# Foot & Ankle Radiology

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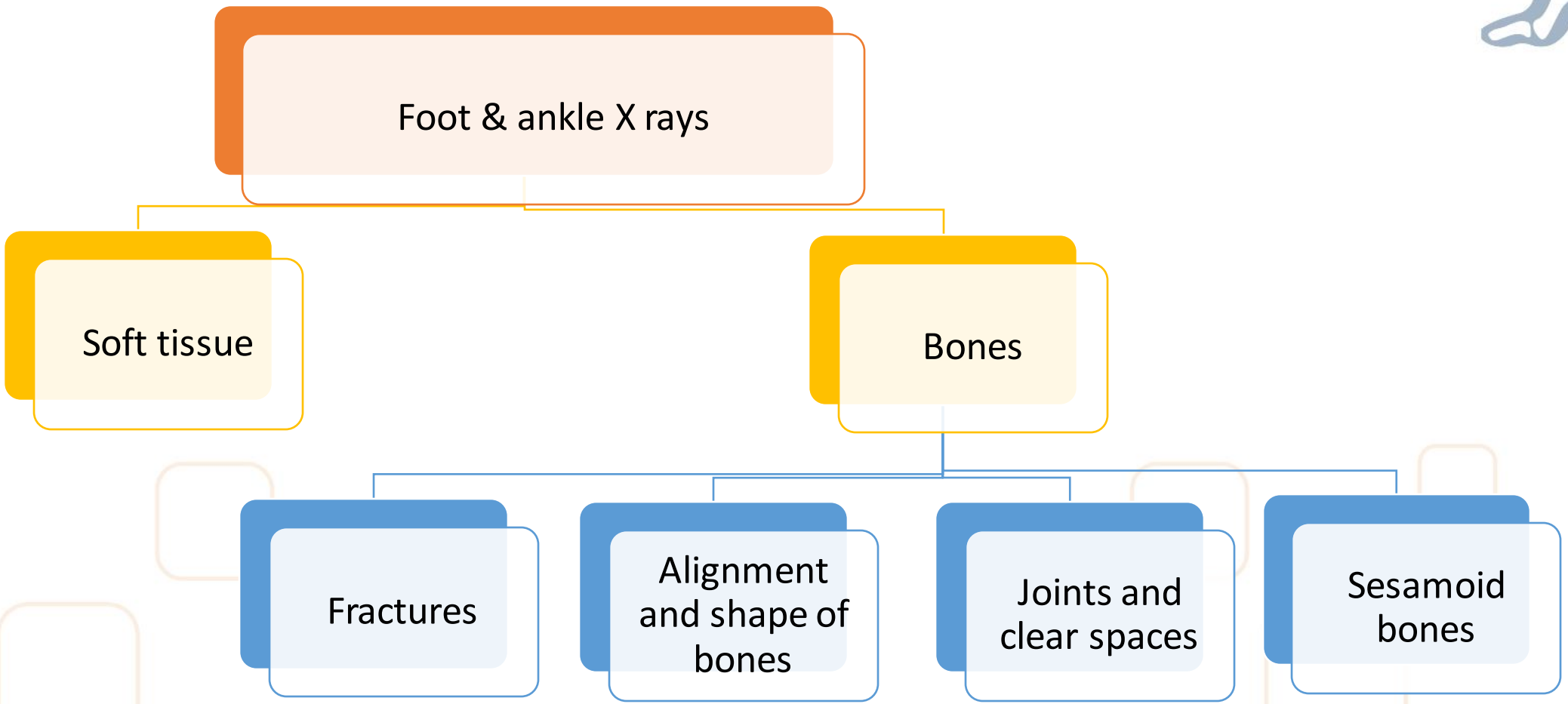
# Learning objectives

- Know techniques of Non weight bearing and Weight bearing radiography of the Foot & Ankle and identify the pitfalls.
- Normal radiological anatomy of the Foot & Ankle.
- Recognise the importance of weight bearing radiography.
- Gain knowledge of importance of angles and measurements in plain radiography.
- Stress radiography of the Foot & Ankle and its role.
- Special views for specific disorders.
- Limitations of Plain radiography and need for ultrasound, CT, MRI, SPEC CT and nuclear imaging.

# What to look for in plain x rays?



# Types of X rays

## Foot & ankle X rays

- Non weight bearing
- Weight bearing
- Stress views
- Special views

# Non Weight Bearing X rays

| Foot | Ankle | Hindfoot |
|---|---|---|
| Ap | Ap | Harris beath view |
| Lateral | Lateral | |
| Medial and lateral oblique | Mortise | |
| Sesamoid view | | |

# Weight Bearing X rays

| Foot | Ankle | Hindfoot |
|---|---|---|
| Ap | Ap | Hindfoot alignment view |
| Lateral | Lateral | Long axial view |
| Sesamoid view | Mortise | |

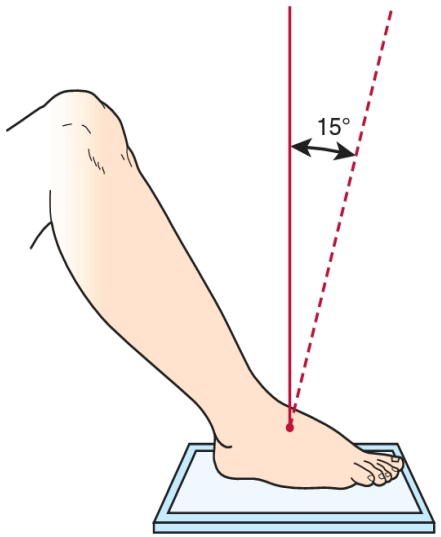
# Stress X rays

| Ankle instability |
| --- |
| Anterior drawer's stress view |
| Varus/valgus stress view |
| External rotation stress view |
| Gravity stress view |

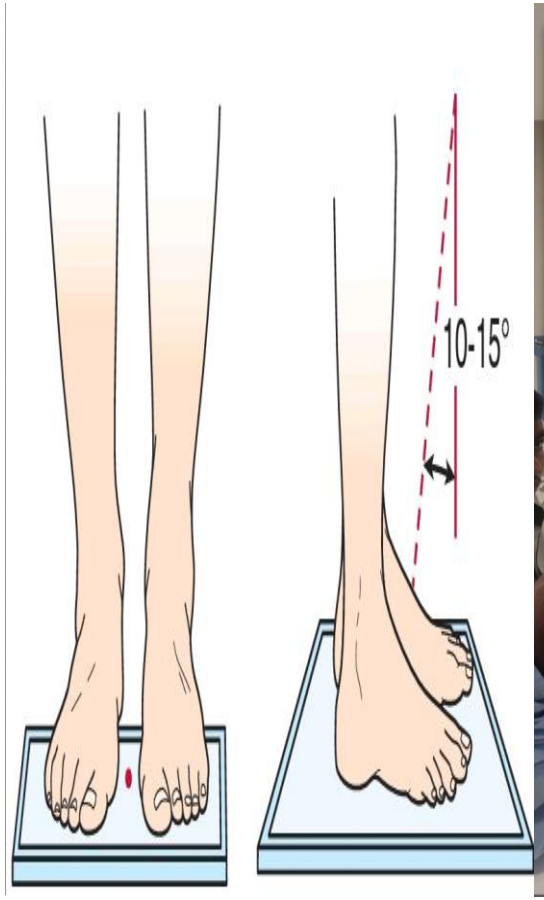
# Special views

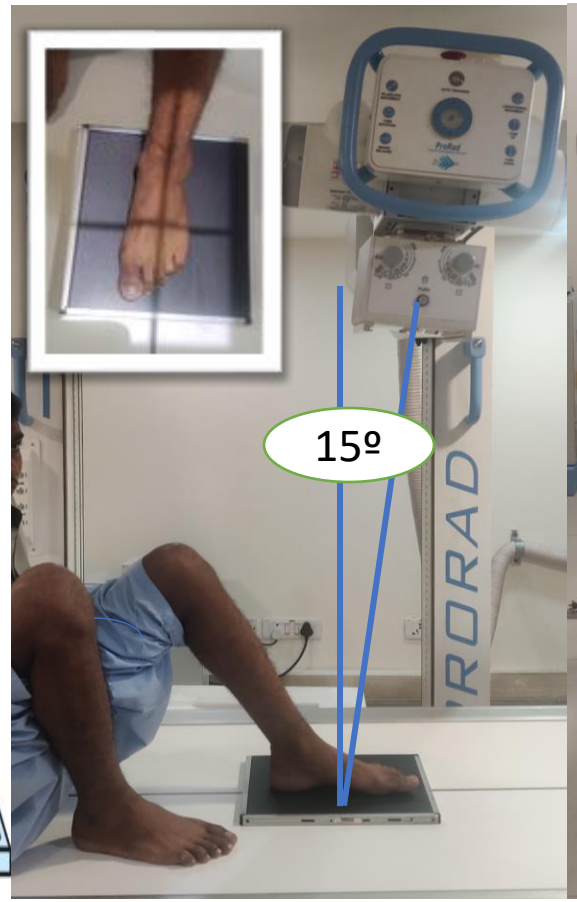
| Foot | Ankle | Hindfoot |
|---|---|---|
| Canale's view | Reverse oblique view | Broden's views |
| | Lateral external rotation view | |
| | Ankle impingement views | |

# Foot Ap view

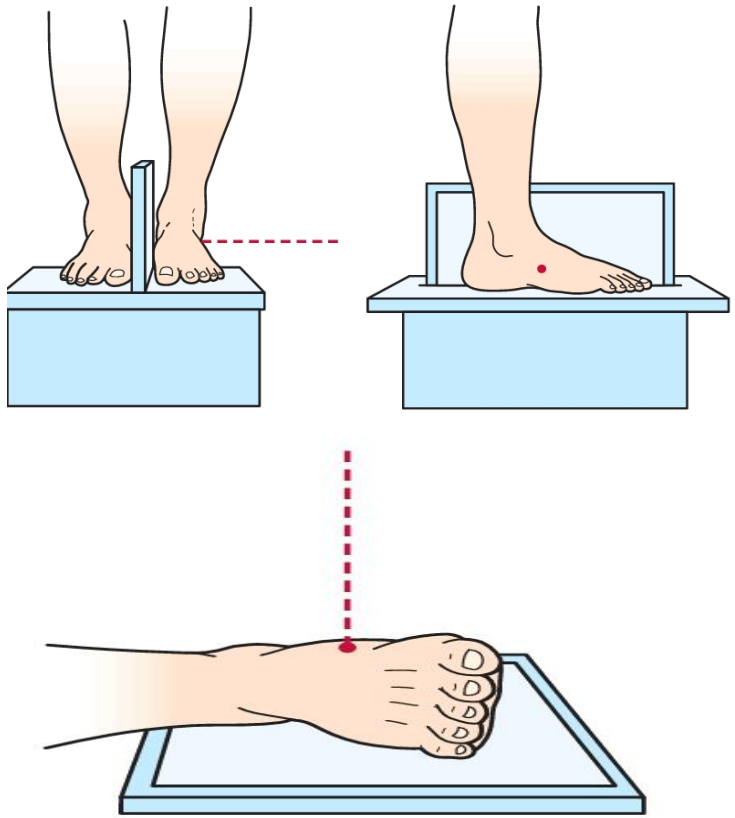



Anteroposterior (AP) view

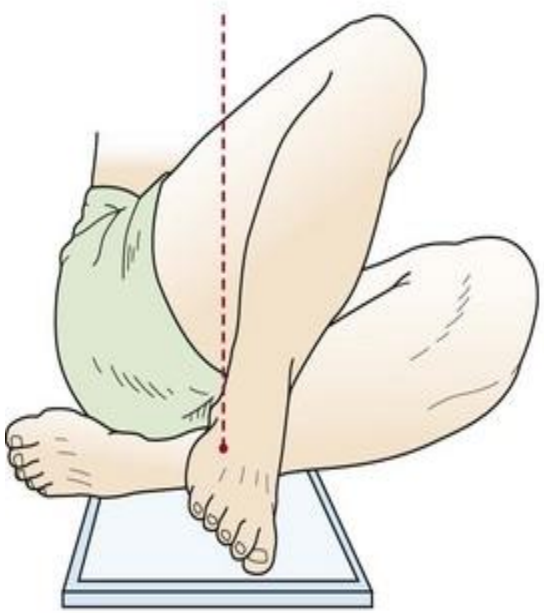



# Foot Lateral

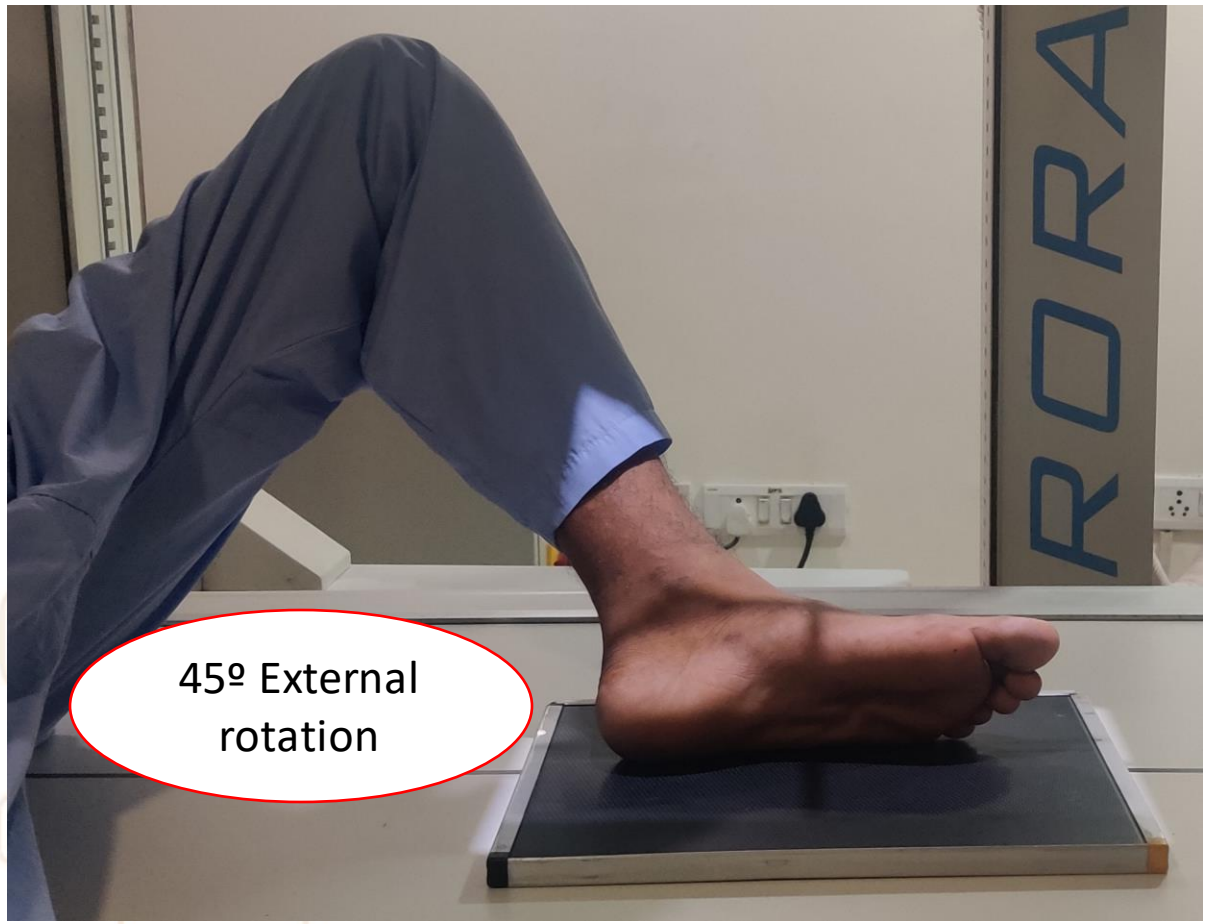


# Foot Medial oblique

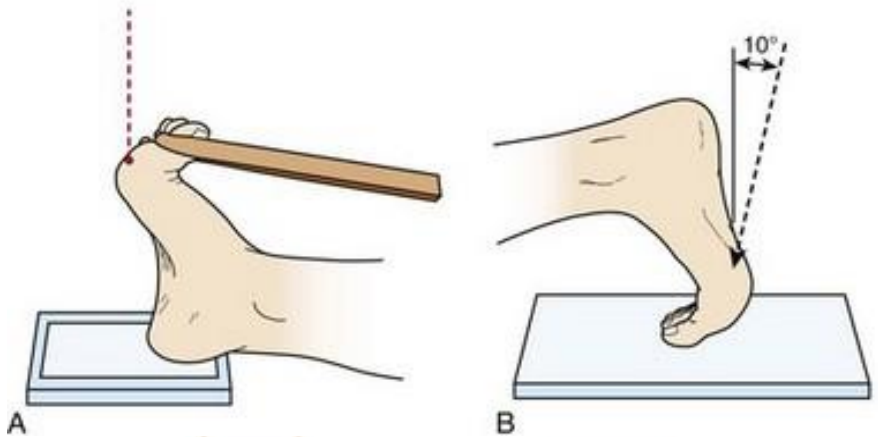


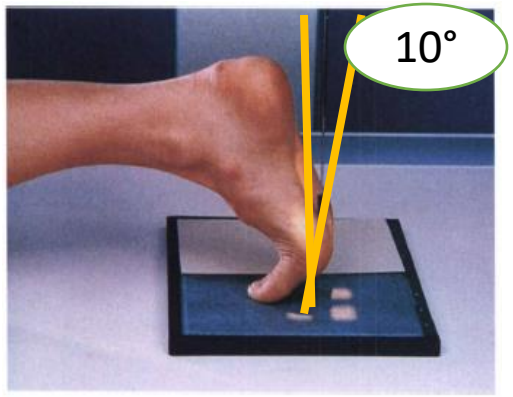
45º Internal rotation

# Foot Lateral oblique




# Foot sesamoid view

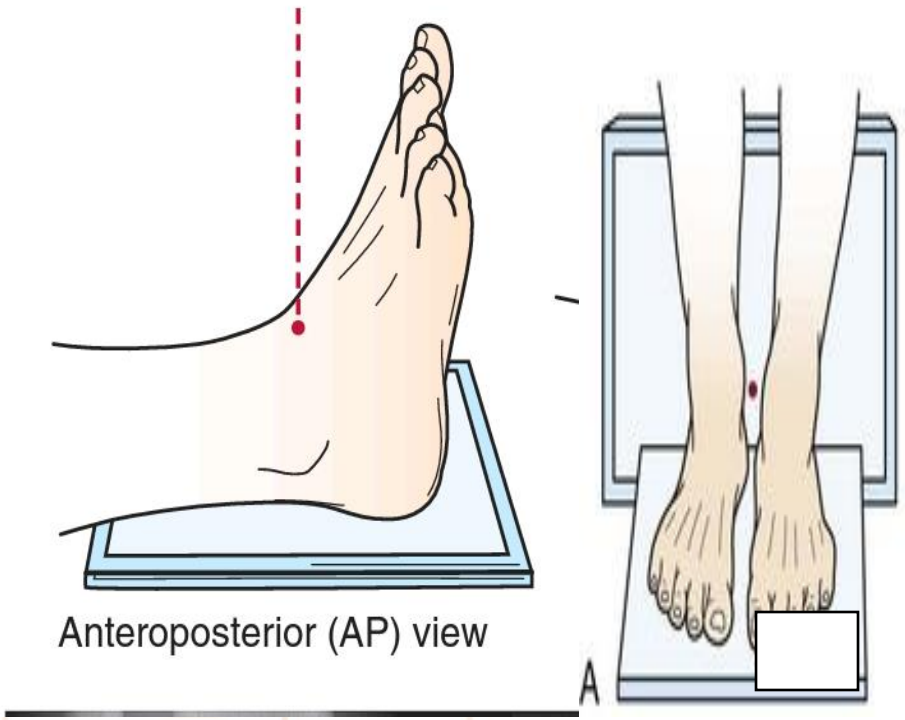


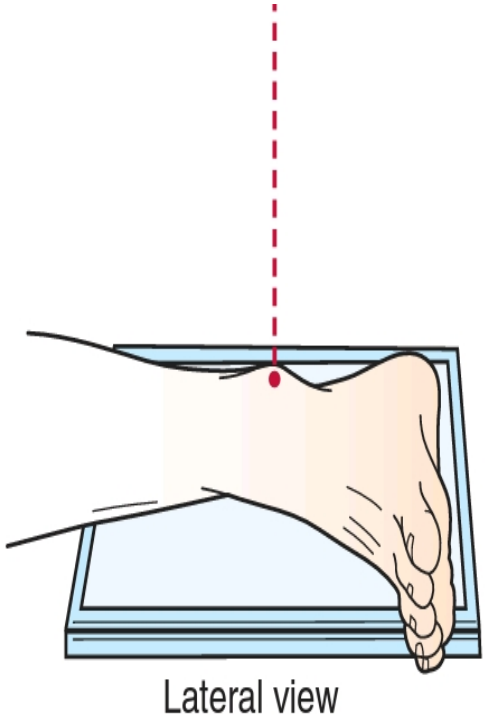

Lewis Method

Holly method

# Ankle AP view

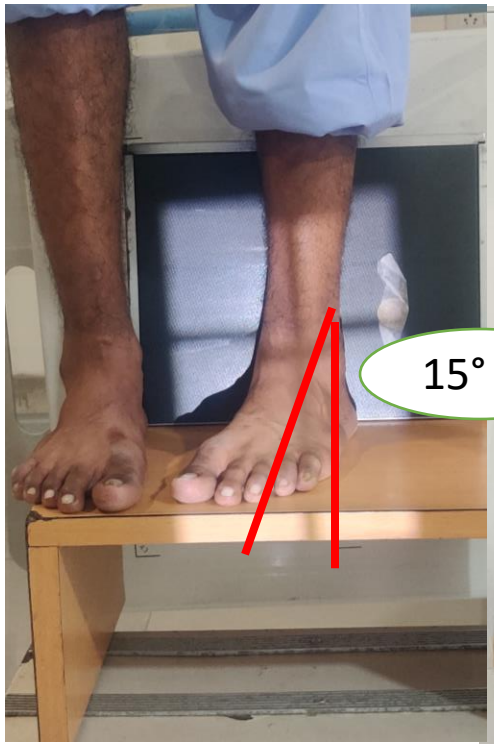



# Ankle lateral view

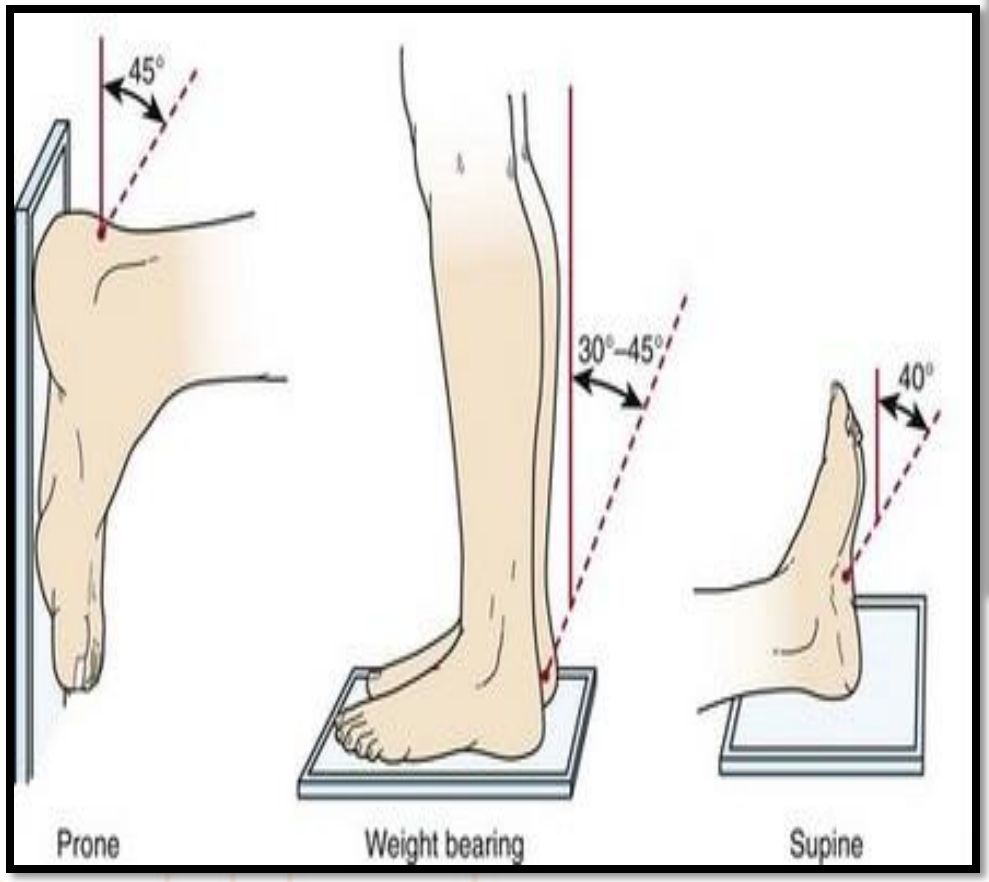


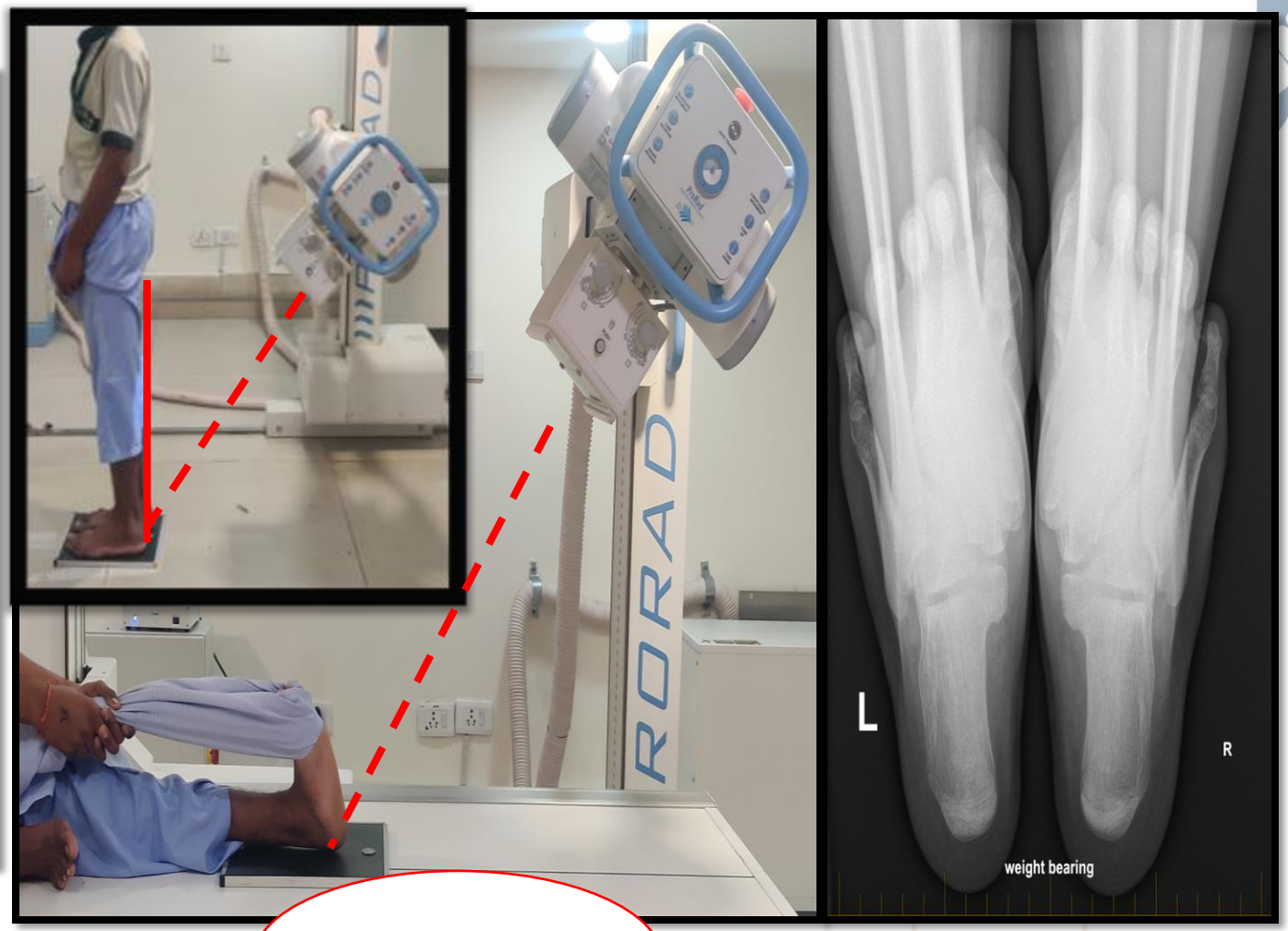

# Ankle Mortise view


15º Internal rotation



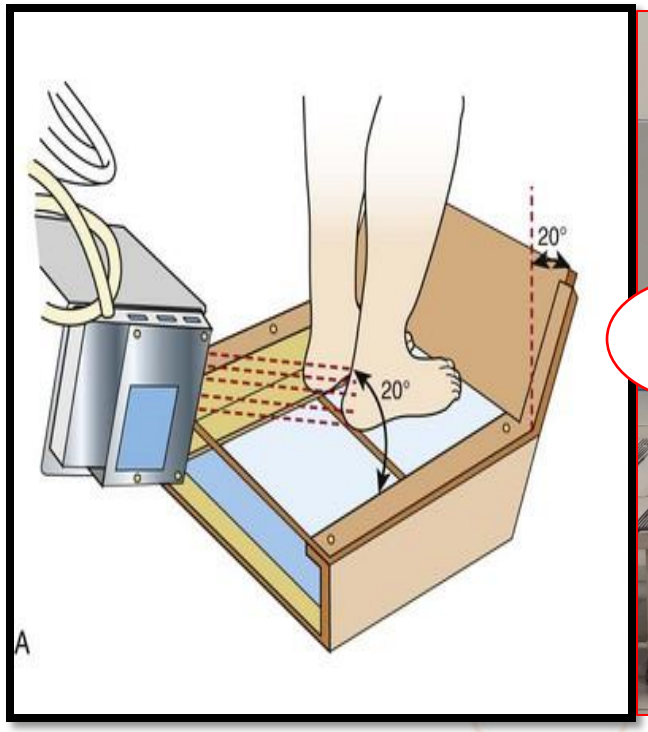

# Harris beath view/long axial view

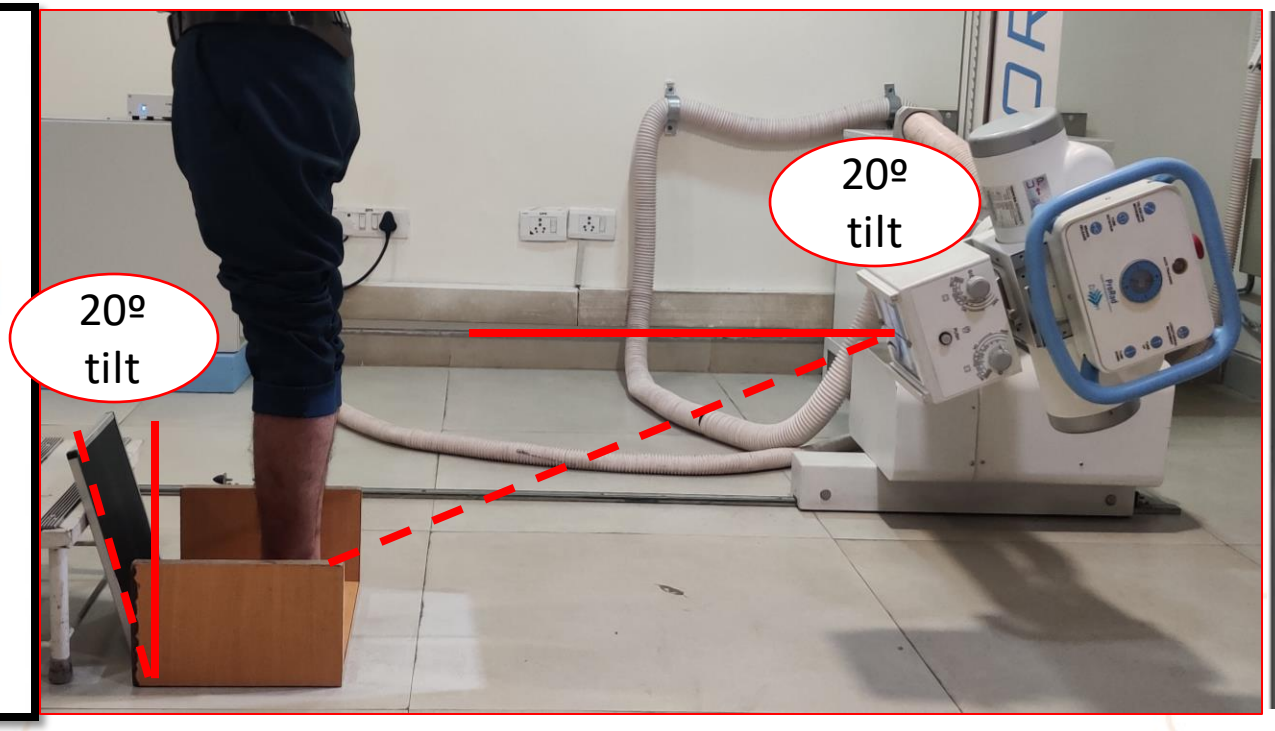


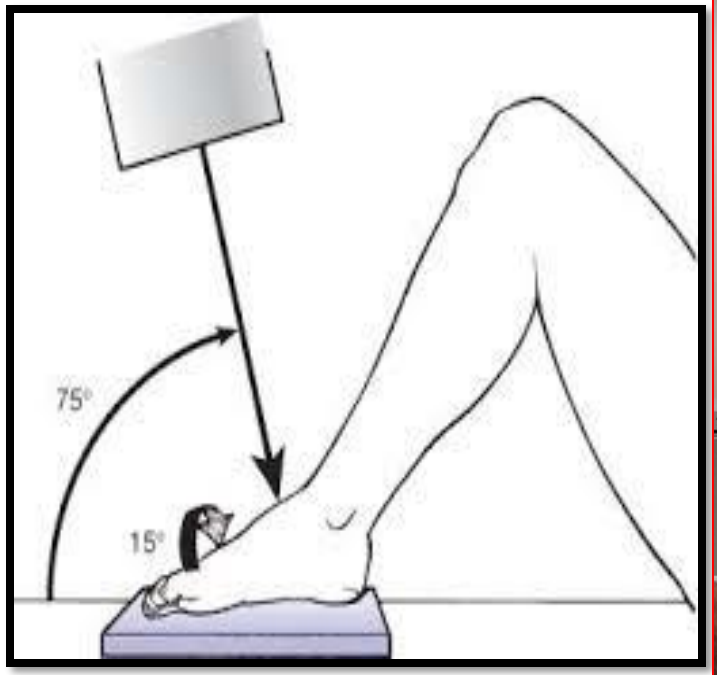

45º tilt

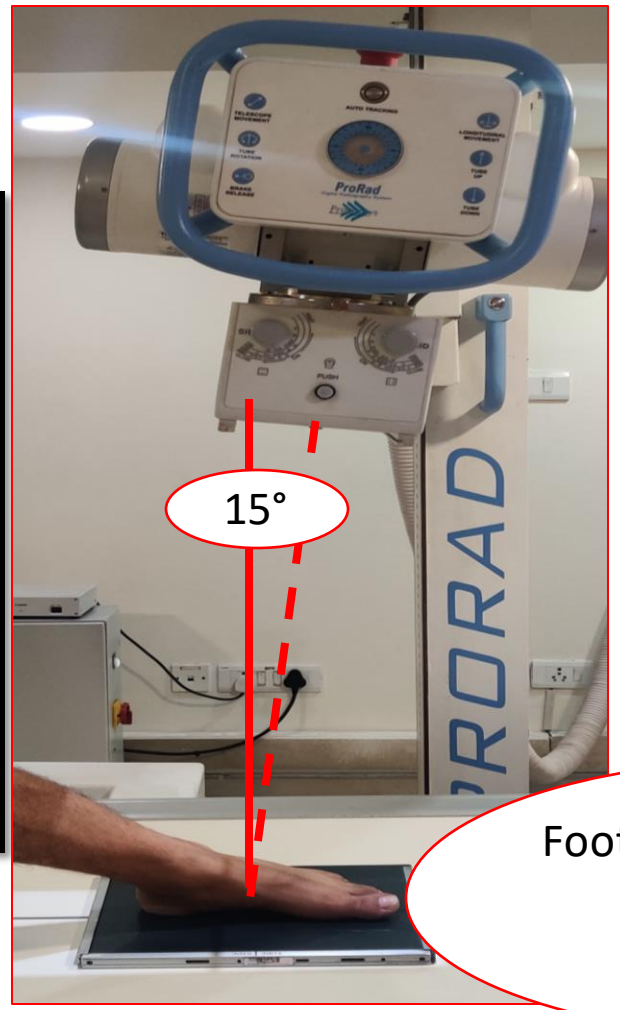
# Hindfoot alignment view




# CANALE's View (talar neck)

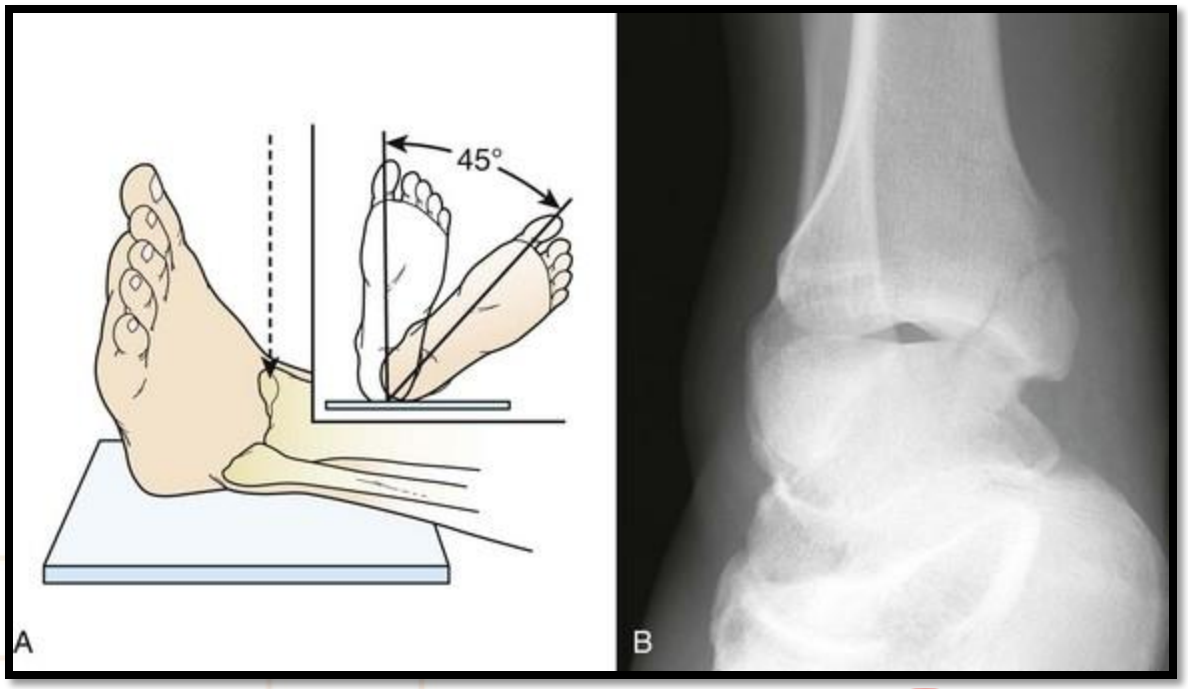



Foot in maximum Equinus
15° pronated
15º cephalic tilt

Talar
neck #

# Reverse oblique ankle view




Medial maleolar #

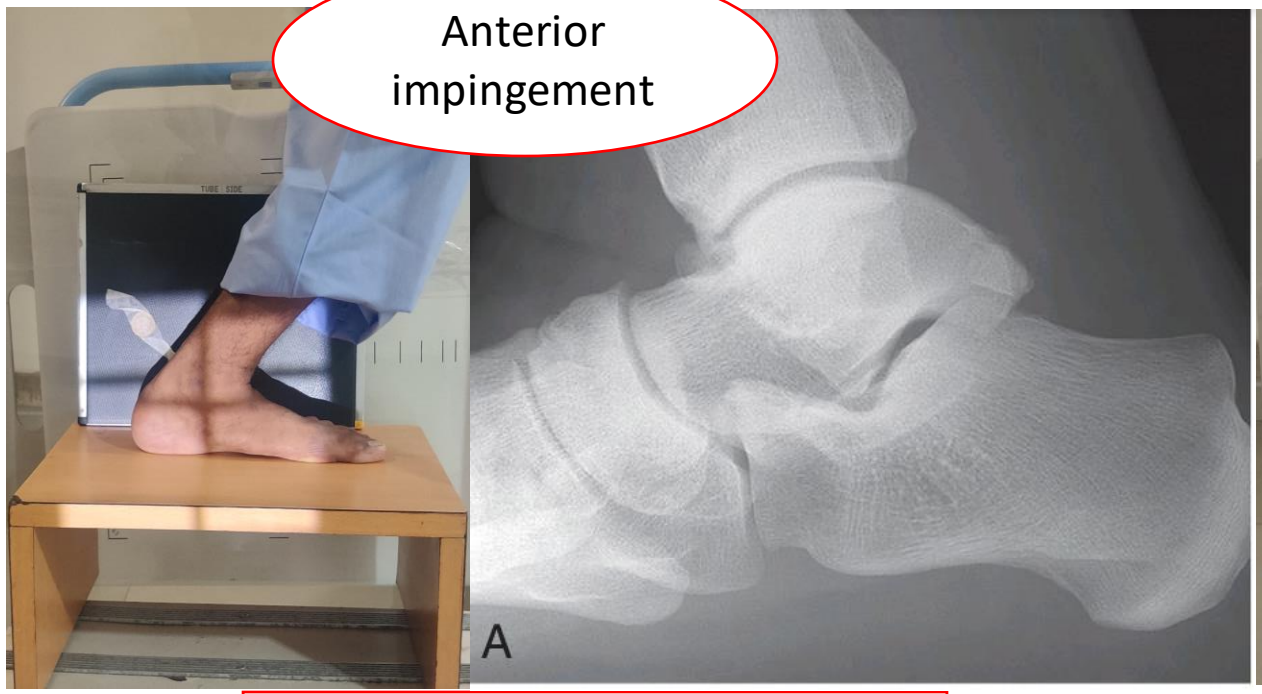
45º external rotation

# External rotation lateral view ankle

posterior maleolar #

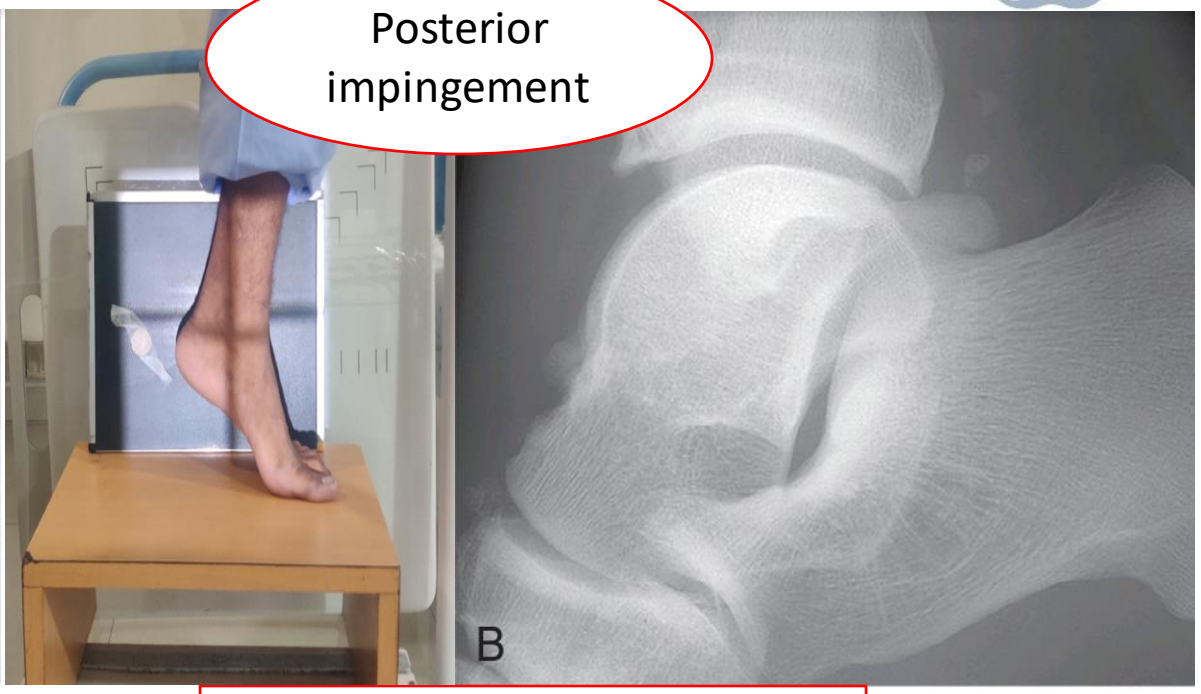
# Ankle impingement views

Anterior impingement



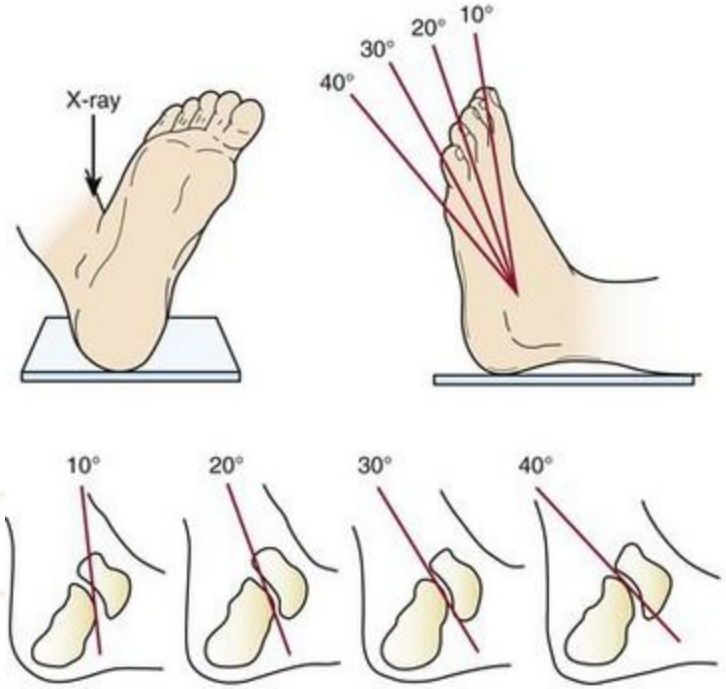

Weight bearing in maximum dorsiflexion

Posterior impingement



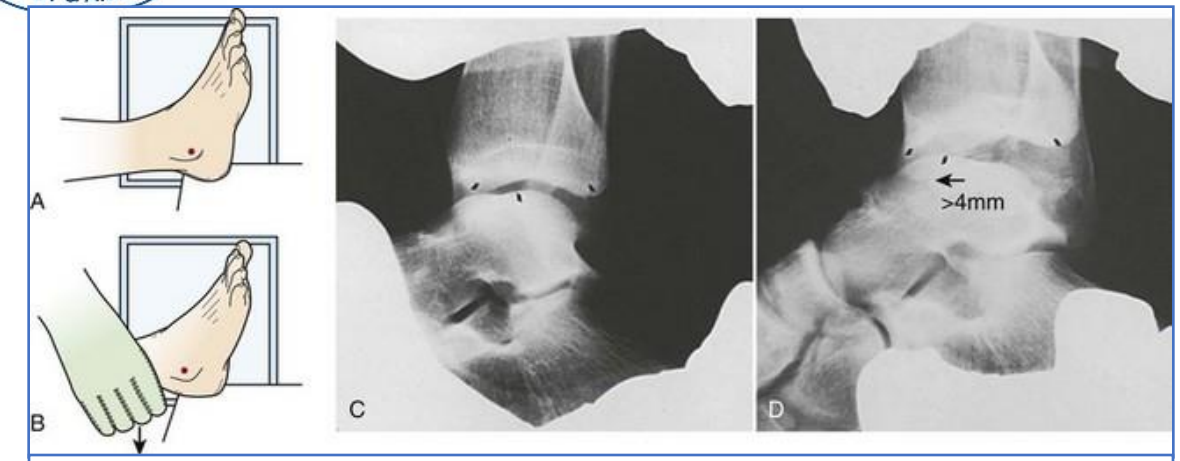

Weight bearing in maximum plantarflexion

# BRODEN's View
# (posterior facet subtalar joint)

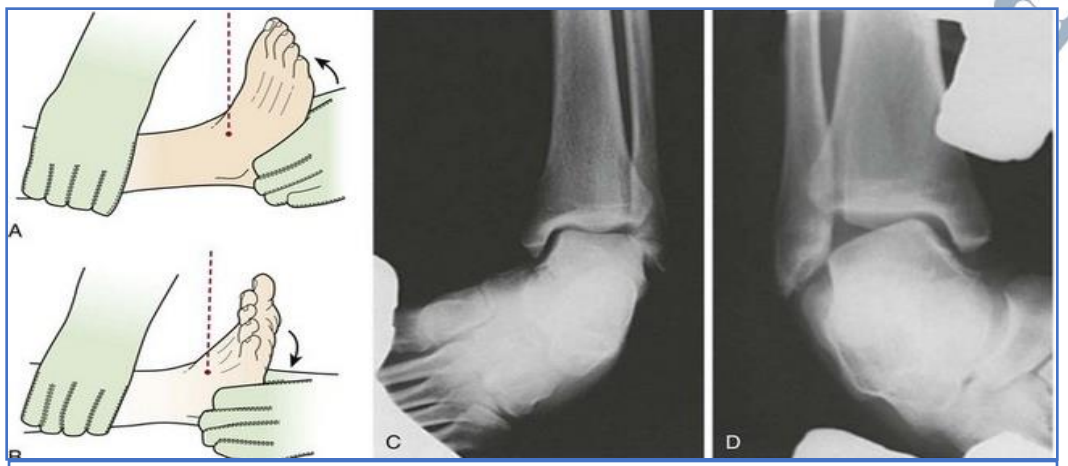



30º
Internal
rotation

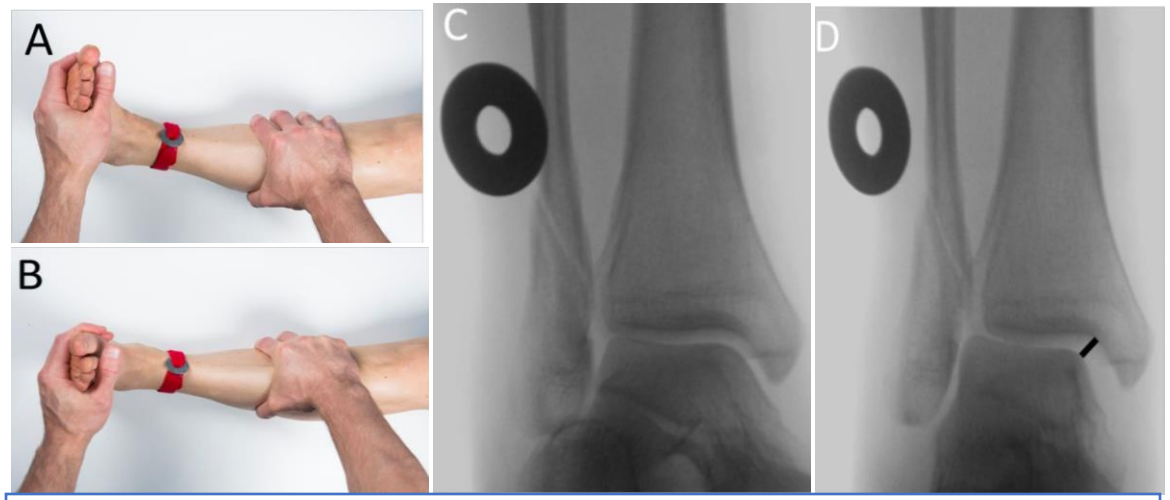
# Ankle instability Views



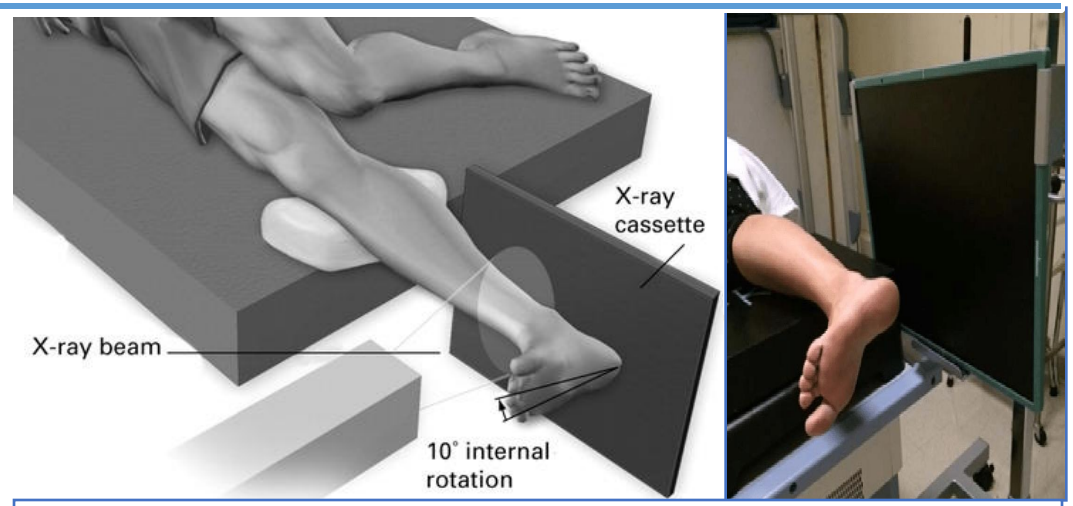

Anterior drawer's stress view(ATFL)




Varus/valgus stress view



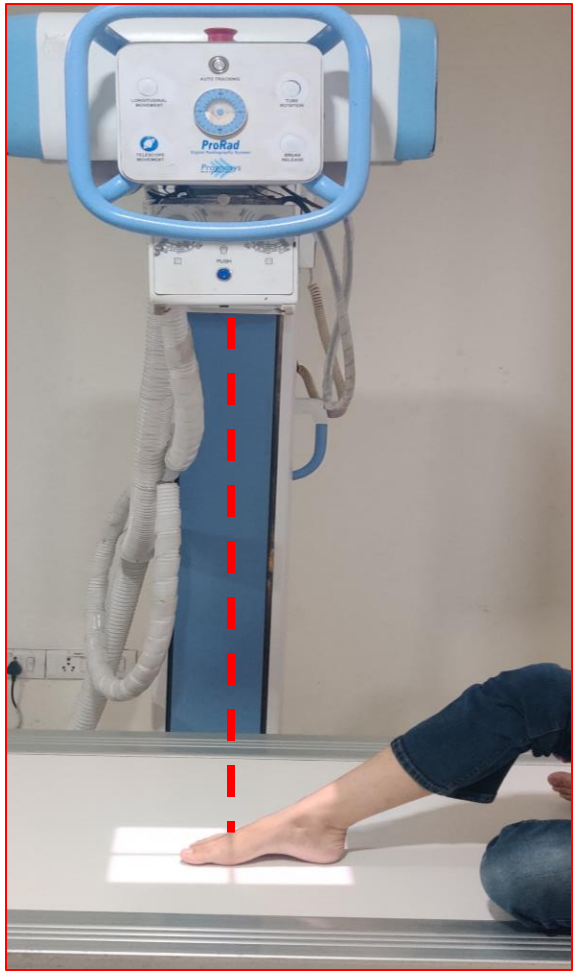

External rotation stress view(AITFL)



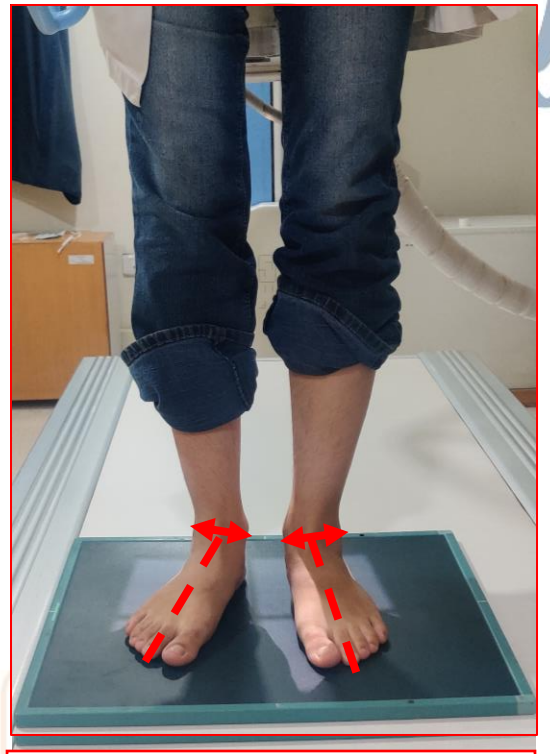

Gravity stress view

# Common PITFALLS in F&A radiology

Weight bearing lateral

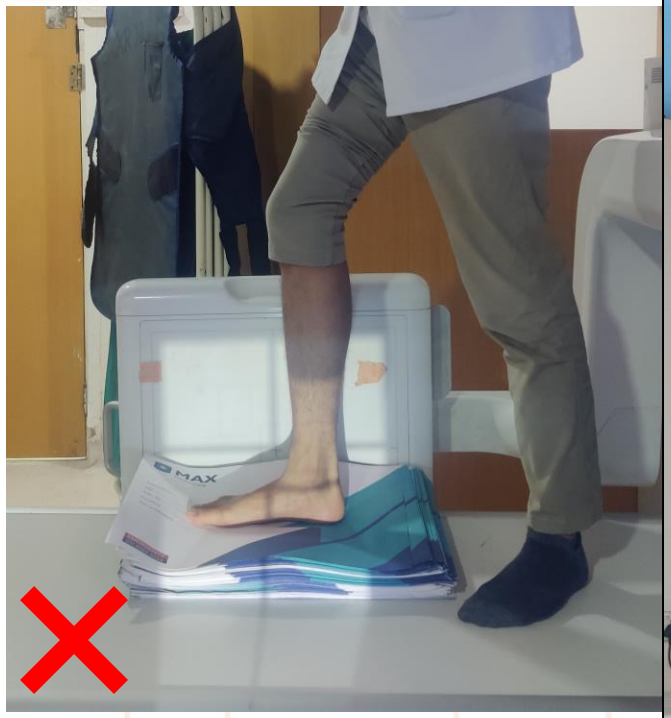



Non Weight bearing Foot AP

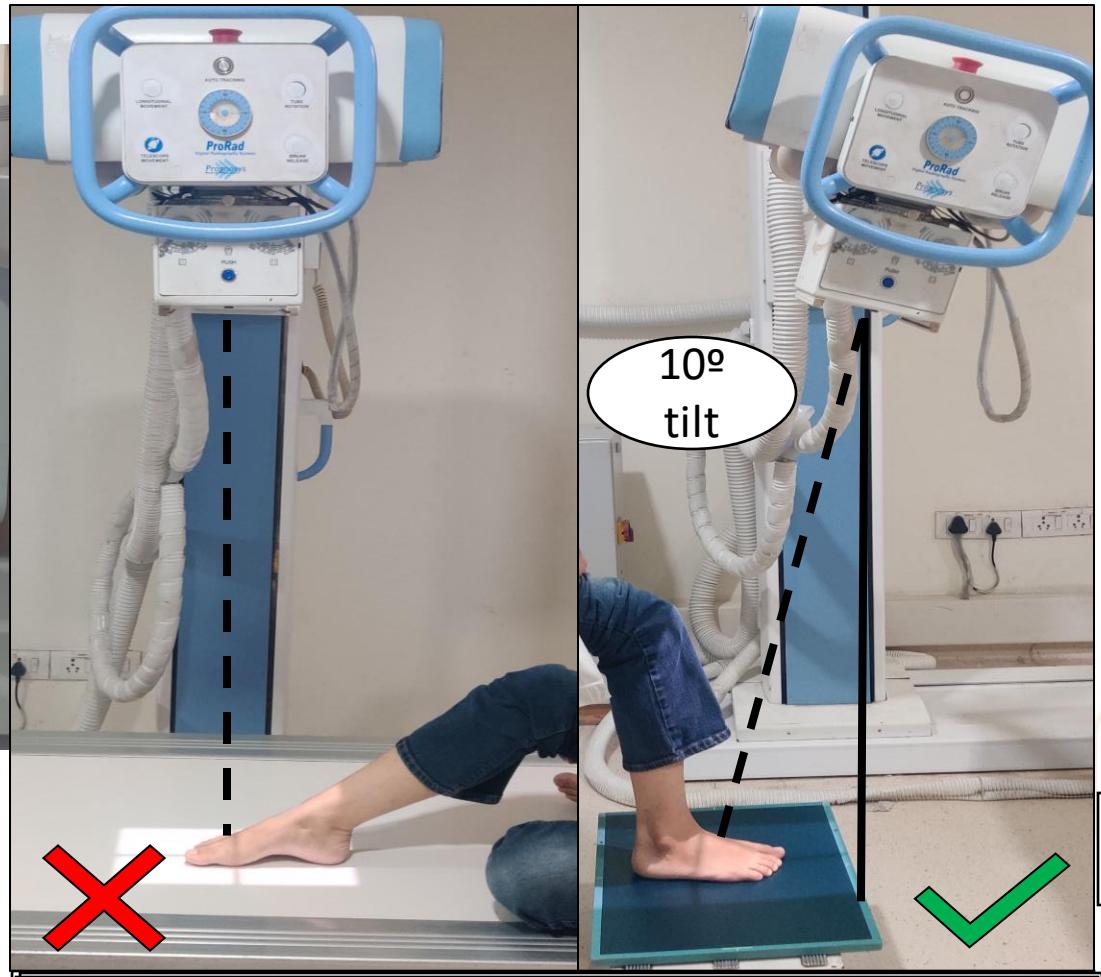


Hindfoot long axial view

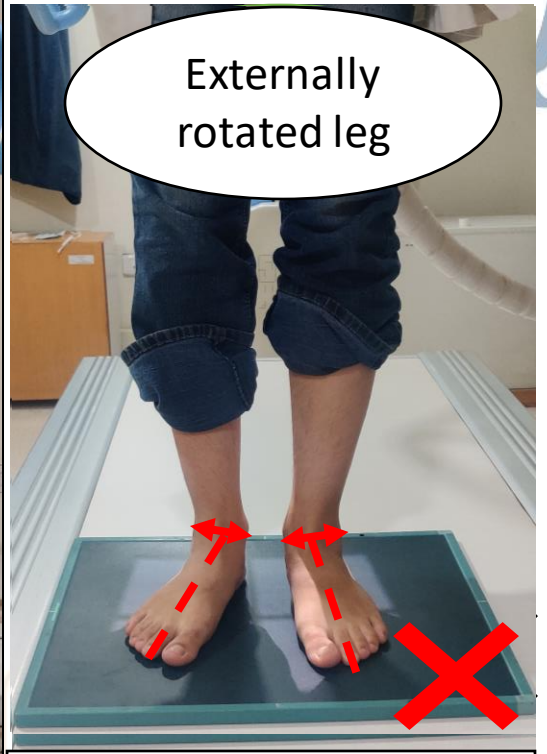
# Common PITFALLS in F&A radiology



Weight bearing lateral

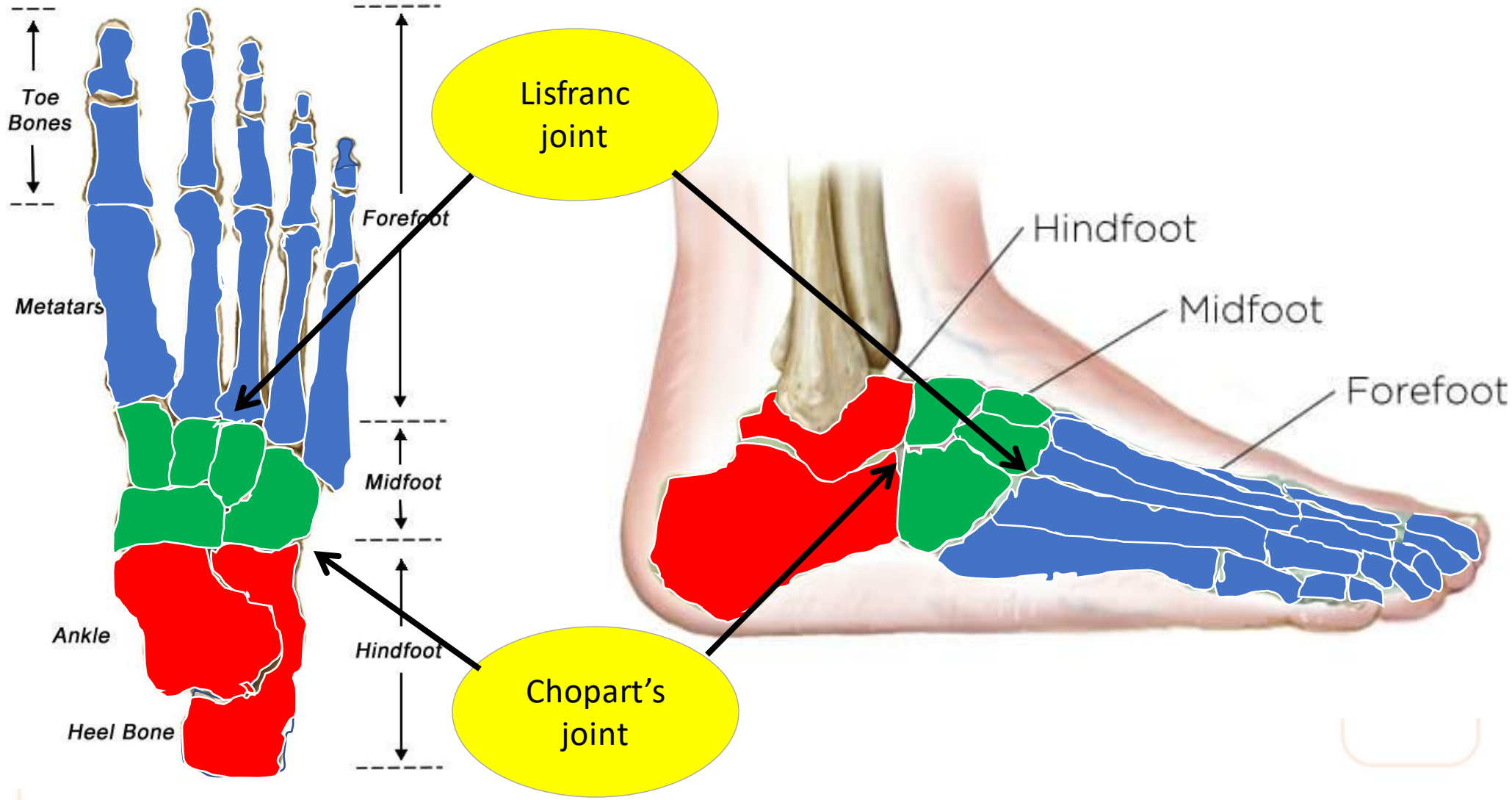



Non Weight bearing Foot AP

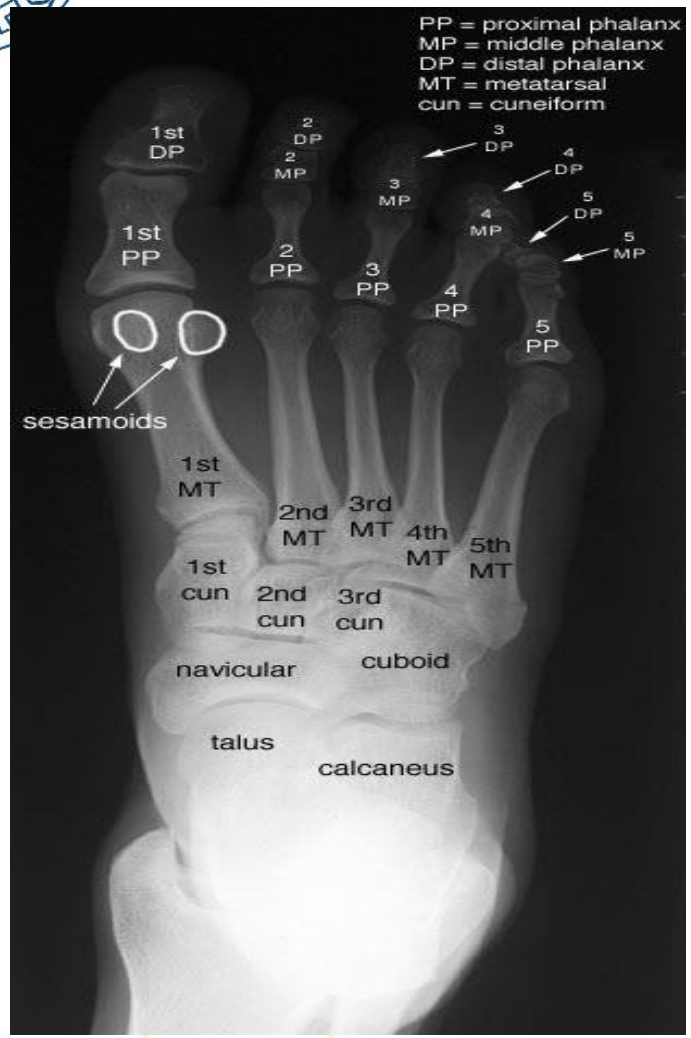



Hindfoot long axial view

# FOOT Radiological assessment



# Foot x Rays

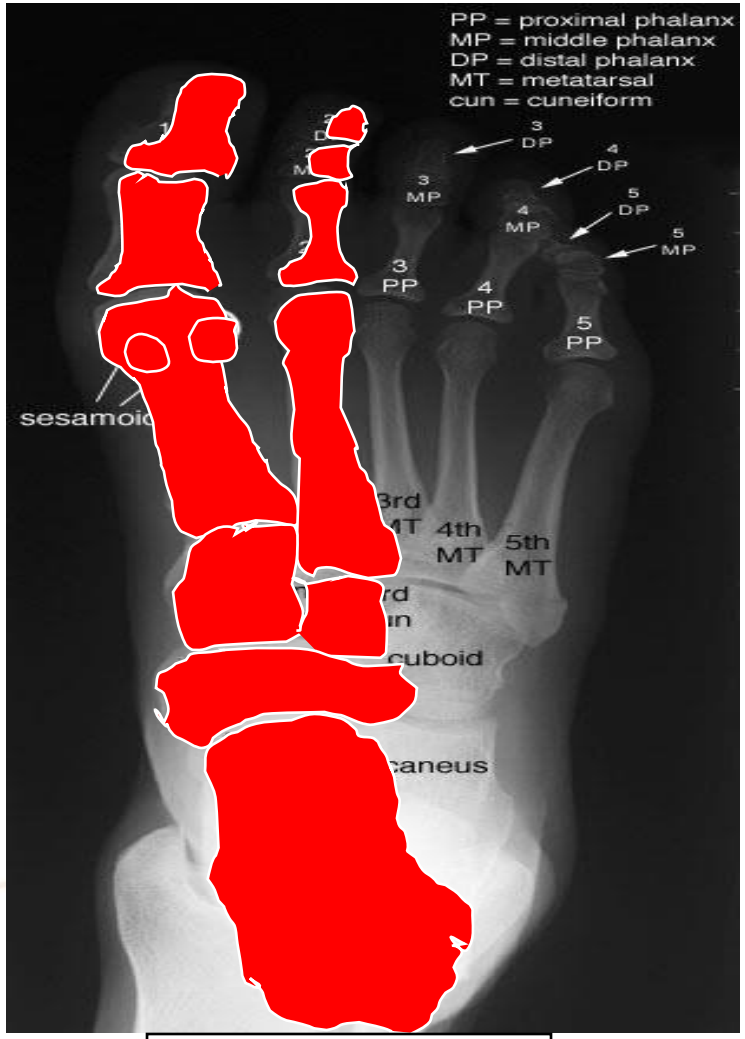



AP VIEW

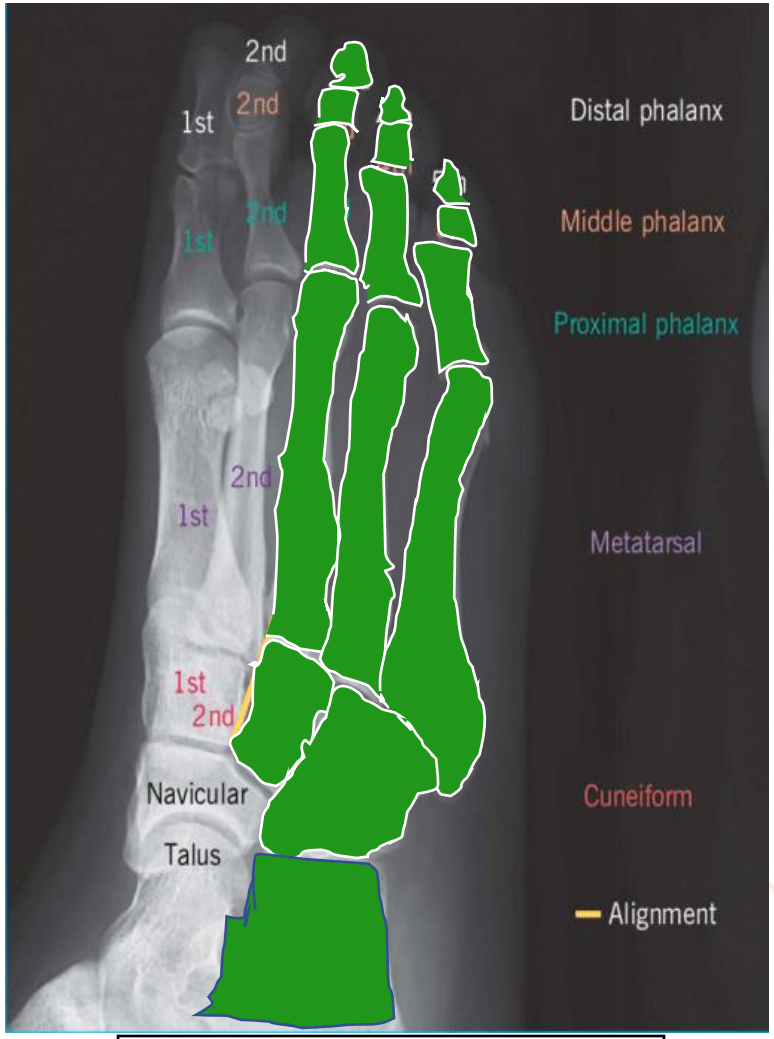
- Soft tissues
- Individual bones
- Joints and clear spaces
- Alignment of bones
- Important measurements and angles
- Accessory bones/Ossification centres


Medial oblique view

# Foot x Rays

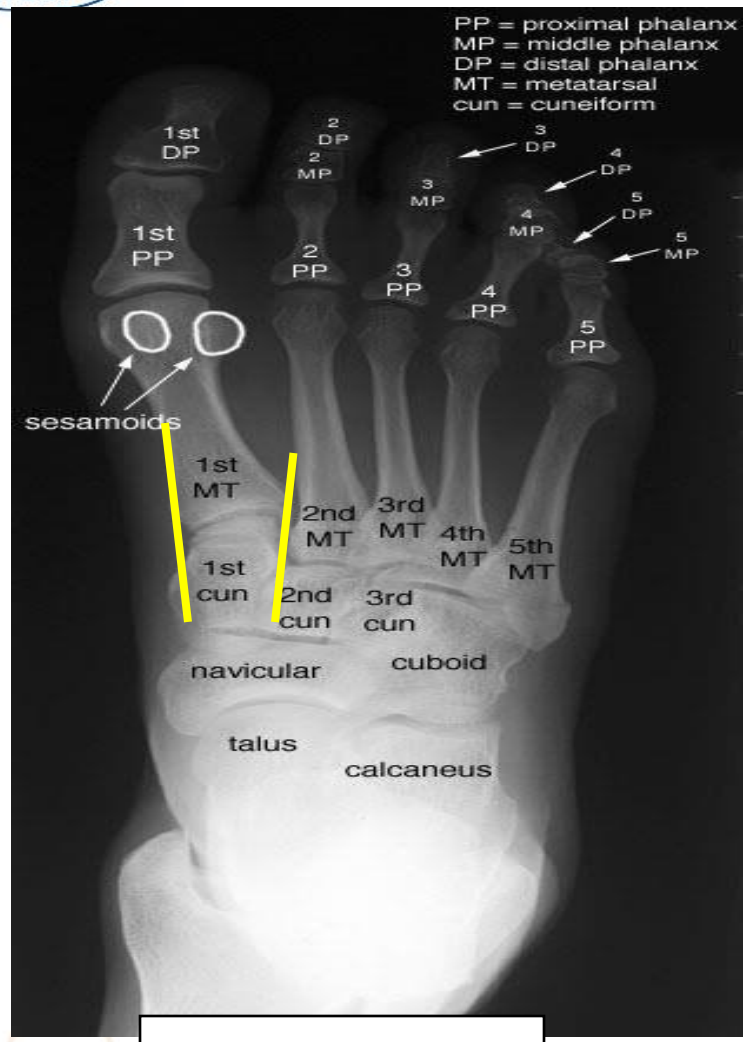



AP VIEW

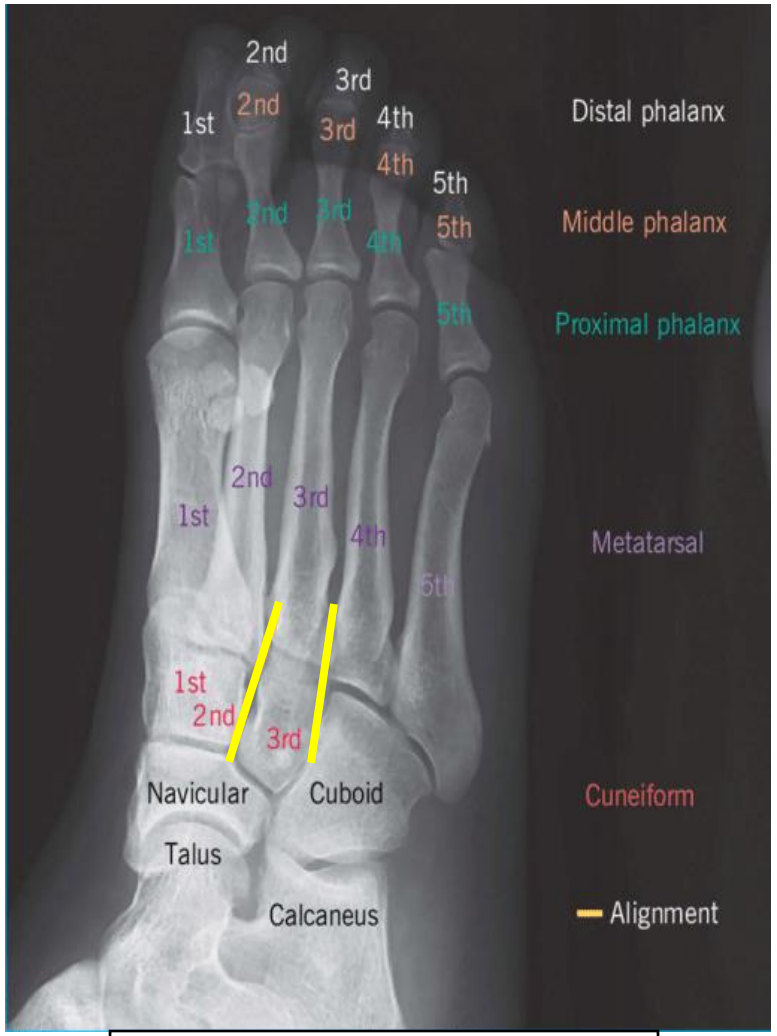



Medial oblique view

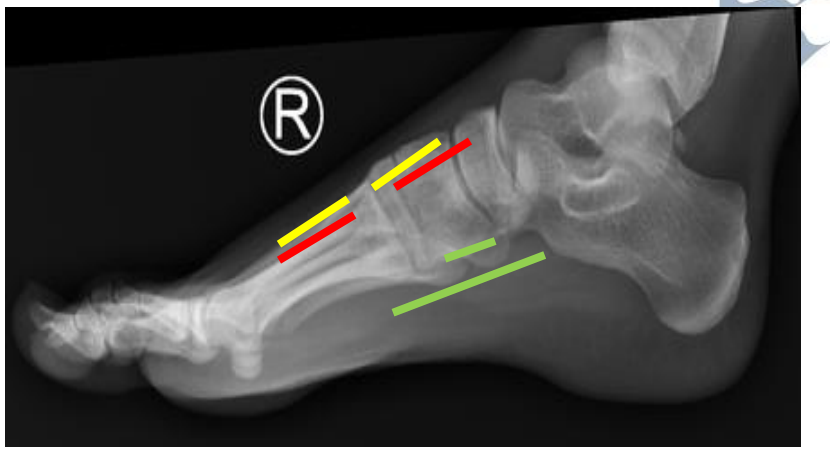
# Foot x Rays




AP VIEW




Medial oblique view



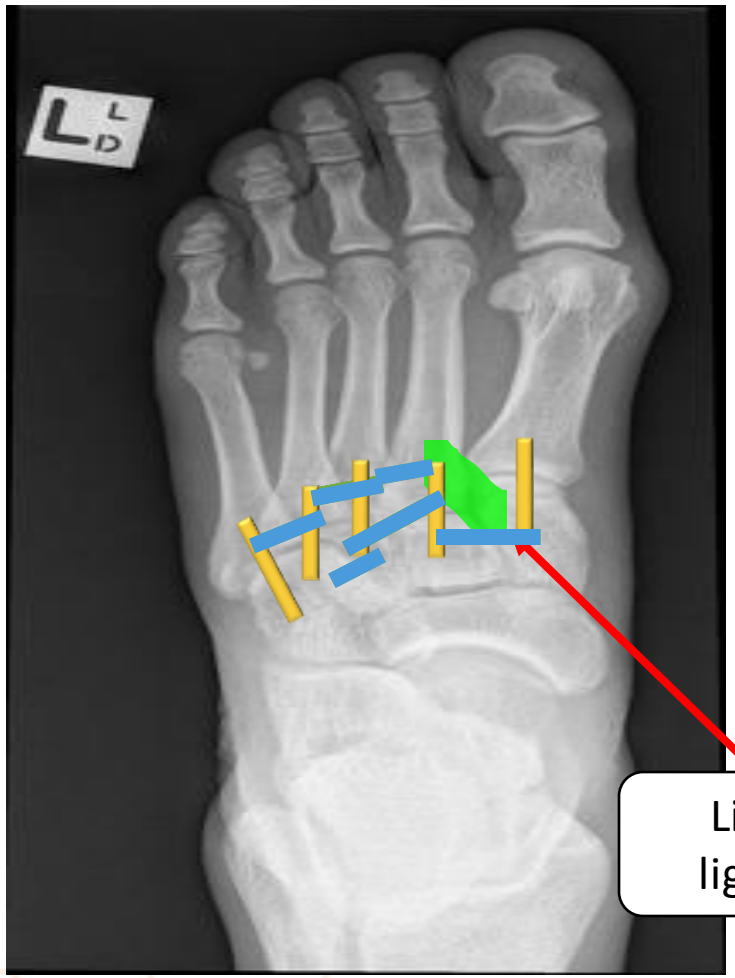

1st MT-Medial cuneiform height

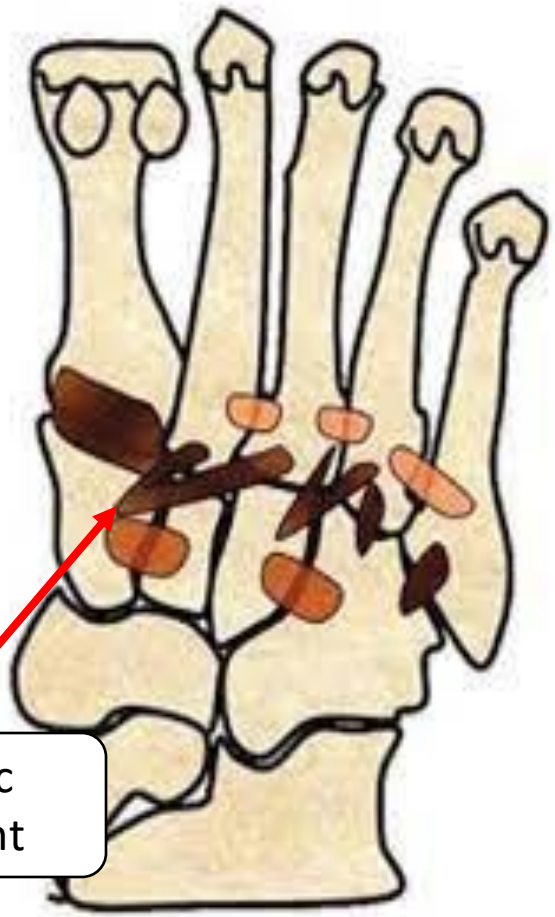
2nd MT-2nd Cuneiform height

5th MT base-Medial cuneiform height

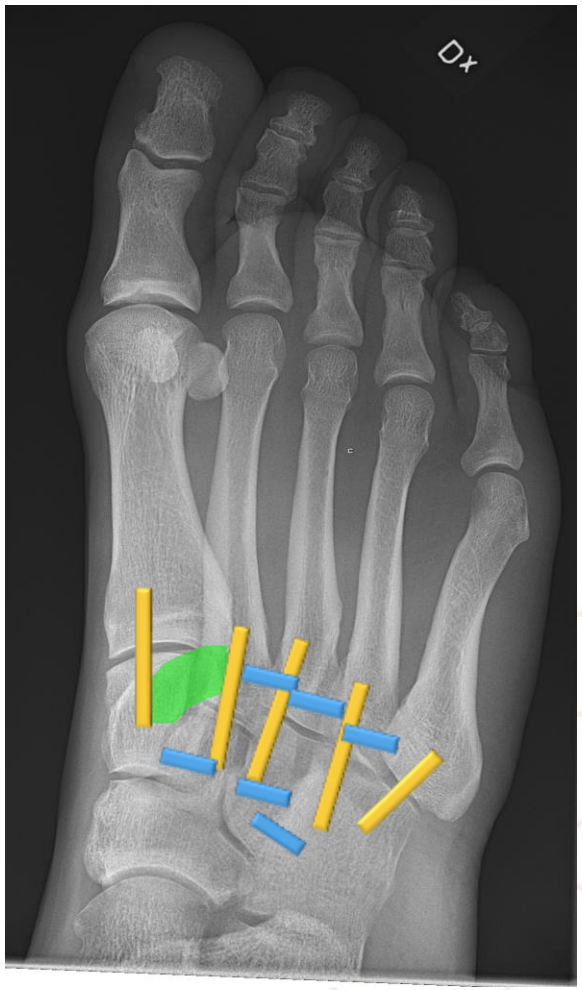
Lateral view

# Lisfranc injuries





Lisfranc ligament



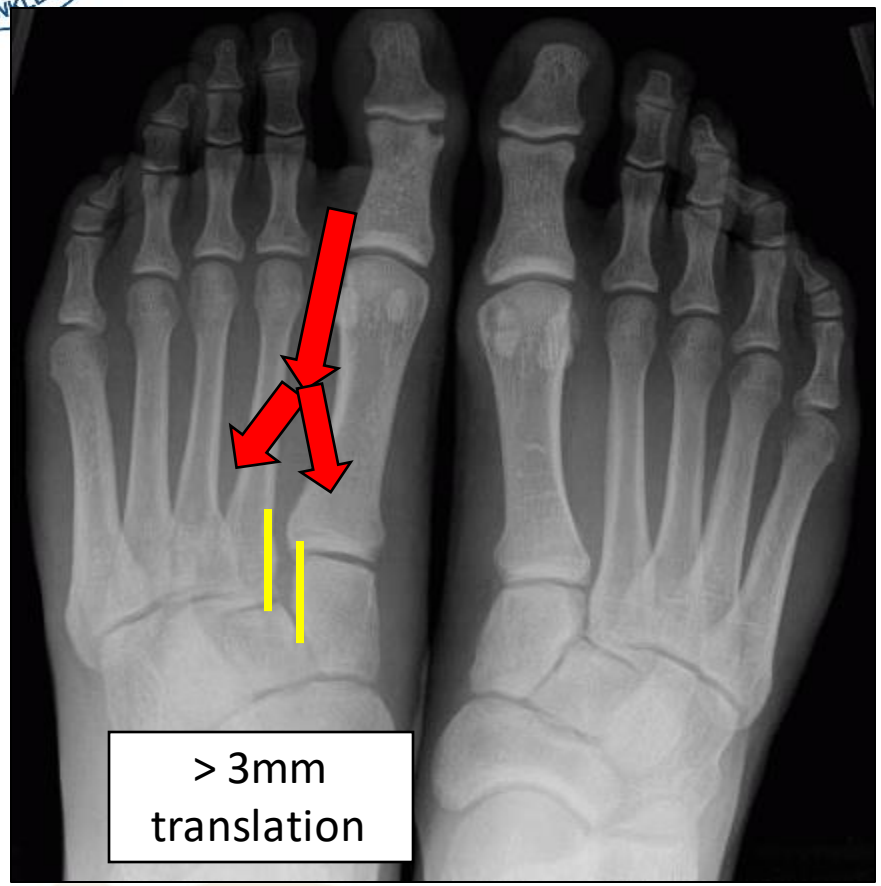
# Lisfranc Injuries

1


2

3

# Lisfranc Injuries

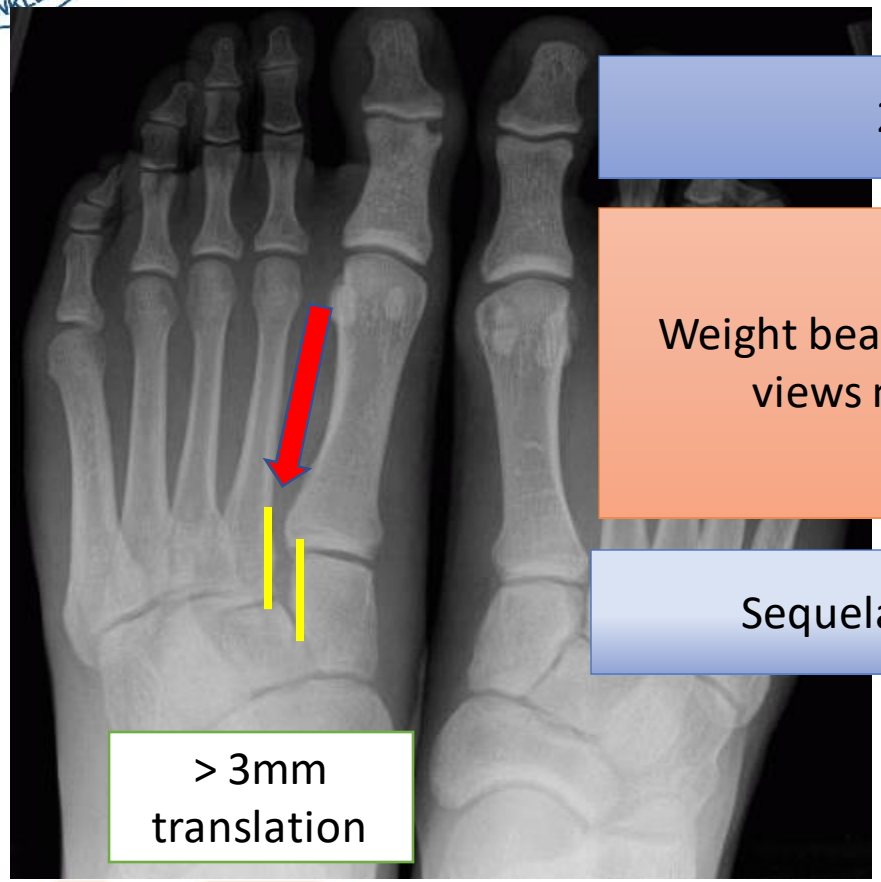



1


2

3

# Lisfranc Injuries

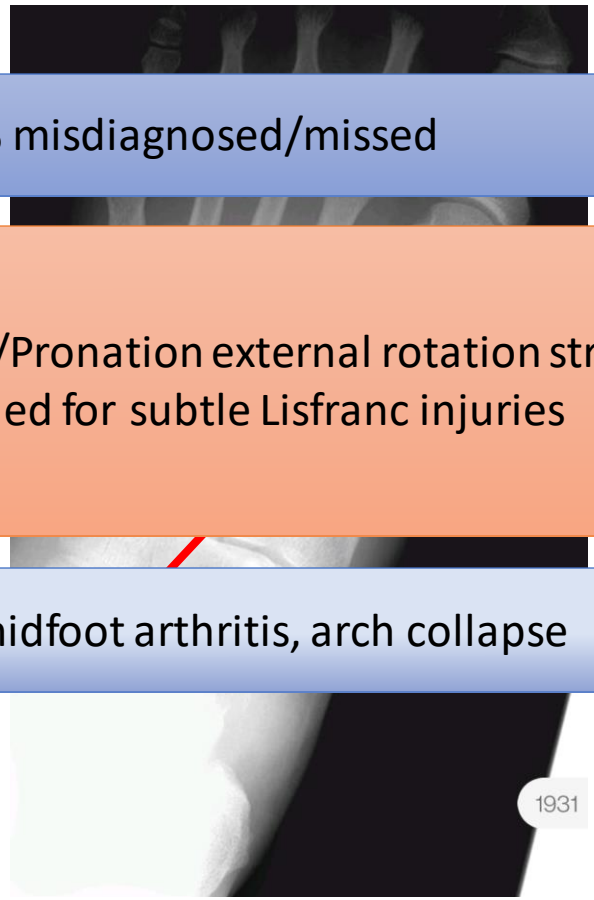


> 3mm translation

20 % misdiagnosed/missed

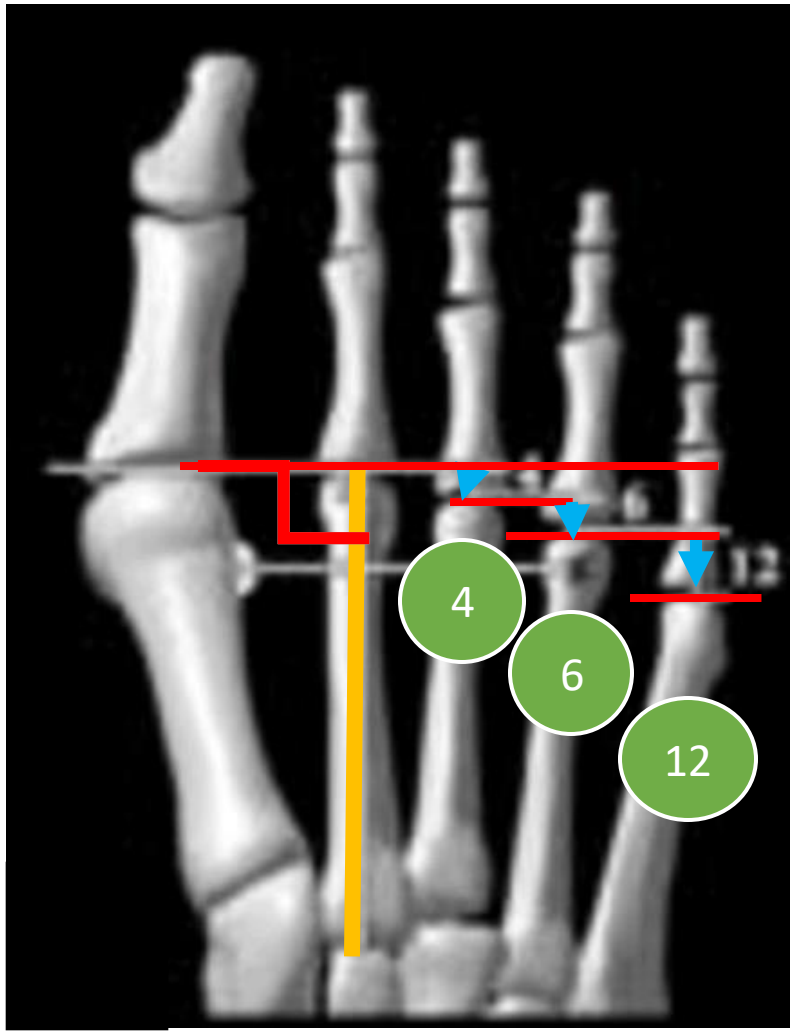
Weight bearing/Pronation external rotation stress views needed for subtle Lisfranc injuries

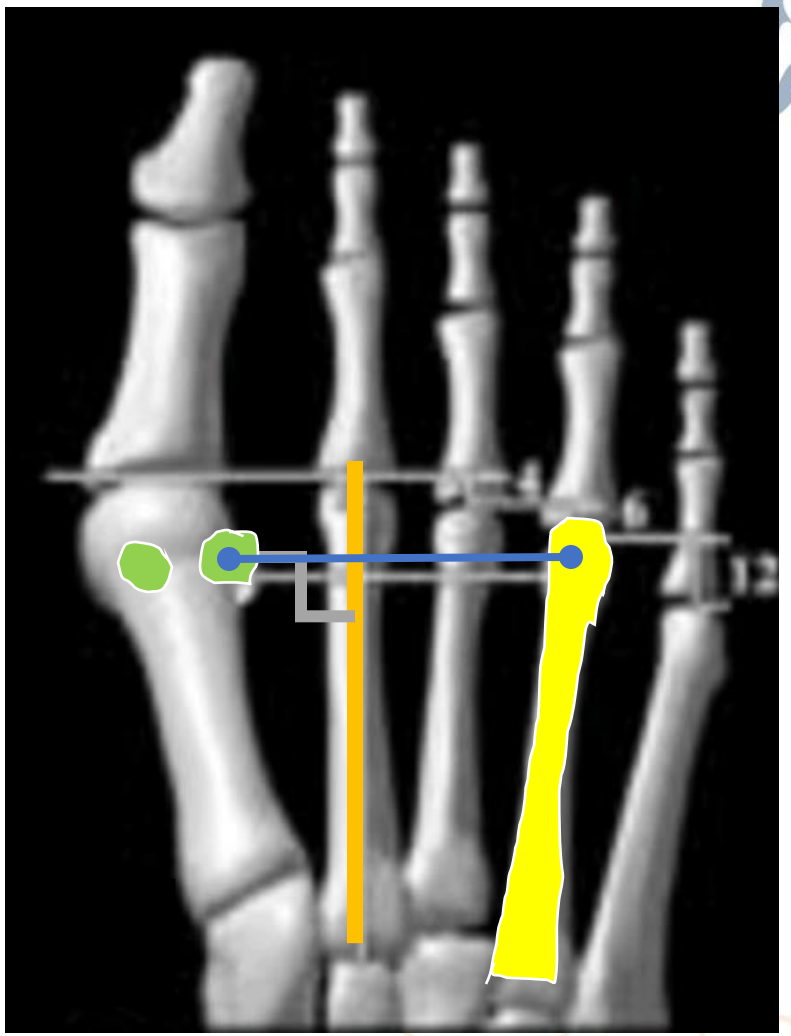
Sequelae-midfoot arthritis, arch collapse



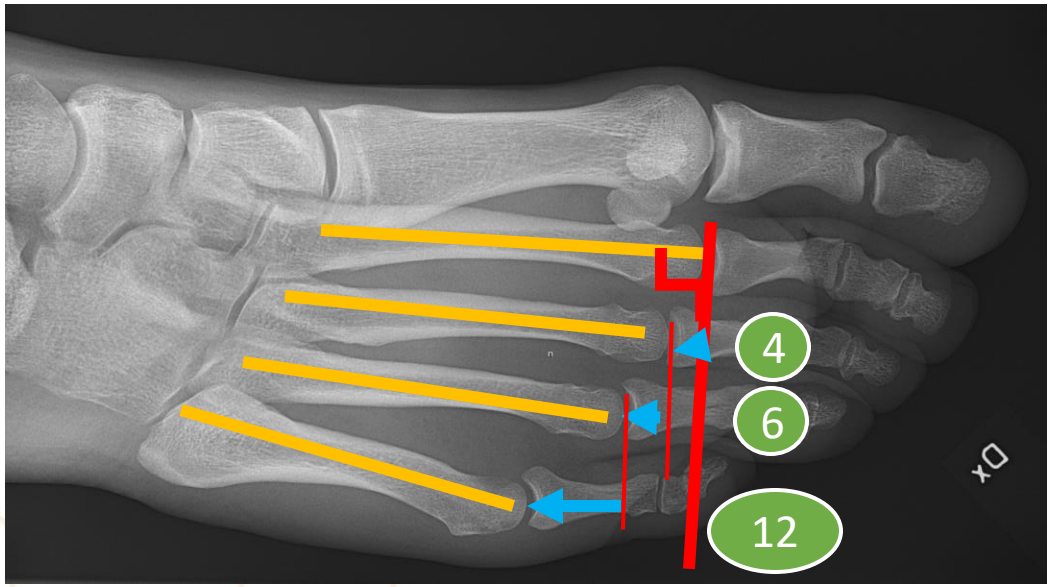

# Lisfranc injuries-treatment

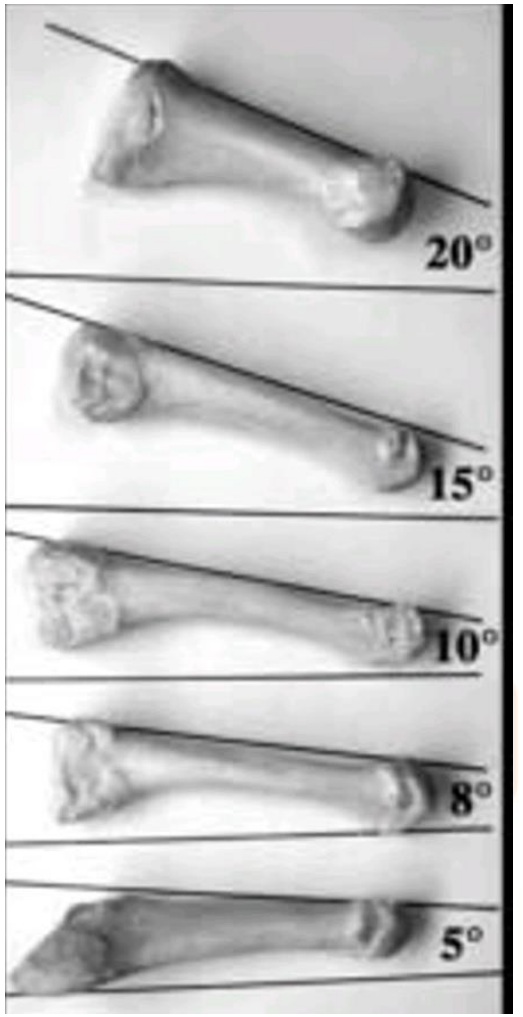
# Foot Parabola and Maestro criteria

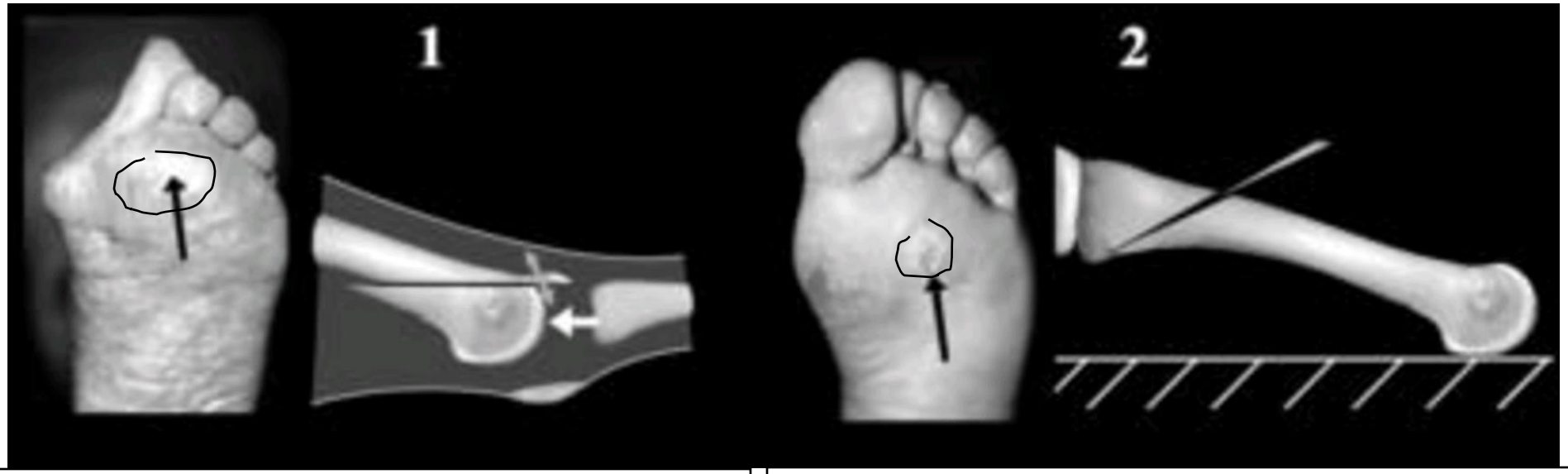



# Foot medial oblique view



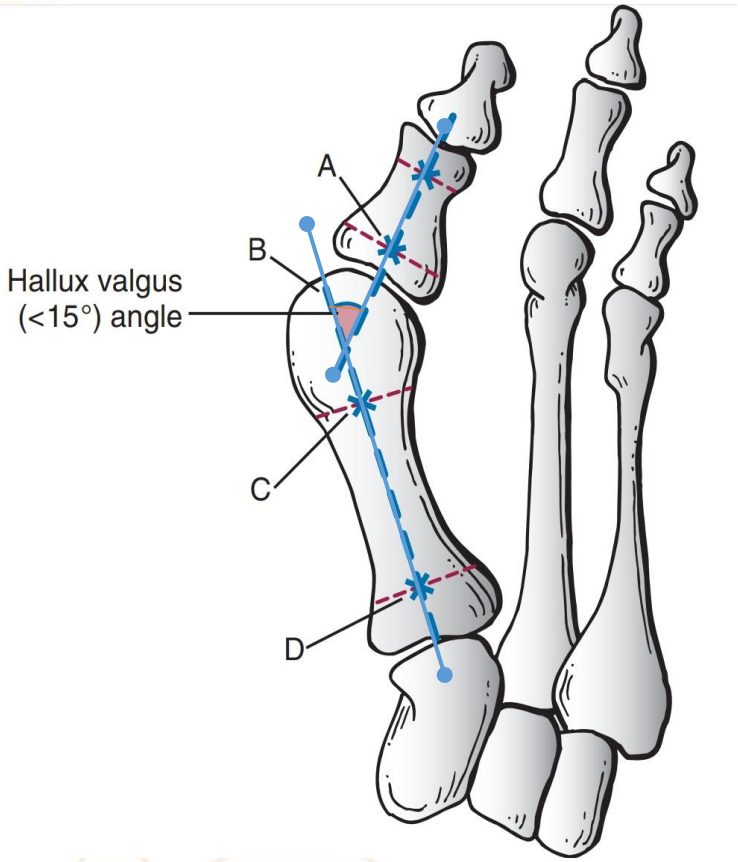
# Metatarsalgia

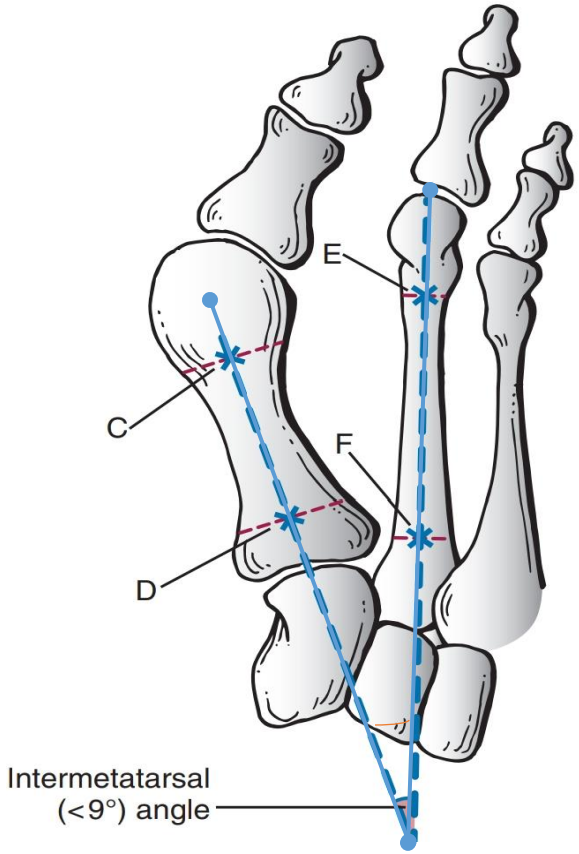


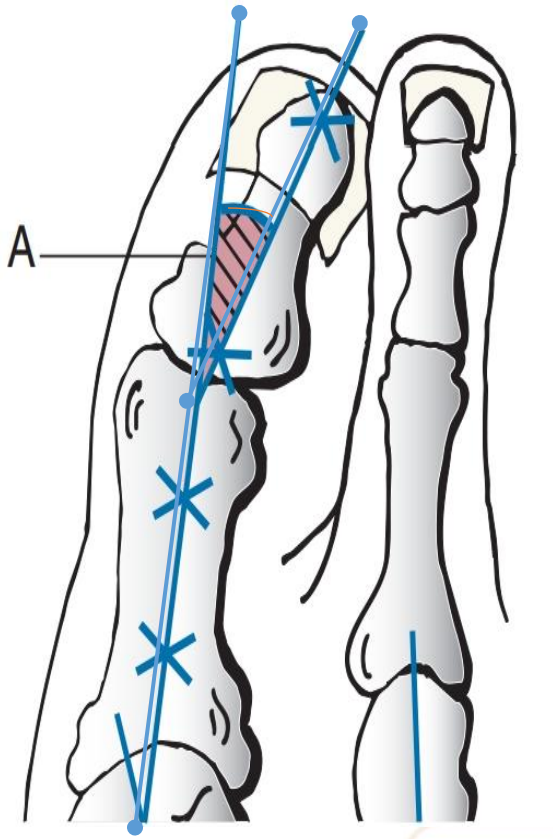

- ✓ Long Lesser MT's-Distal callus
- ✓ Treated by Weil's osteotomy

- ✓ Plantar flexed lesser MT's-Proximal callus
- ✓ Treated by BRT osteotomy

# Measurements in the Forefoot



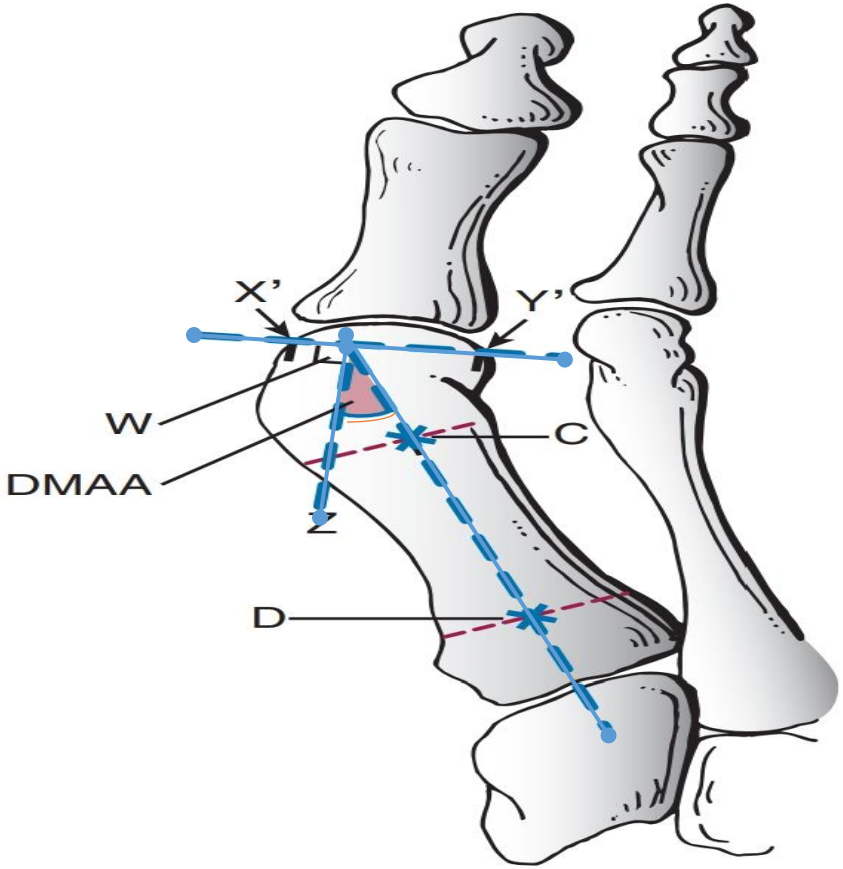




Hallux Valgus angle (<15º)

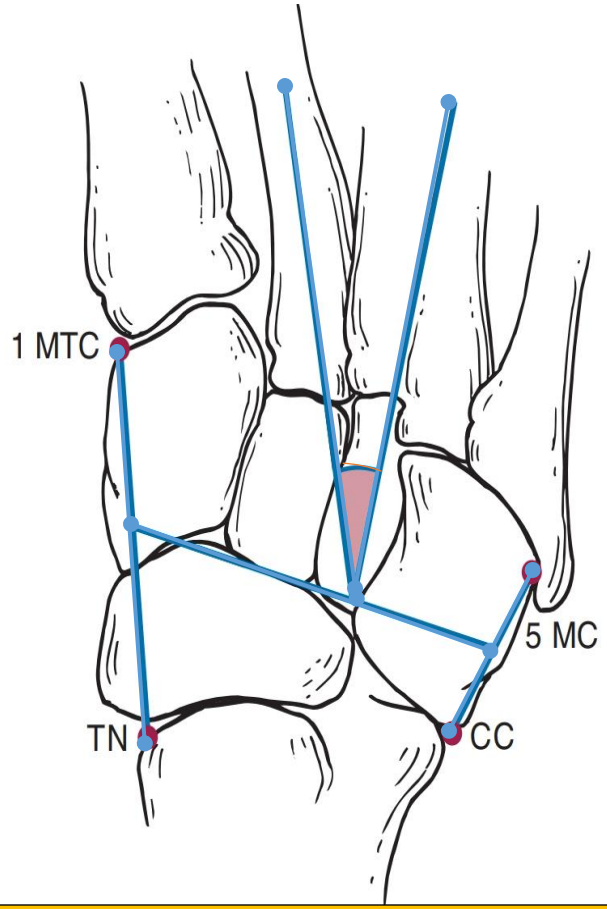
Intermetatarsal angle (<9º)

Interphalangeal angle (<10º)

# Measurements in the Forefoot

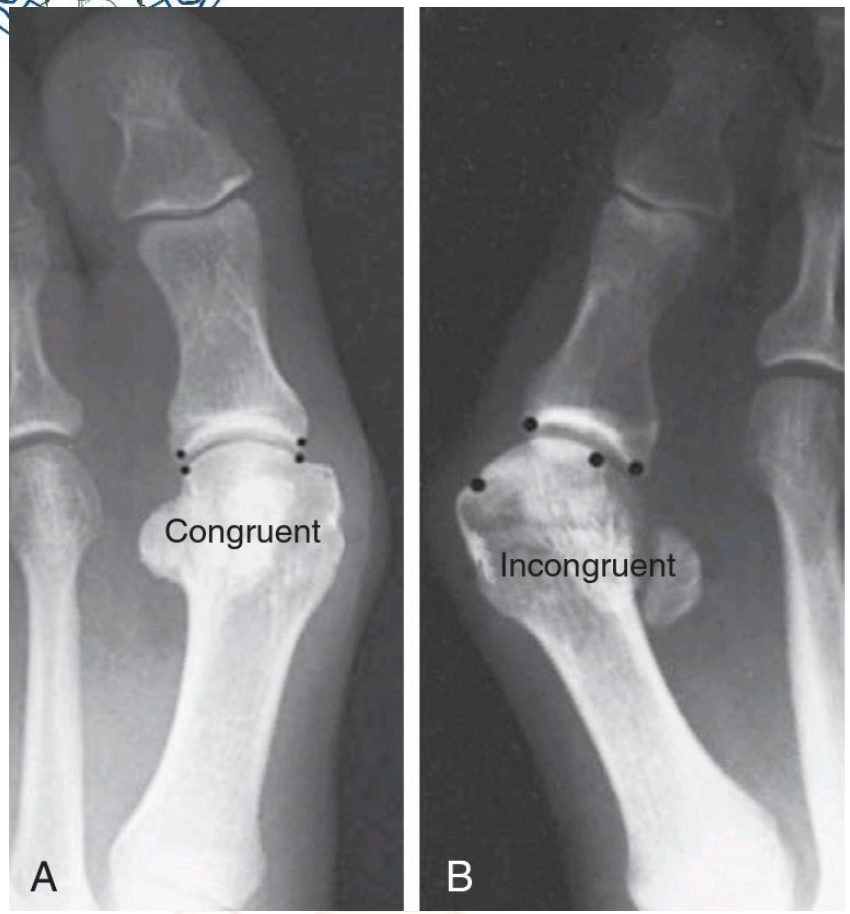


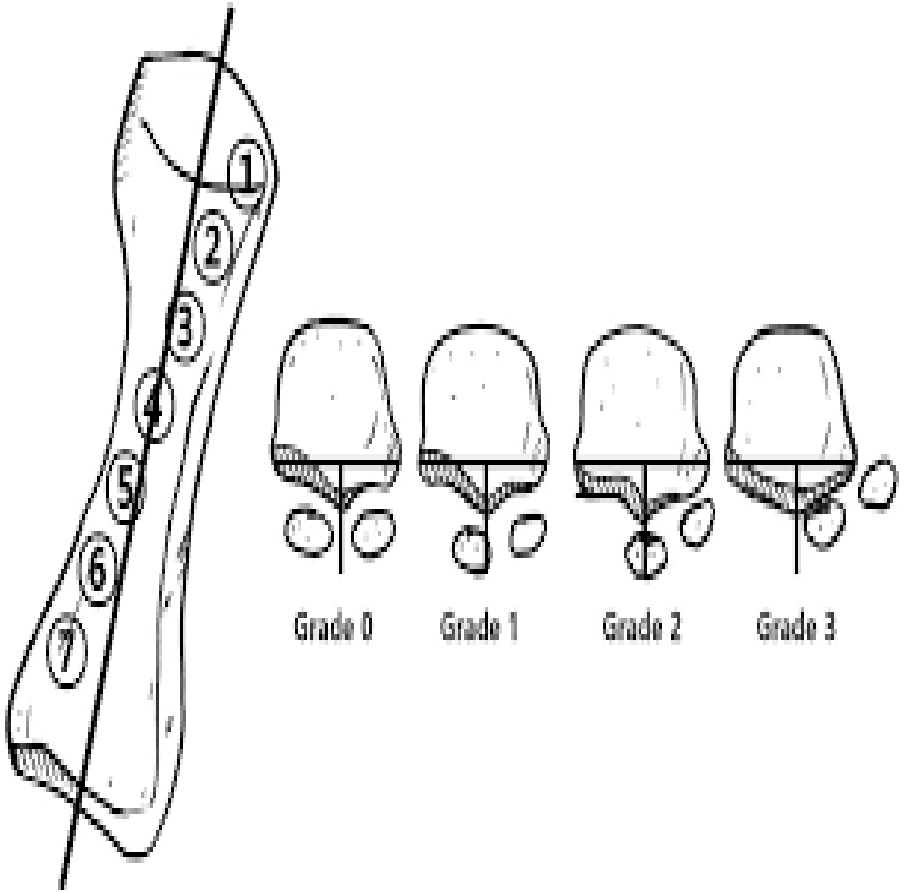

Distal Metatarsal articular angle(DMAA) (<6º)




Metatarsus adductus angle(DMAA)(0-15º)

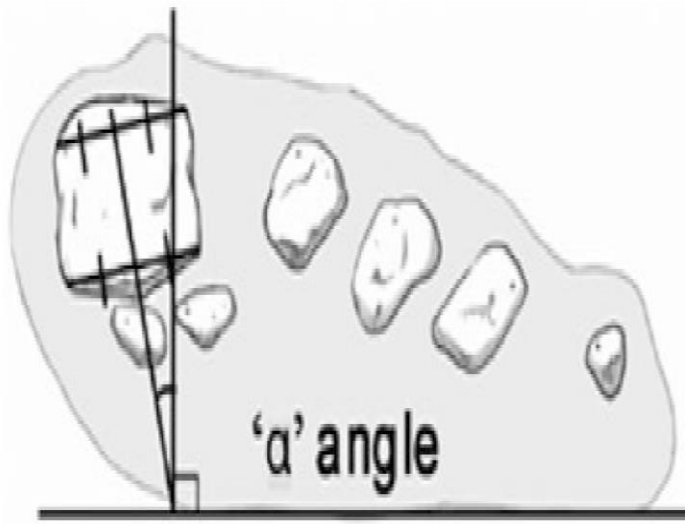
# Measurements in the Forefoot







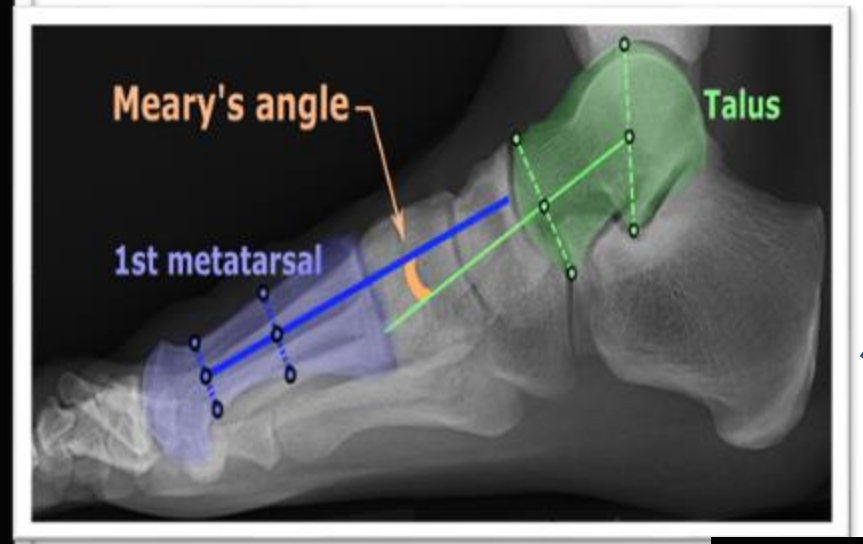


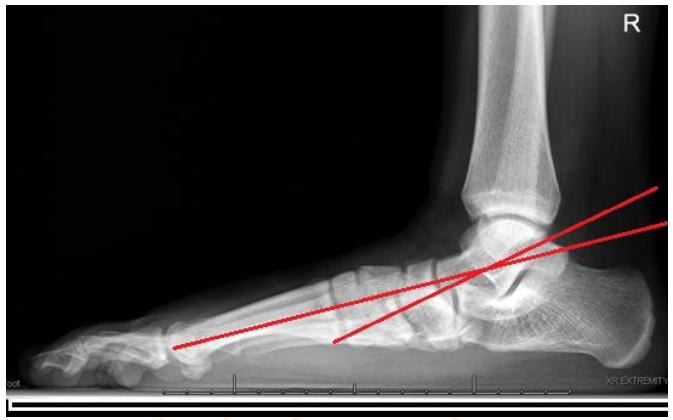

Congruence of 1st MTP joint

Tibial sesamoid position

Rotation of metatarsal (alpha angle=5º)

# Measurements in the Midfoot





Talo1st MT (Meary's angle)

Lateral -4 to +4°

Negative in Pes Planus

Increased in Pes Cavus

# Measurements in the Midfoot


Talonavicular coverage angle(<7º)

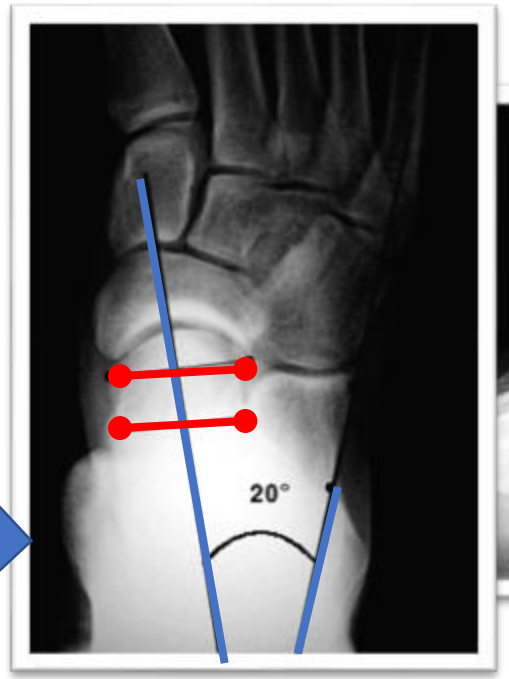

Pes cavus

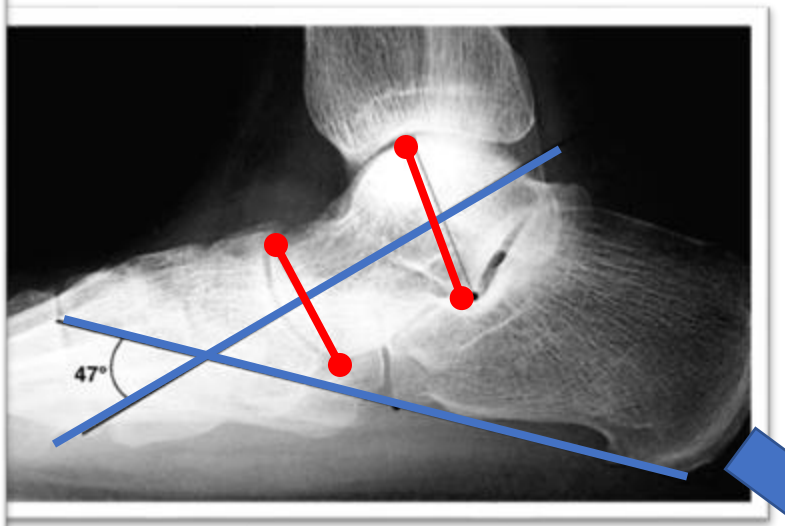

Cyma line

Medial cuneiform-5$^{th}$ MT height(17 mm)


Pes planus(<6 mm)

# Measurements in the Hindfoot






Talocalcaneal (kite's angle)

AP-15-30°

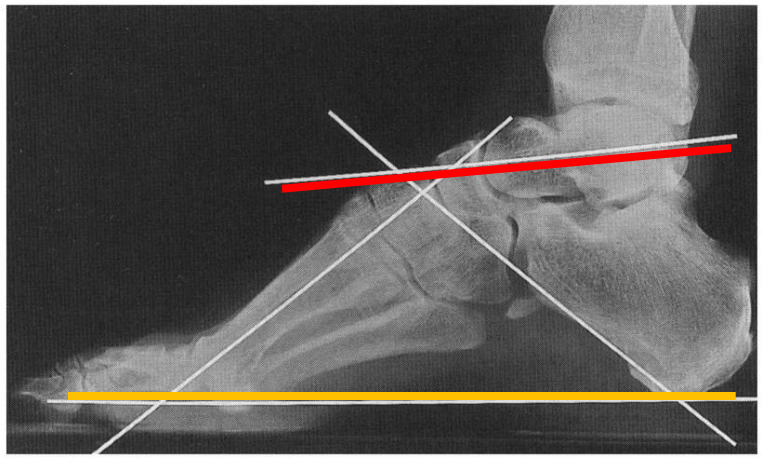
Lateral-25-45°

Increased in Pes Planus

Decreased in Pes Cavus

# Measurements in the Hindfoot

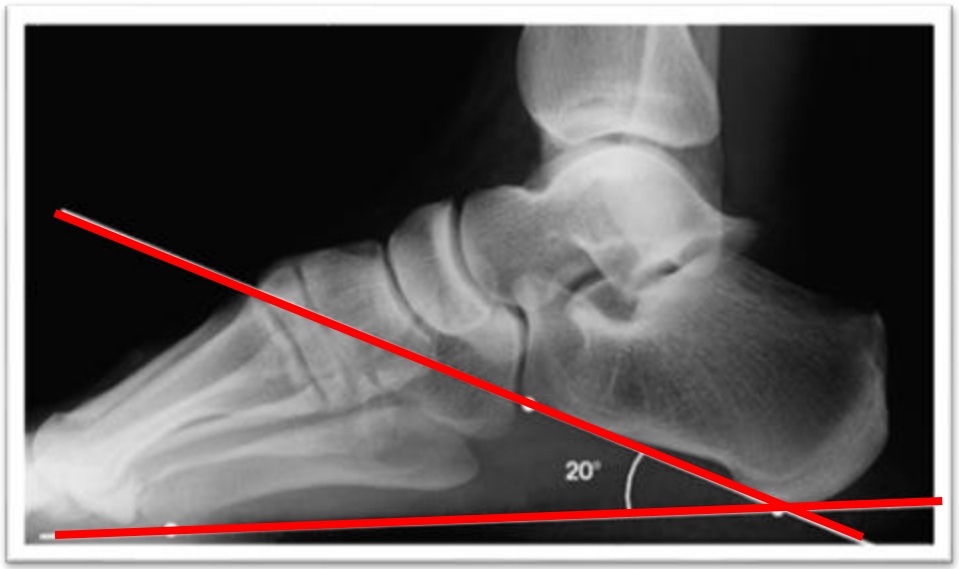
Talar Declination angle(21°)

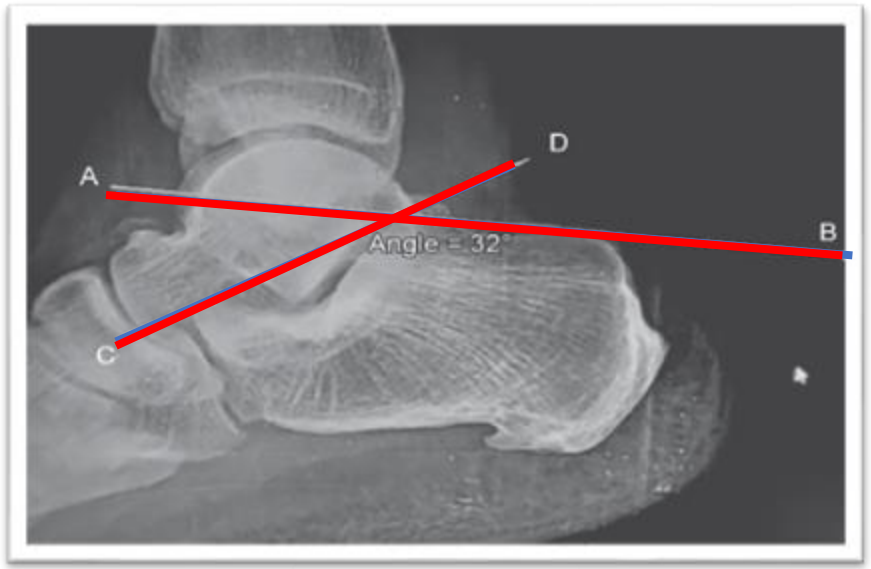


Decreased in Pes cavus, Calcaneal fractures

Increased in Pes Planus, Ankle Equinus, Midfoot Charcot

# Measurements in the Hindfoot





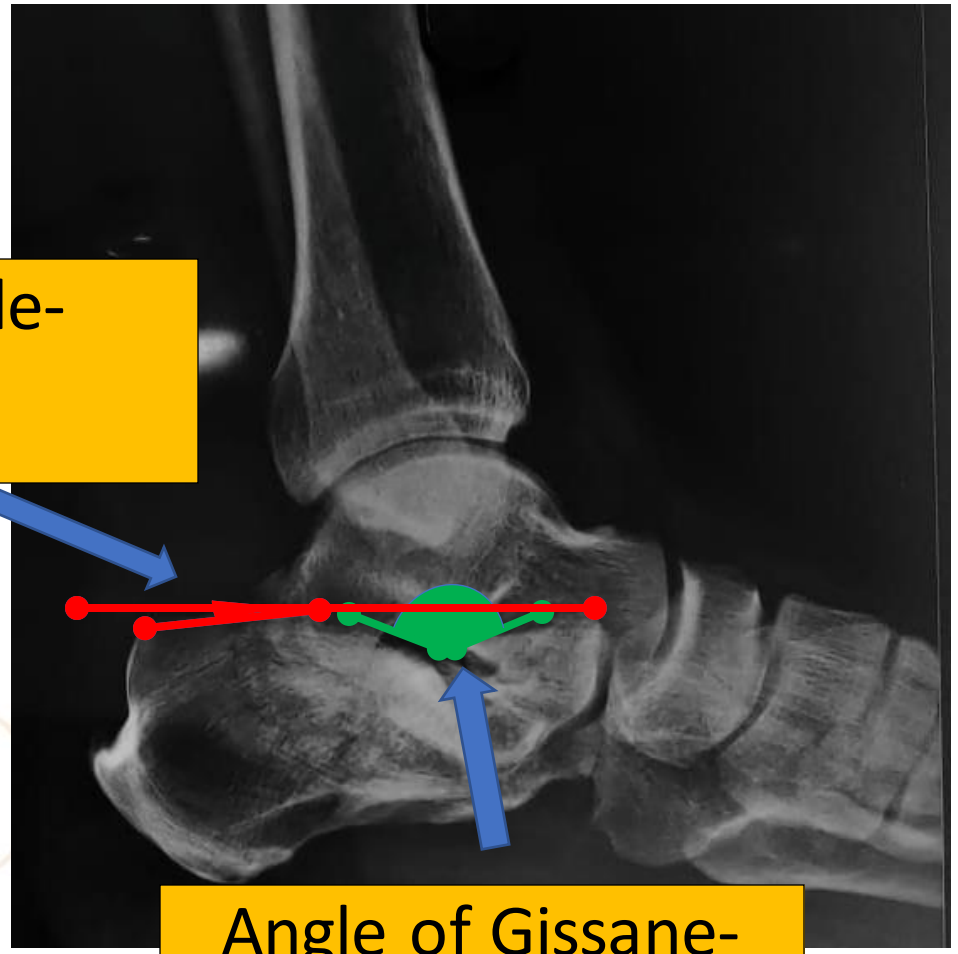
Calcaneal pitch angle (18-20°)

Bohler's angle (25-40°)

Angle of Gissane (120-145°)

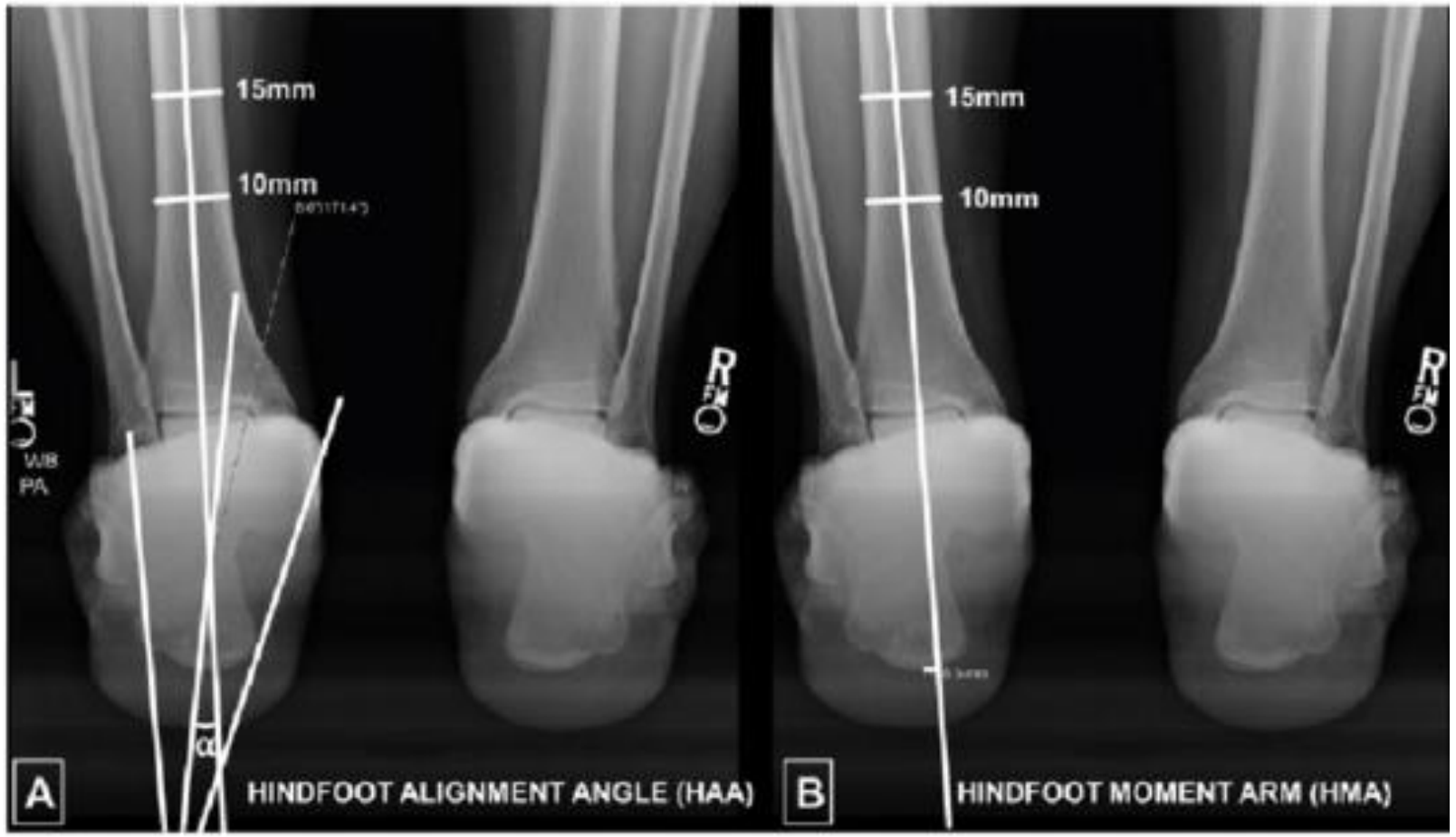
# Calcaneal fracture assessment

Bohler’s angle- decreased



Angle of Gissane- increased

# Measurements in the Hindfoot




Hindfoot alignment angle

Hindfoot moment arm

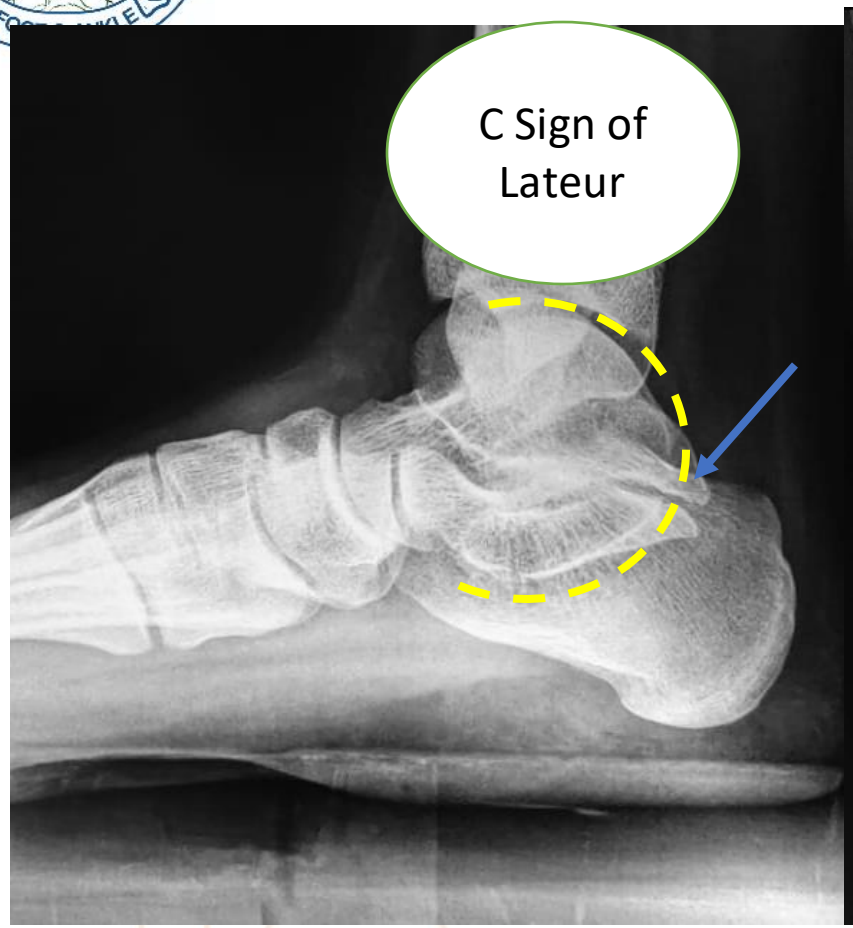
# Accessory bones of foot

Os Trigonum


Os Naviclare

Os Intermetatarseum

# Tarsal coalition

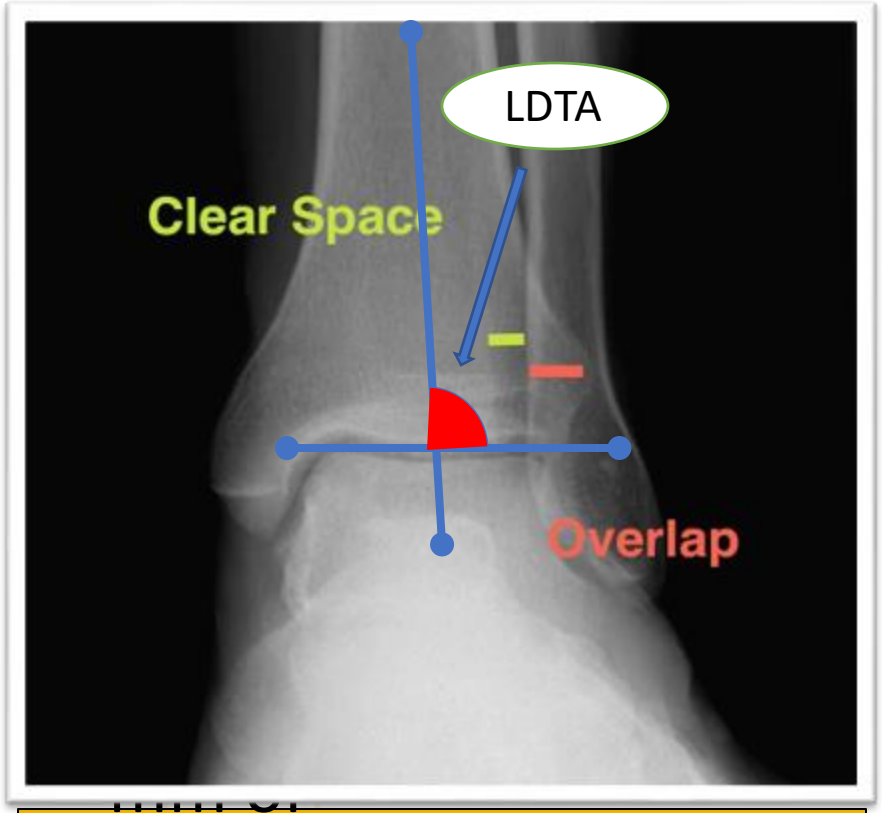


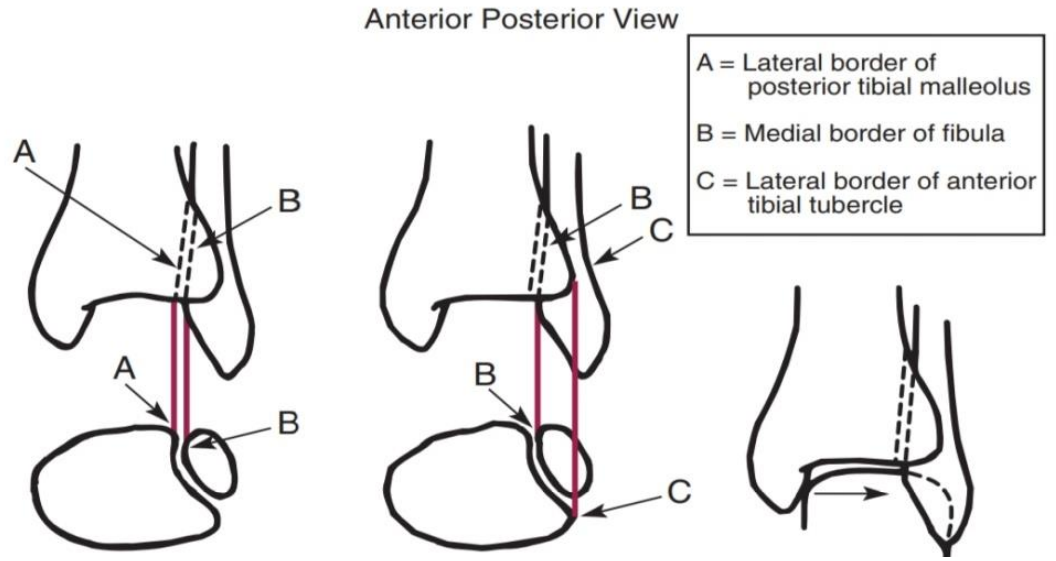


Talocalcaneal coalition

Calcaneonavicular coalition

# Ankle Ap VIEW



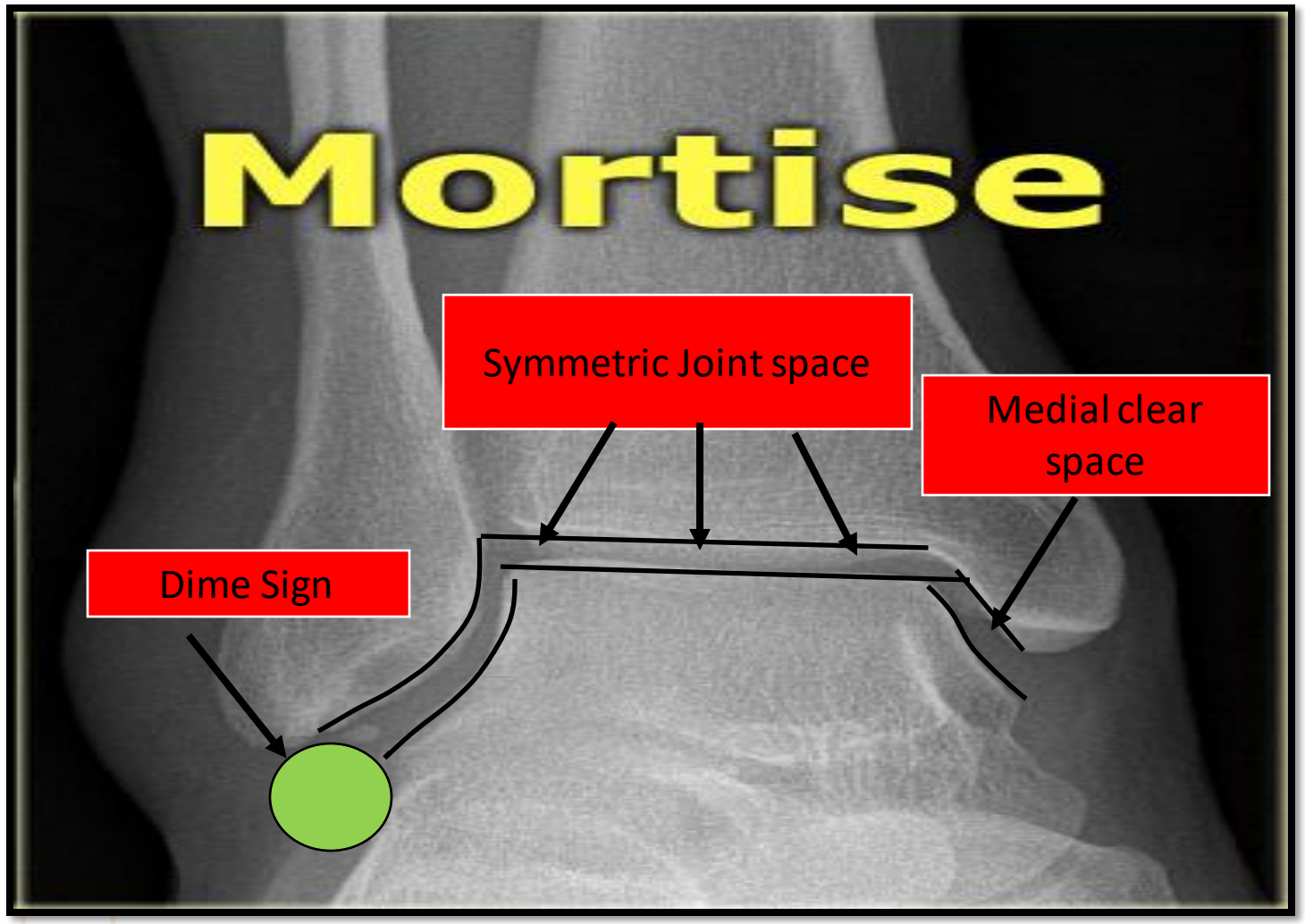




Tib-Fib Clear Space(A-B)

Tib-Fib Overlap (B-C)

- Tib-Fib Overlap <10 mm indicates Syndesmotic Instability.
- LDTA=89°(86°-92°)

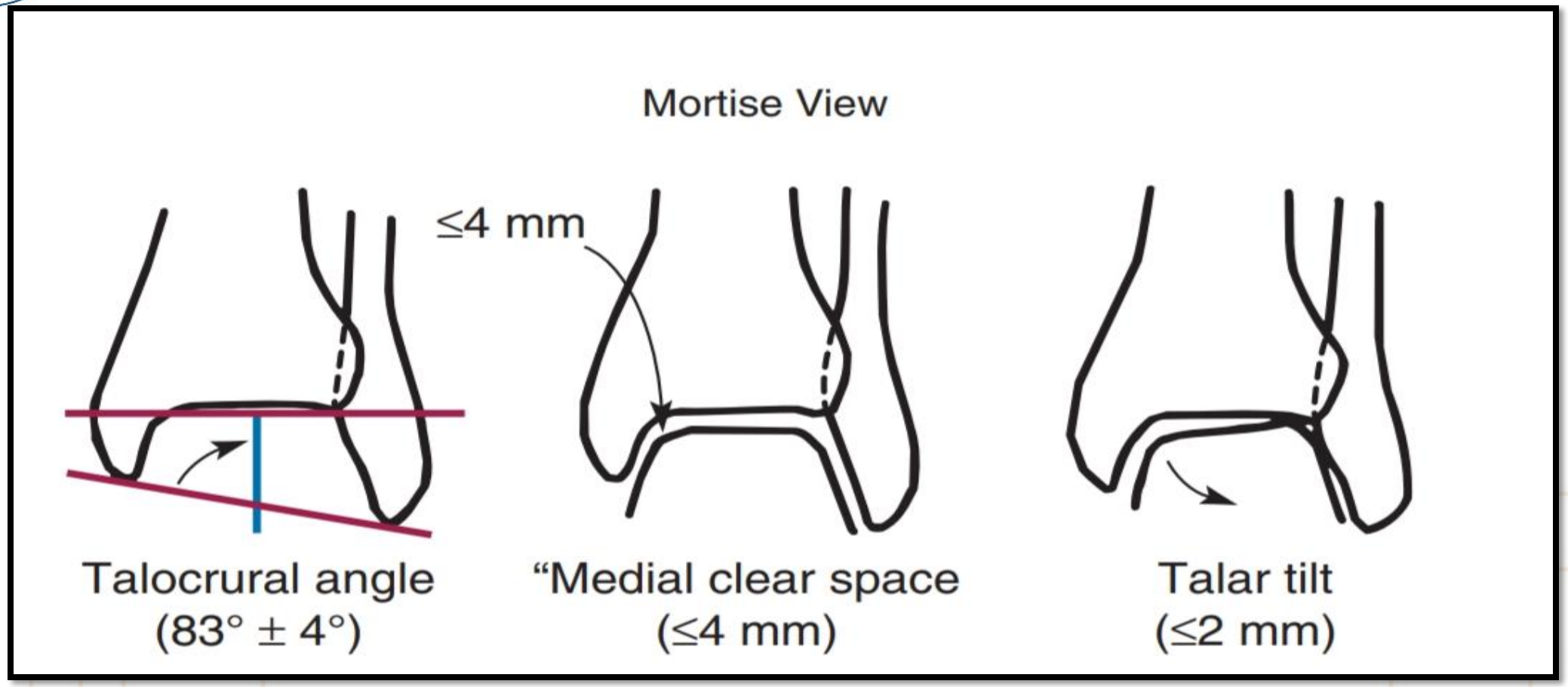
# Ankle Mortise view



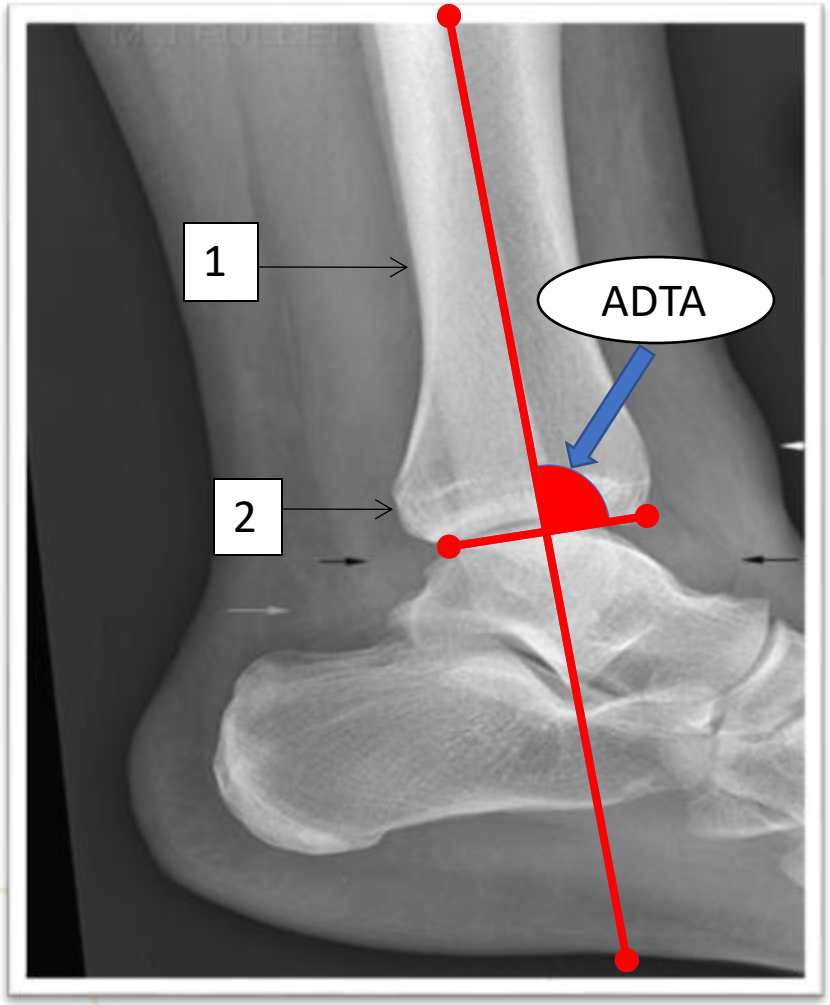

***Mortise View***

- Medial clear space *<4mm or>1mm*
- Symmetric Joint space Superior, medial and laterally(<2mm)
- Unbroken Shenton line
- Dime Sign

# ANKLE MORTISE VIEW



# Ankle Lateral view

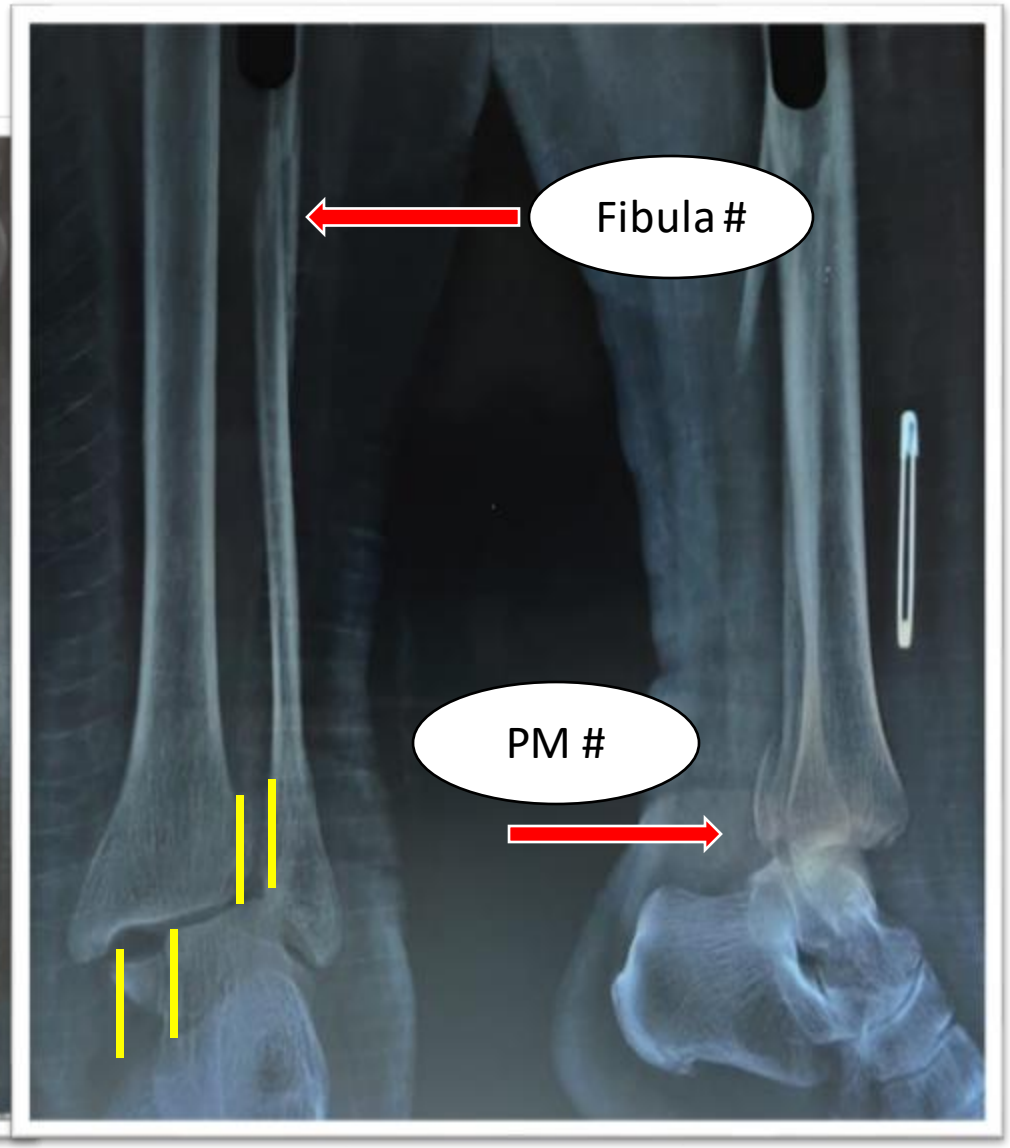



ADTA=80°(78°-82°)

1. Posterior border of fibula overlies posterior 1/3 of tibia
2. Posterior maleolar fractures

Lateral Radiography has higher correlation to anatomical diastases than mortise view (Xenos 1995)

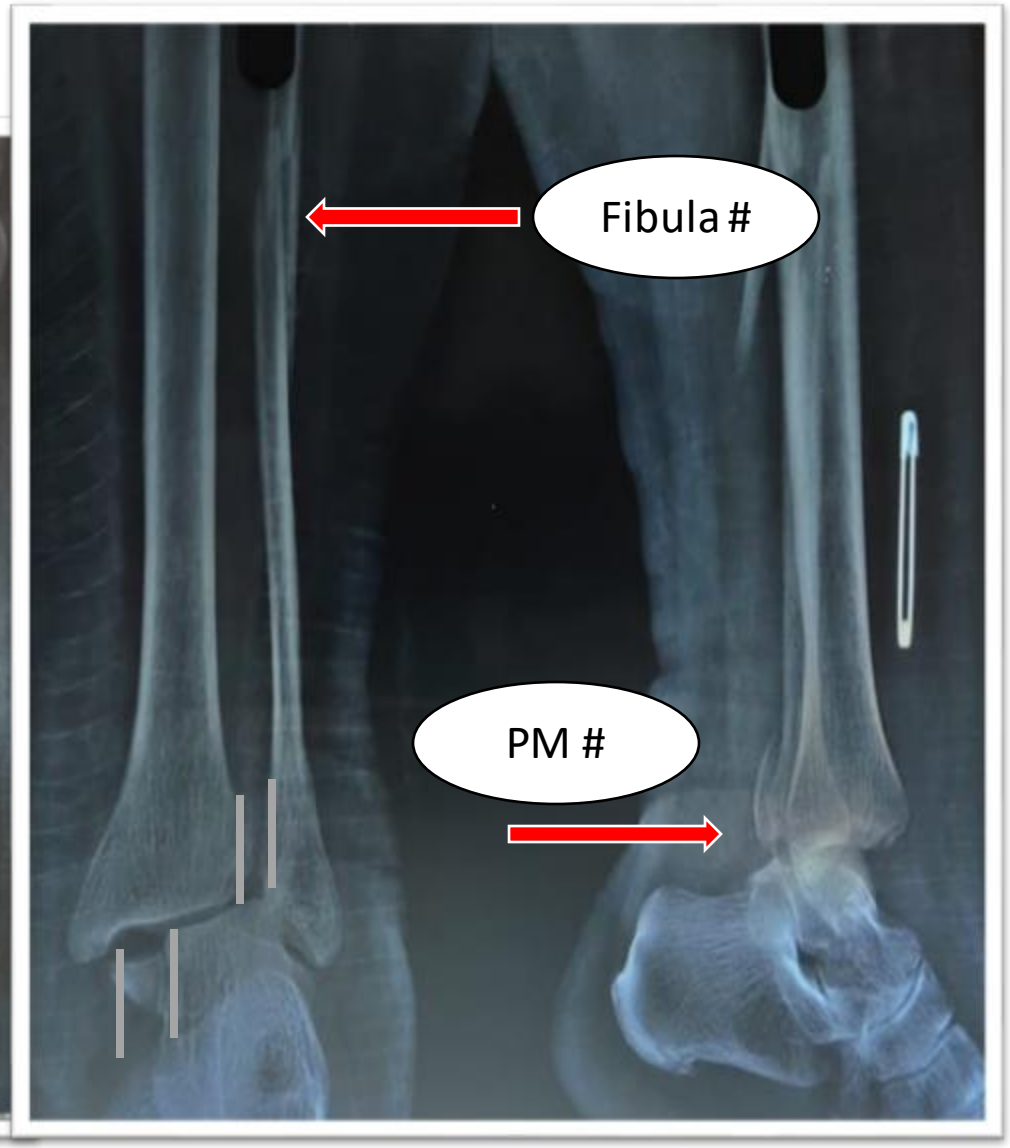
# Ankle X ray EVALUATION




- Lateral and posterior tarsal translation
- Increased medial clear space
- Lateral tarsal tilt
- Tibiofibular clear space >5 mm
- Decreased tibiofibular overlap
- High fibular fracture
- Disturbed talocrural angle
- Posterior malleolar fracture

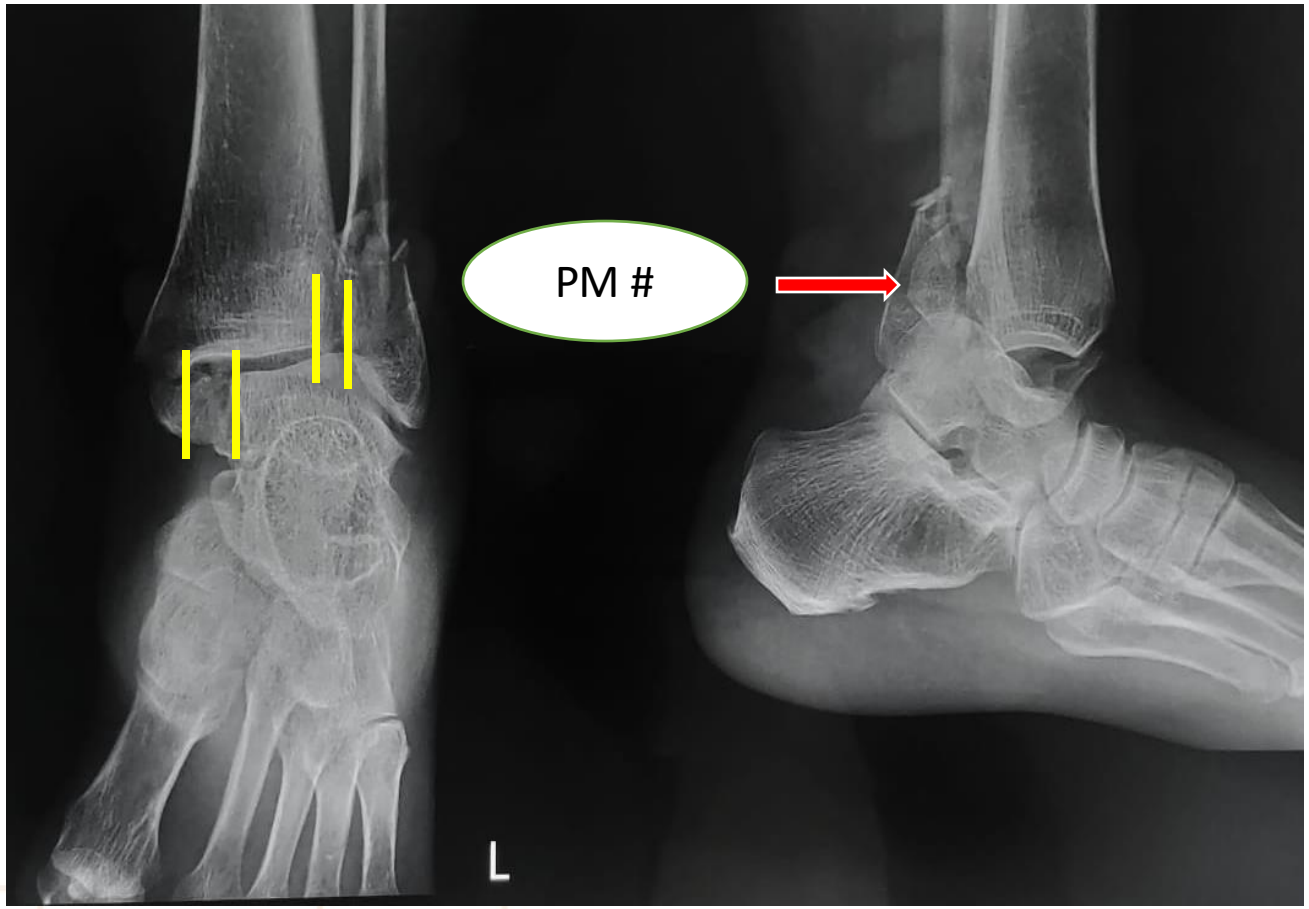
PER 4 injury pattern

# Ankle X ray EVALUATION




- Increased medial clear space
- Short Fibula

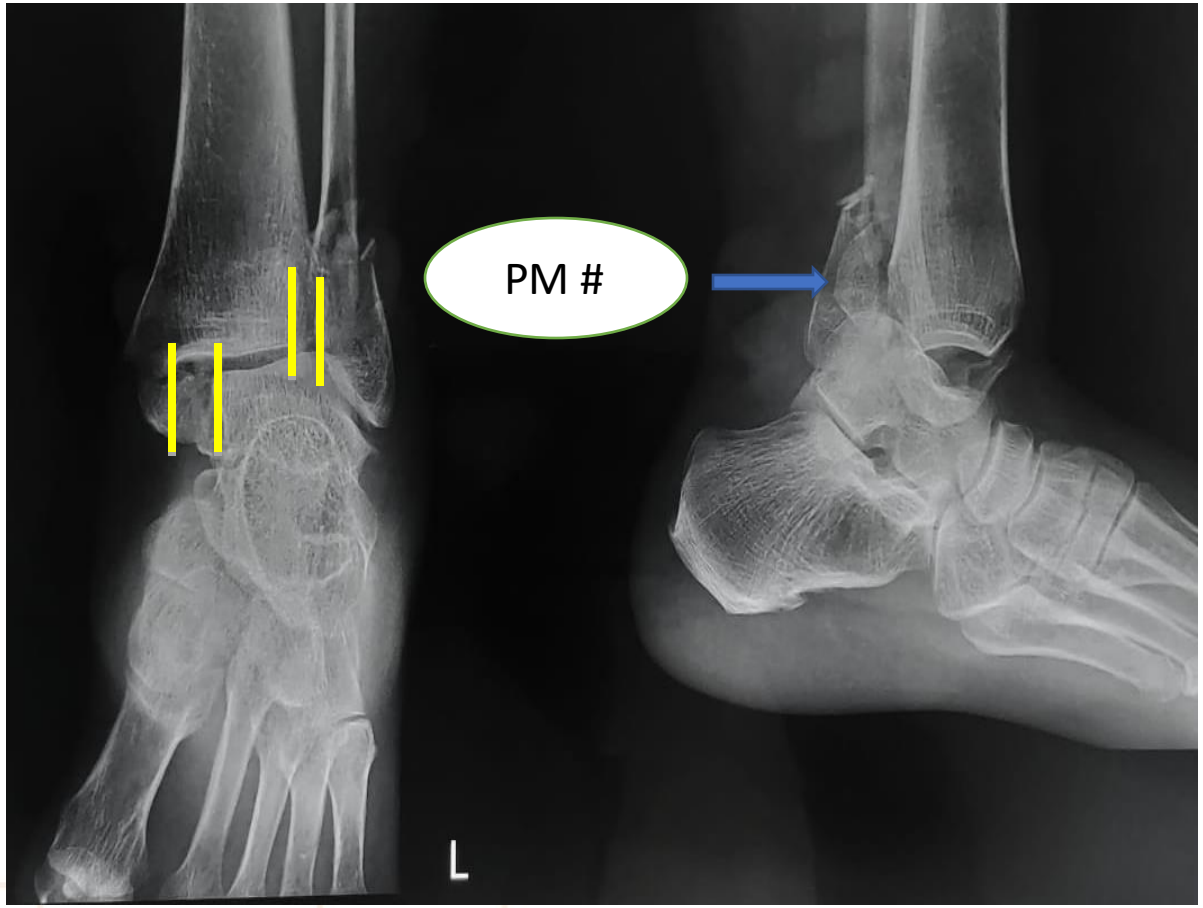
# Ankle X ray EVALUATION

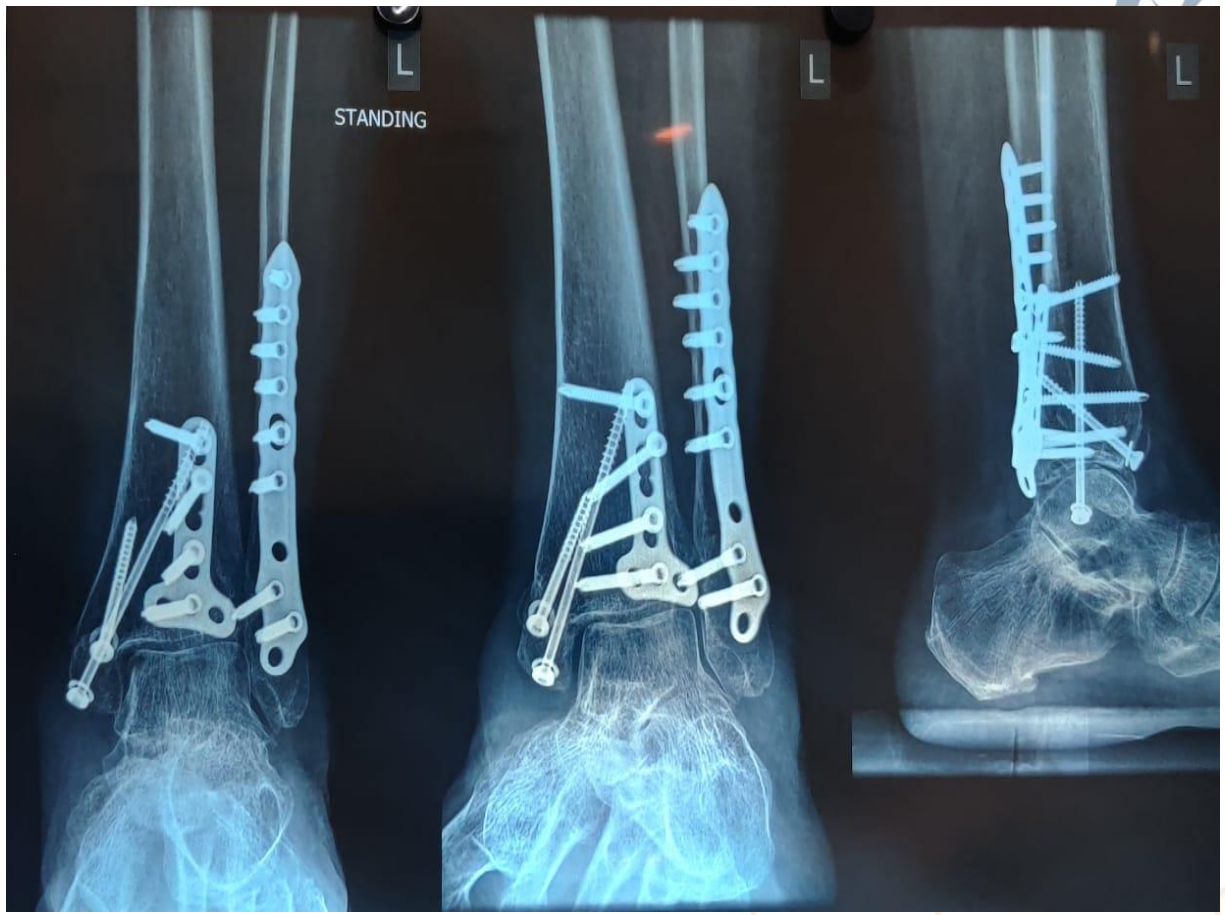



- Lateral and posterior tarsal translation
- Increased medial clear space
- Lateral tarsal tilt
- Tibiofibular clear space >5 mm
- Decreased tibiofibular overlap
- Trimaleolar fracture
- Disturbed talocrural angle

SER 4 injury pattern

# Ankle X ray EVALUATION



# Limitations of plain radiography

- Interobserver variability
- Magnification quantification is difficult-Use Calibration marker
- 2 Dimensional imaging
- Does not provide soft tissue information
- Difficult to detect early joint involvement in infections, arthritis or charcot foot

# Take Home Message

- Important to know the techniques of weight bearing and non weight bearing X rays of the Foot & Ankle and recognise the pitfalls.
- Knowledge of normal anatomy is a must to recognise the pathology.
- Special views are invaluable for diagnosis and treatment of talus and calcaneal fractures, occult medial and posterior malleolar fractures and ankle impingement.
- 20 % of Lisfranc injuries are missed-need for high index of suspicion to prevent late collapse and arthritis.
- Angles and measurements play an important role in assessment and treatment of certain foot and ankle conditions like Pes planus, Pes Cavus, Hallux valgus, Charcot foot and equinus.
- Assessment of foot parabola helps to diagnose the cause of lesser metatarsalgia and direct its treatment.
- Plain radiography has its limitations which should be complemented with CT, MRI, ultrasound and nuclear imaging.

# THANK YOU