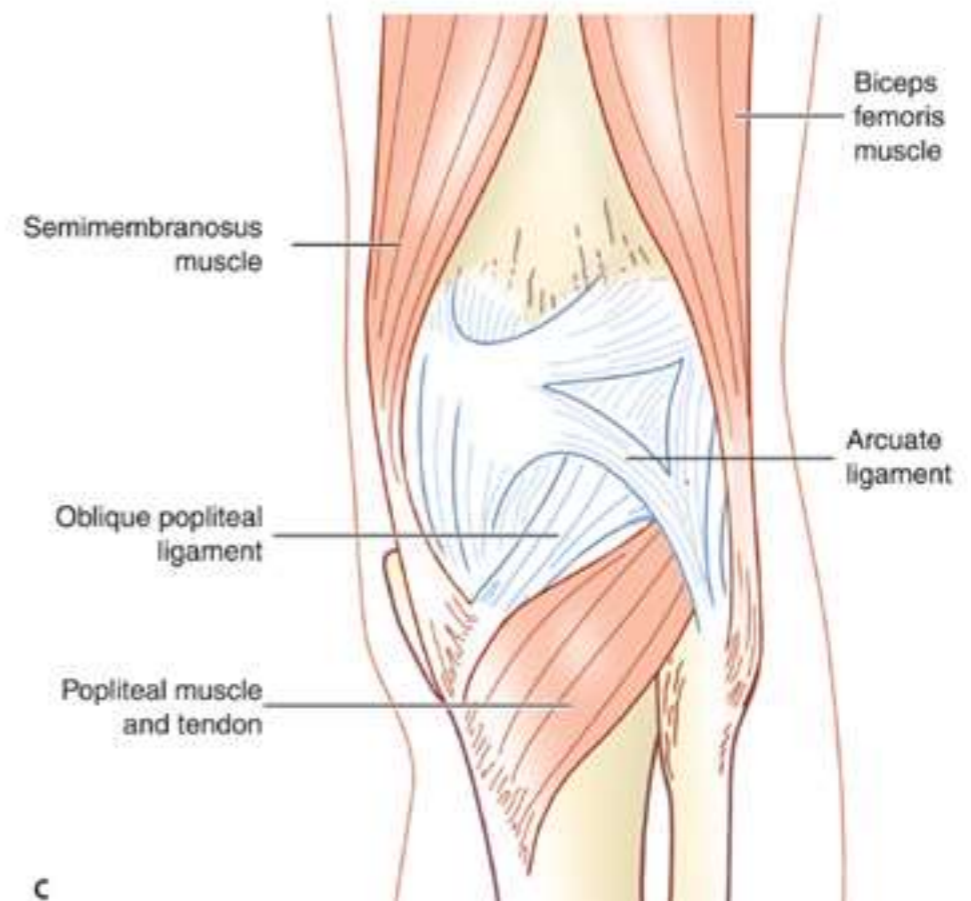
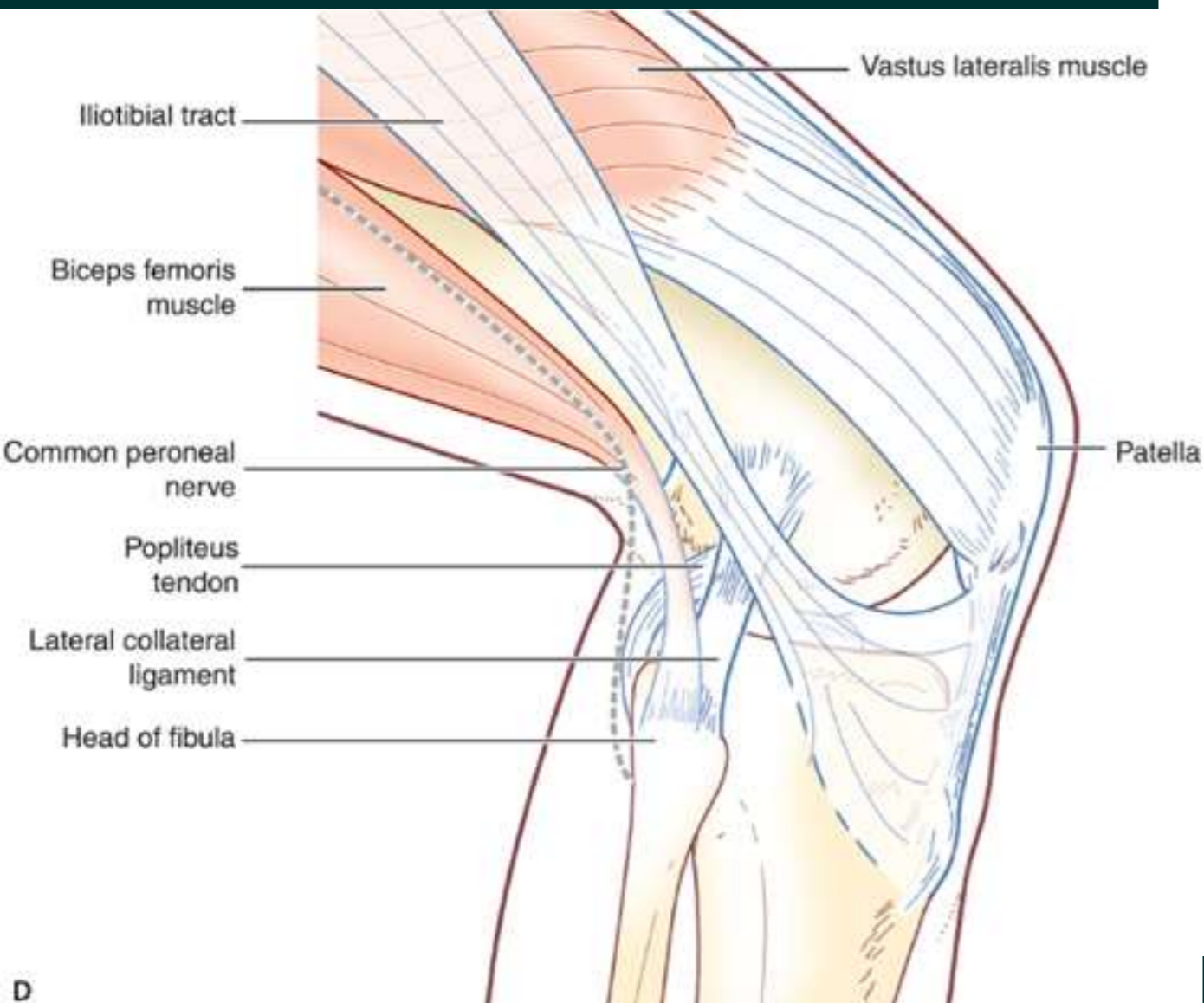
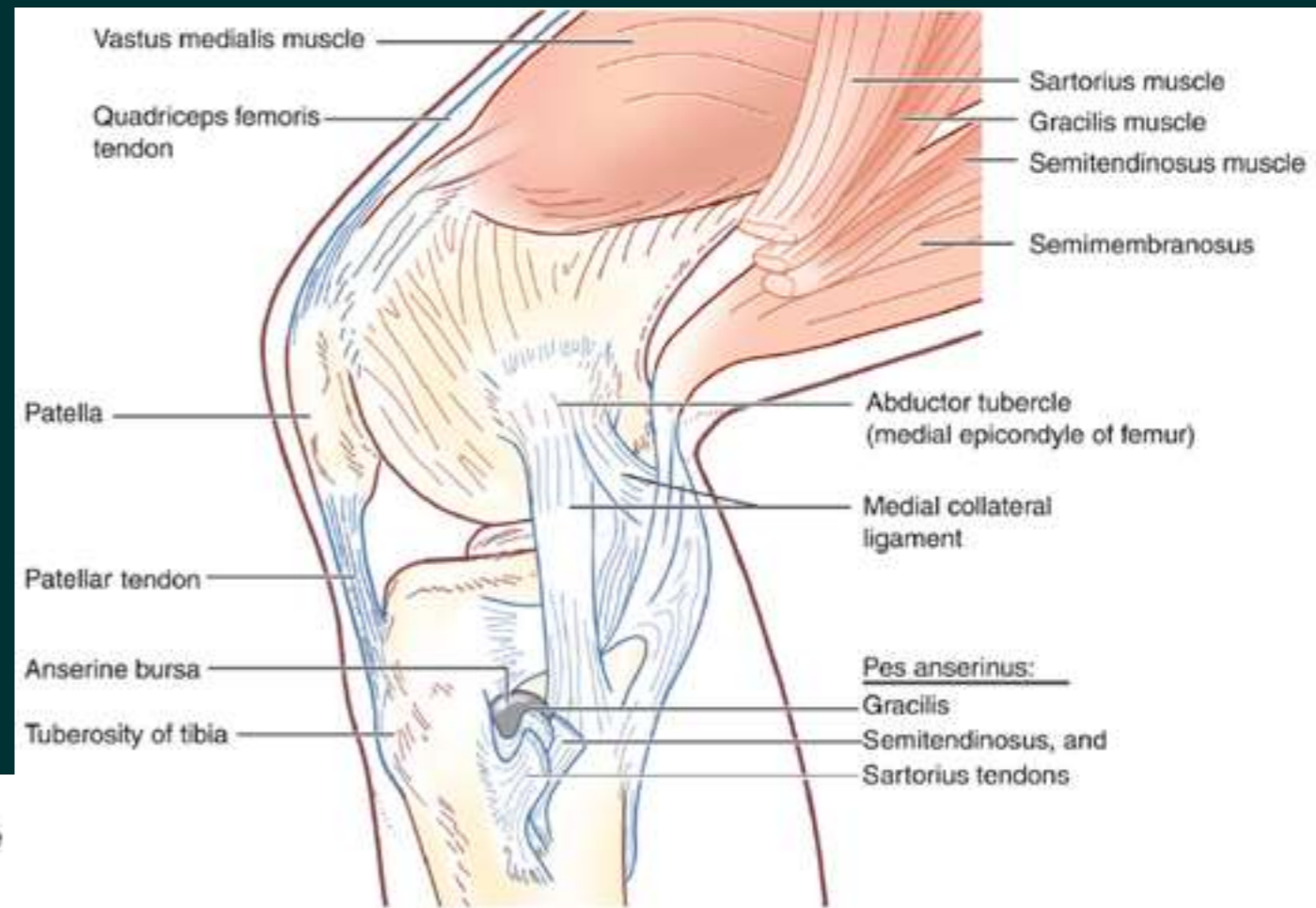
# Take Home

- Examine the Talar dome carefully
- CT if unsure
- Assure follow-up
- 25% require >1 year before becoming asymptomatic

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- **Segond**
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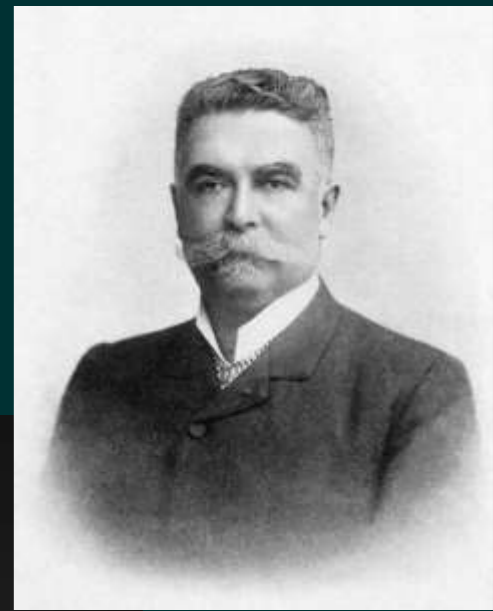
# Knee Anatomy



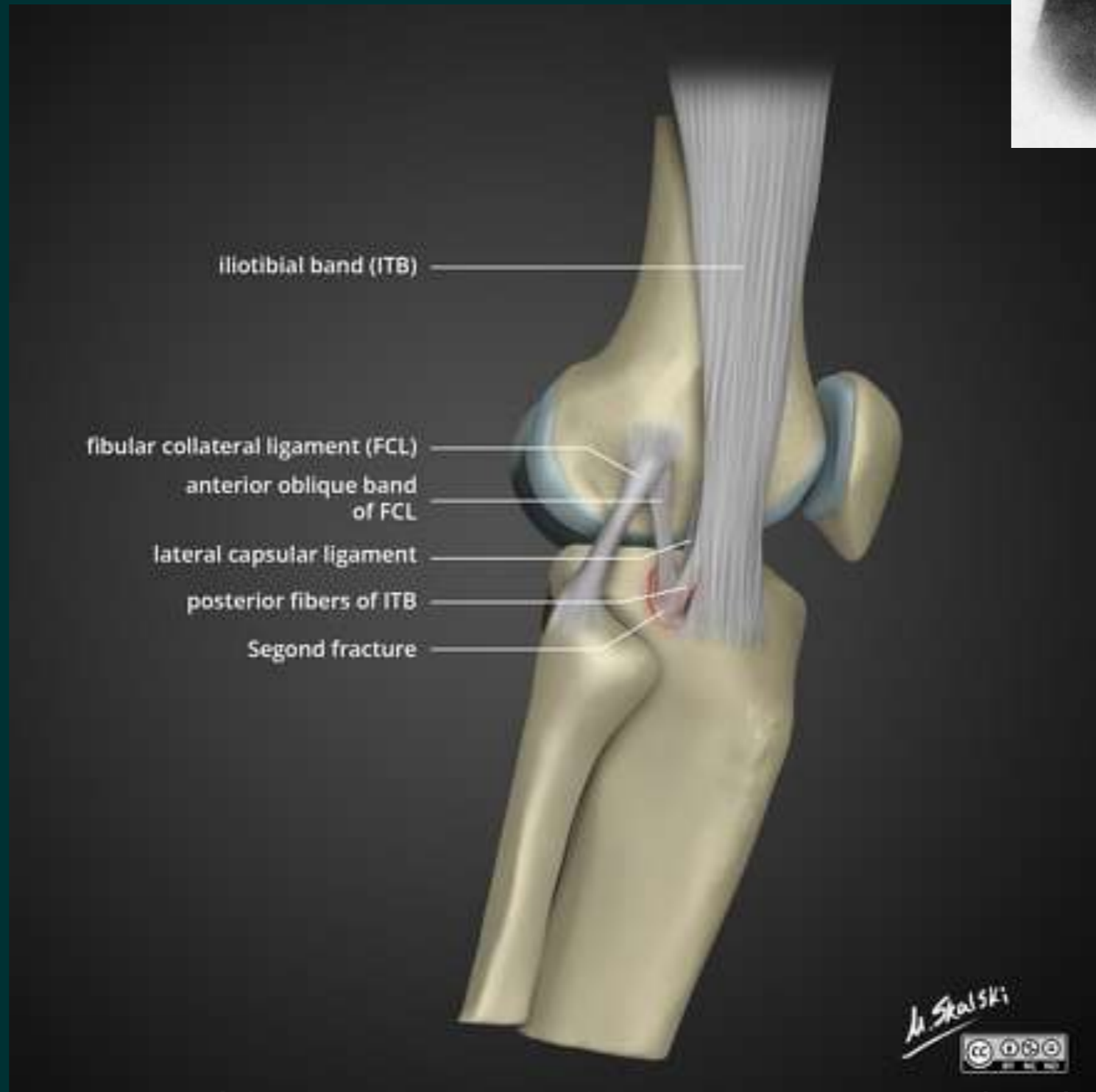
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# Segond Fracture



- Avulsion of LCL, ITT, AOB of FCL
- avulsion of long head of biceps femoris
- rare association with ACL tear
- 70% meniscal tear (post. horn)



# Segond Fracture

- A good indication for an MRI



# Segond Fracture



# Reverse Segond Fracture

- Avulsion of an elliptic bone fragment arising from the medial articular surface of the proximal tibia
- Association:
  - MCL disruption
  - PCL, sometimes ACL tears
  - Medial meniscal tears

# Reverse Segond Fracture

- MRI time

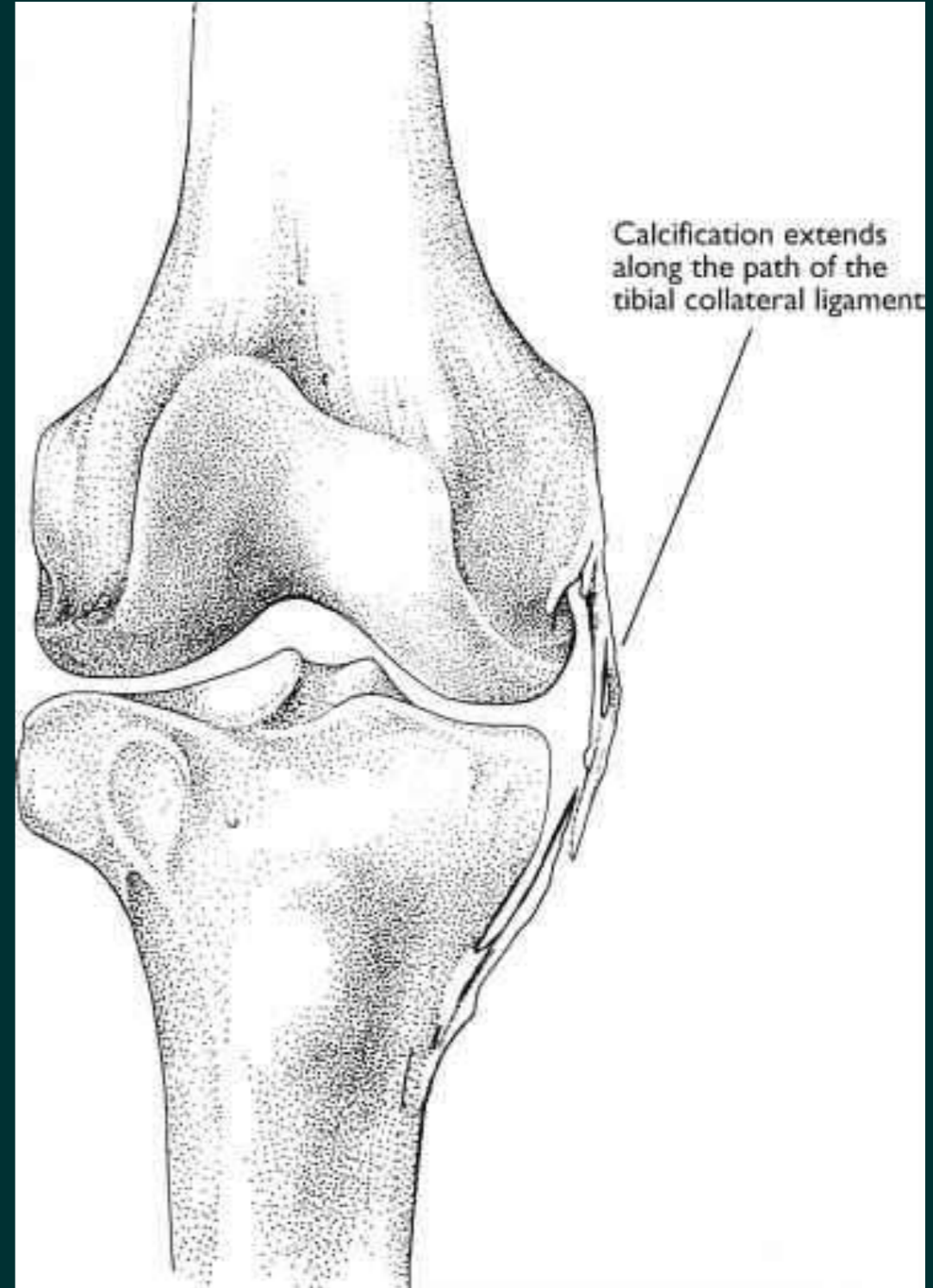




# Reality



# Pellegrini-Stieda



# Take Home

- Difficult to see fracture
- CT for fracture diagnosis
- MRI is the imaging of choice for ligamentous diagnosis

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# Tibial Plateau Fractures



# CT

- Tibial Plateau Fracture



# Take Home

- CT is always necessary to define extent of fractures and plan eventual surgery

# Fractures Discussed

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# Coronoid Fractures



Fracture type and location	Subtype	Description
Tip	1	$\leq 2$ mm of coronoid bony height (flake fracture)
	2	$\geq 2$ mm of coronoid body height
Anteromedial	1	Anteromedial rim
	2	Anteromedial rim+tip
	3	Anteromedial rim+sublime tubercle ( $\pm$ tip)
Basal	1	Coronoid body and base
	2	Transolecranon basal coronoid fractures

# Coronoid Fracture Classification

O'Driscoll



Type 1



Type 2



Type 3

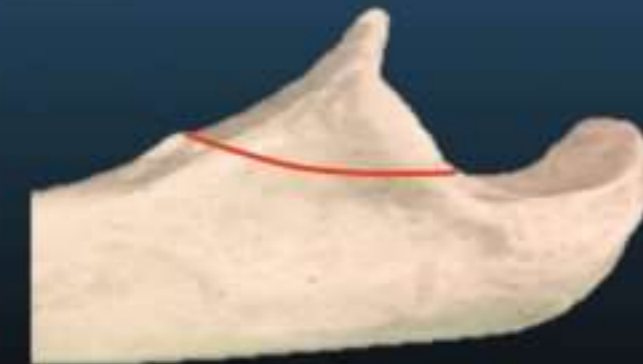
Regan-Morrey



Type 1



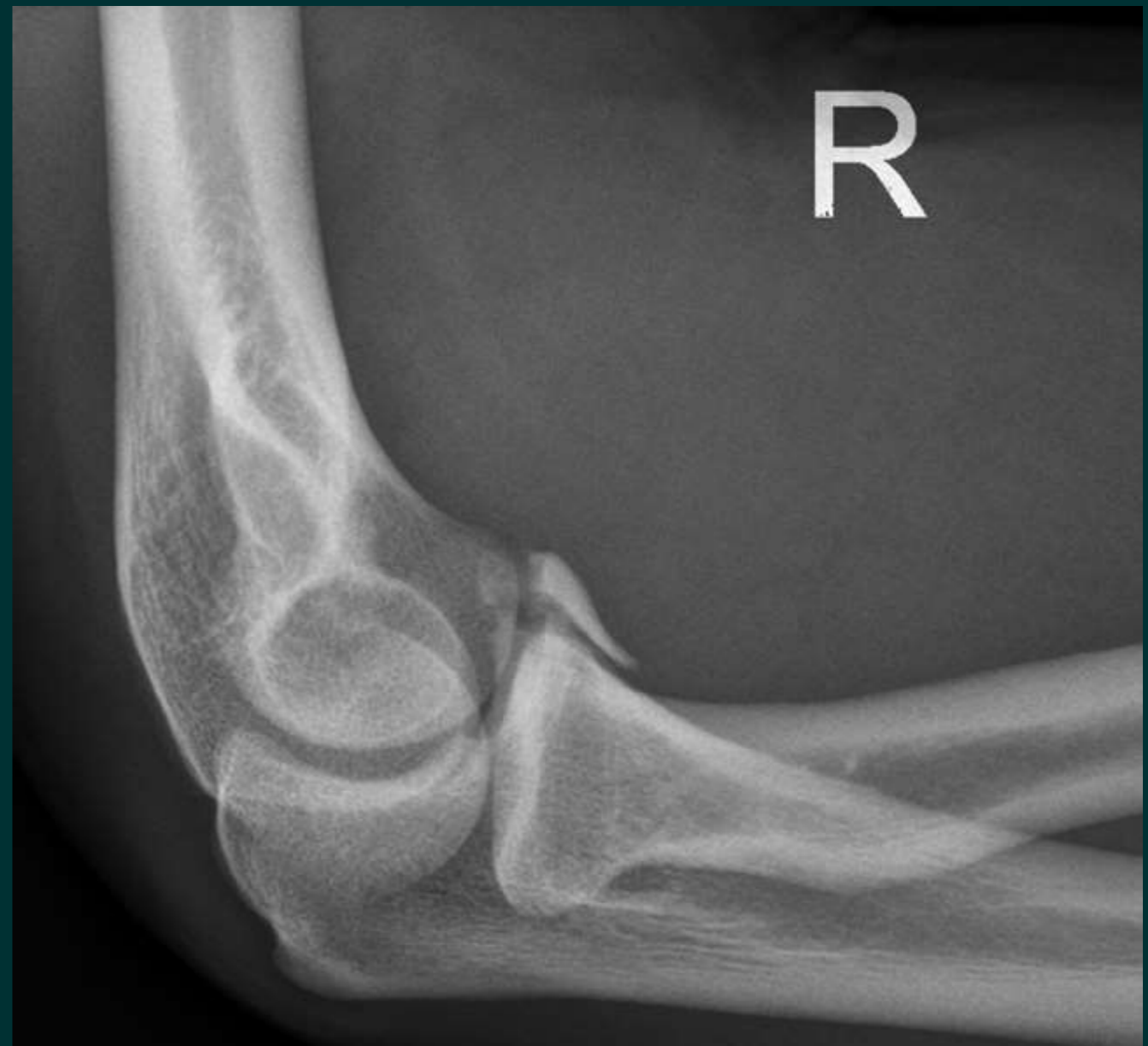
Type 2



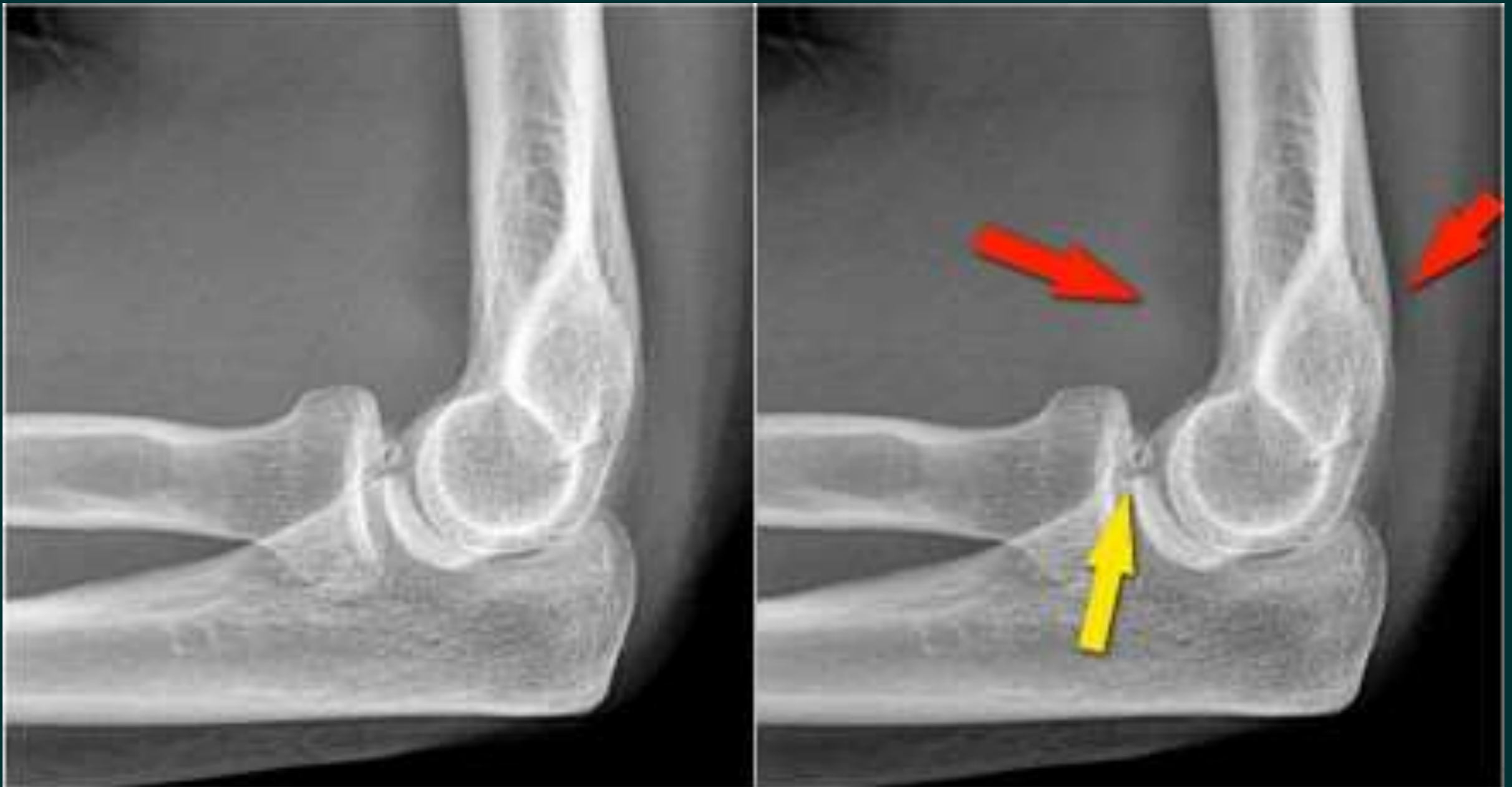
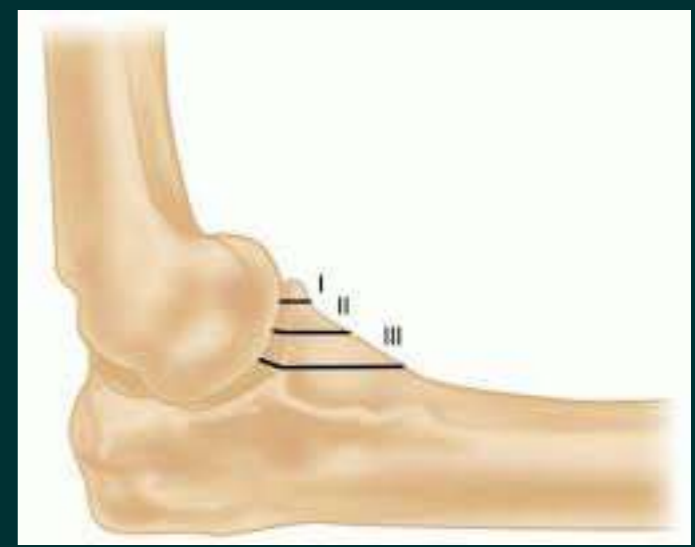
Type 3

A handwritten signature in red ink, located in the bottom right corner of the slide.

# Type II Coronoid Fracture



# Coronoid Fracture Elbow



# Take Home

- Small fracture - probably an avulsion fracture
- Large fracture - Part of a dislocation process

# Fractures Discussed

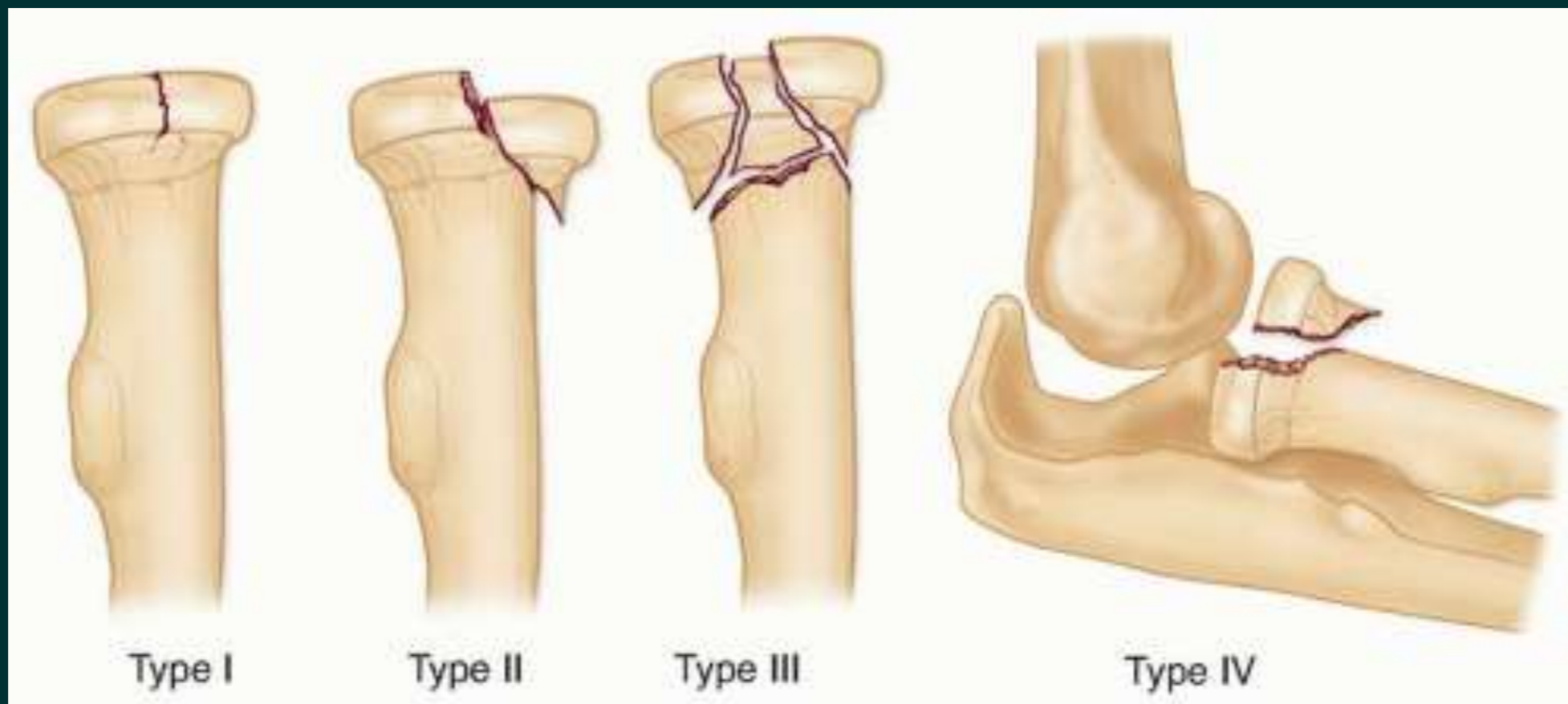
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# Radial Head Fractures



# Radial Head Fracture

- MASON JOHNSON CLASSIFICATION
- Describe Fracture as:
  - Degree of displacement
  - Amount of articular surface involved
  - Presence of comminution or dislocation





# Fractured Radial Head

- Comminuted fracture of the Radial head
- Essex-Lopresti Fracture??



# Essex-Lopresti Fracture-Dislocation

- Comminuted fracture of the radial head
- Disruption of the Interosseous membrane
- DRUJ dislocation
- Migration of radius proximally
- Ulnar carpal impingement
  - Leads to permanent wrist pain



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# Take Home

- Aspirate joint blood
- check Range of Motion
- Active Range of Motion Exercises ONLY

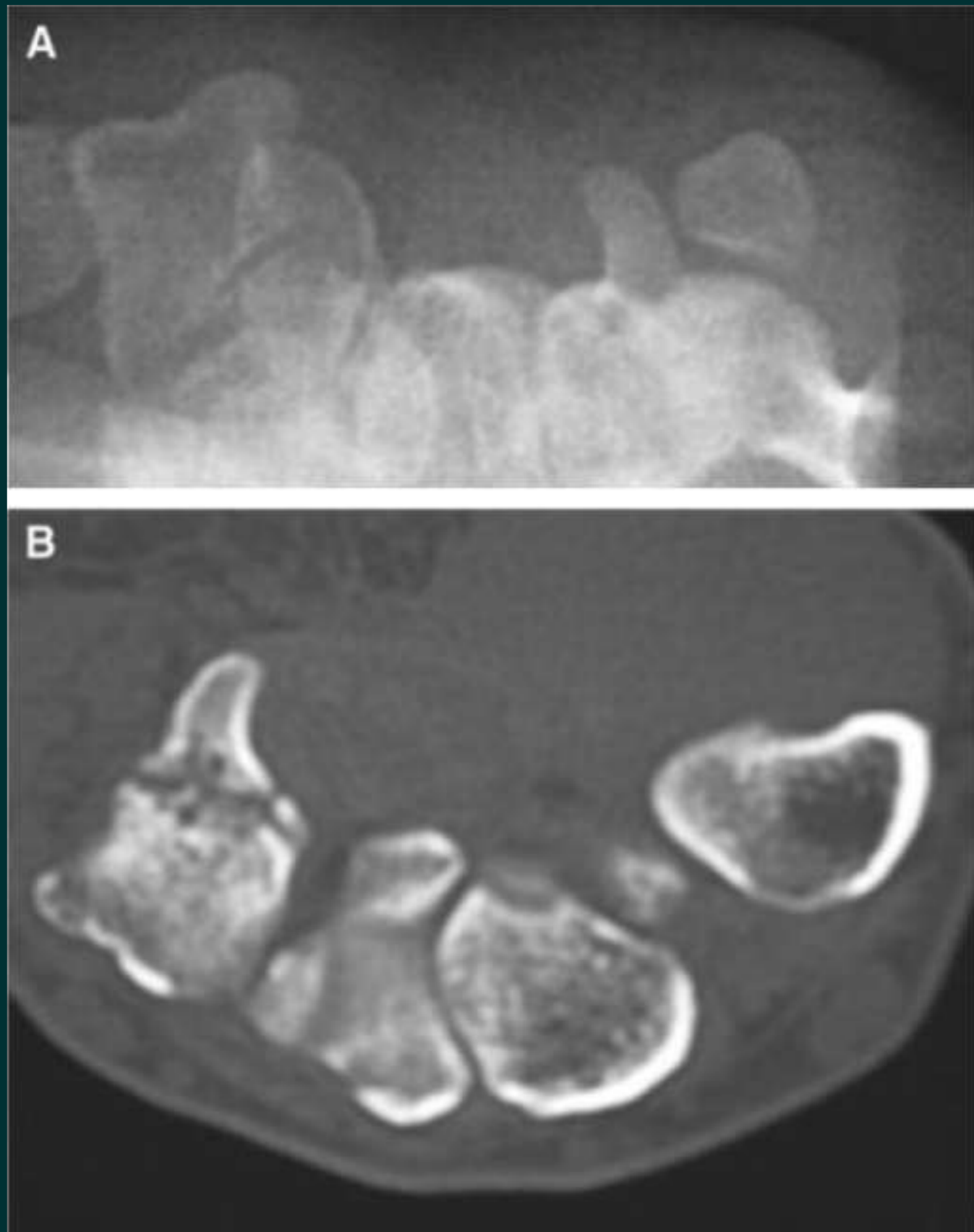
# Chosen Carpal Bone Fracture

# The Hook of the Hamate



# Carpal Tunnel View

- CT scan



# Take Home

- Use CT liberally in suspected carpal fractures
- CT false positive for Scaphoid fracture 0.8%
- CT false negative for scaphoid fracture 5.6%
- X-Ray false negative 20-54%



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# HIP



- Hip X-Ray: 90-98% sensitivity
- Occult hip fractures approx. 3-9%

# Take Home

- Hip Pain, patient can't walk, normal X-rays = CT

2 weeks  
apart



# Scapular neck fracture

