ANKLE ARTHROPLASTY: WHERE IS THE LOVE?

Jason Patterson, MD

Ortho in the West

Arthritis to Arthroplasties

OrthoArizona

Foot and Ankle Institute

Objectives

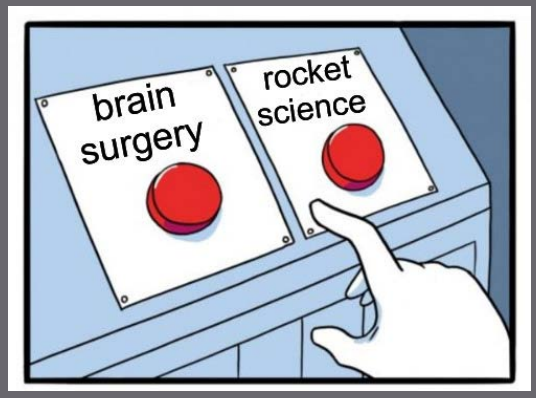
- Very casual, please interrupt with questions/comments!

OrthoArizona
Foot and Ankle Institute

Foot and Ankle

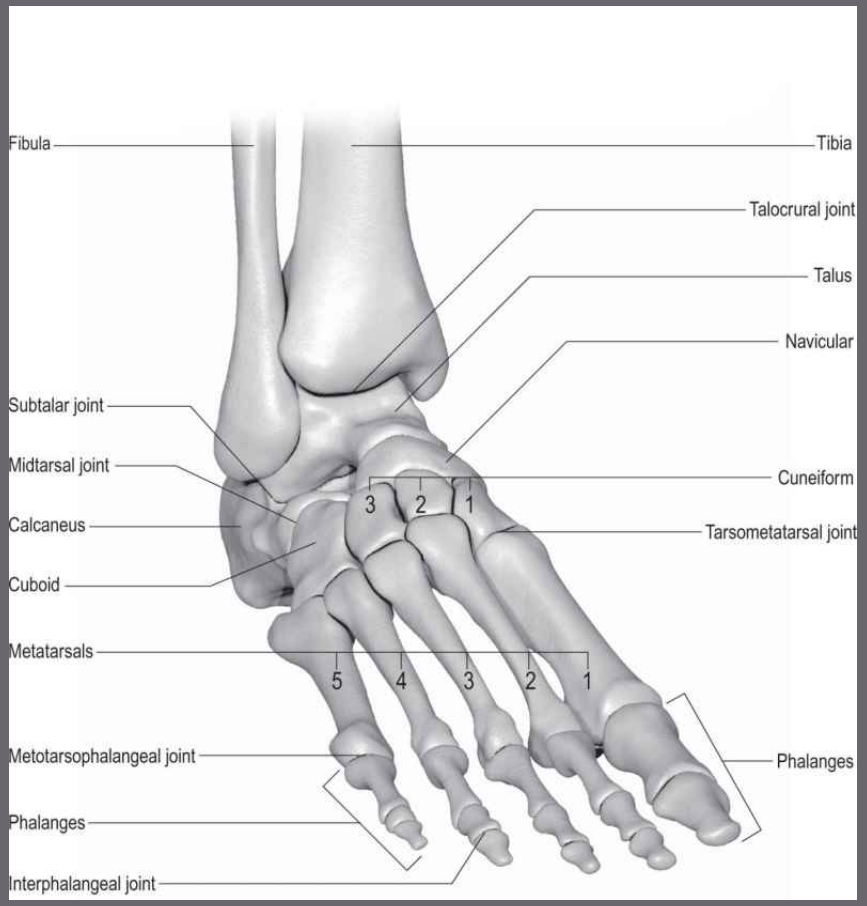
FACTS

- Most complex aspect of orthopedics
- Not for everyone
- Not for faint of heart
- Thinking man's profession
- Top of the class



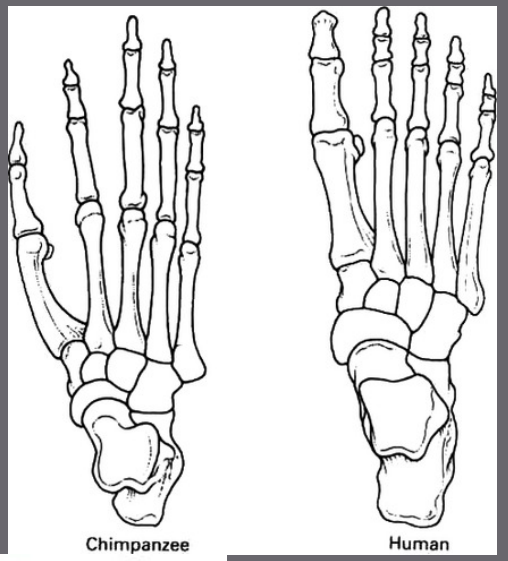
Foot and ankle

- Over 30 joints in the foot and ankle
- Arthritis can occur in any of them
- Most are still treated surgically with fusion



DIP and PIP joints

- Not as functionally important in foot as in hand
- Typically only important when they cause problem or cosmesis
- Has some role in neuropathic patients for balance

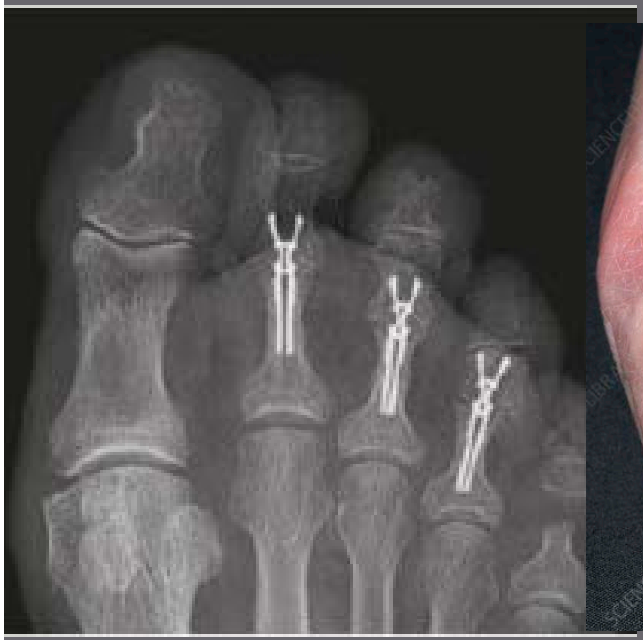


Lesser toes

- No implants currently available for PIP or DIP joints of the lesser toes
- Surgical repair of DJD or deformity is accomplished with fusion and/or soft tissue procedures

Lesser toes


Bunion, Hammertoe Correction, Ankle Slimming.
11 / 16 Dr. Bright Chen, Houston, TX

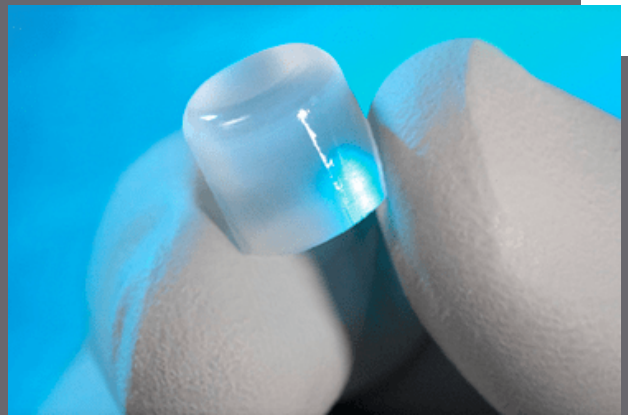


Lesser toe MTP joints

- Resection arthroplasty common for RA
- Also done for severe deformity
- Used to alleviate pressure in neuropathic pts

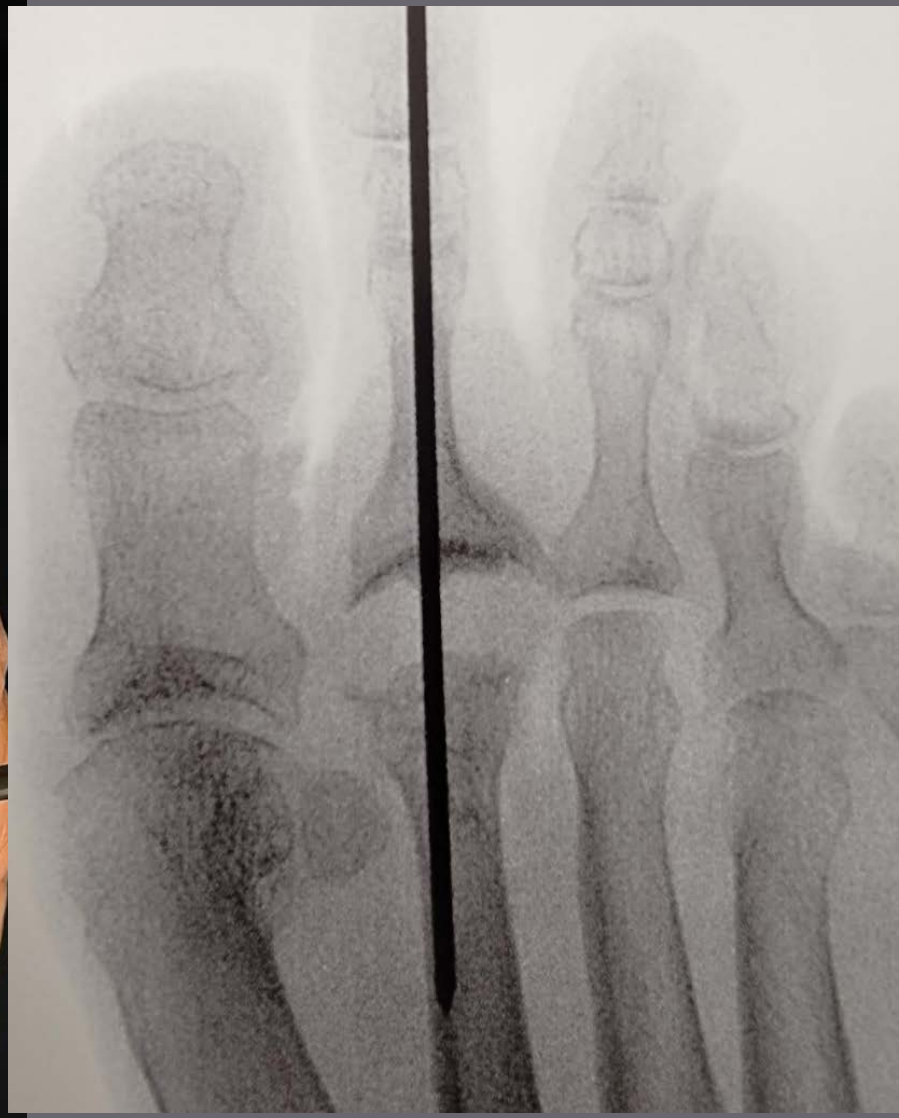
Lesser toe MTP arthroplasty

- Several implants available
- Most are hemi implants for met head side
- Metal and non metal implants available



66 yof with 2nd mtp pain

- 8 years ago



First MTP joint

- First MTP DJD is very common
- Mild arthritis or hallux rigidus can be treated with cheilectomy or OATS
- Cartiva or other interposition arthroplasty can be used

Fusion MTP joint - pros

- Still considered by most to be gold standard
- Alleviates pain
- Corrects deformity
- High fusion rate

Fusion MTP joint -cons

- Shortens first ray
- Loss of motion
- Challenging with certain shoewear
- Gait is altered
- May interfere with certain activities
- Nonunion can occur

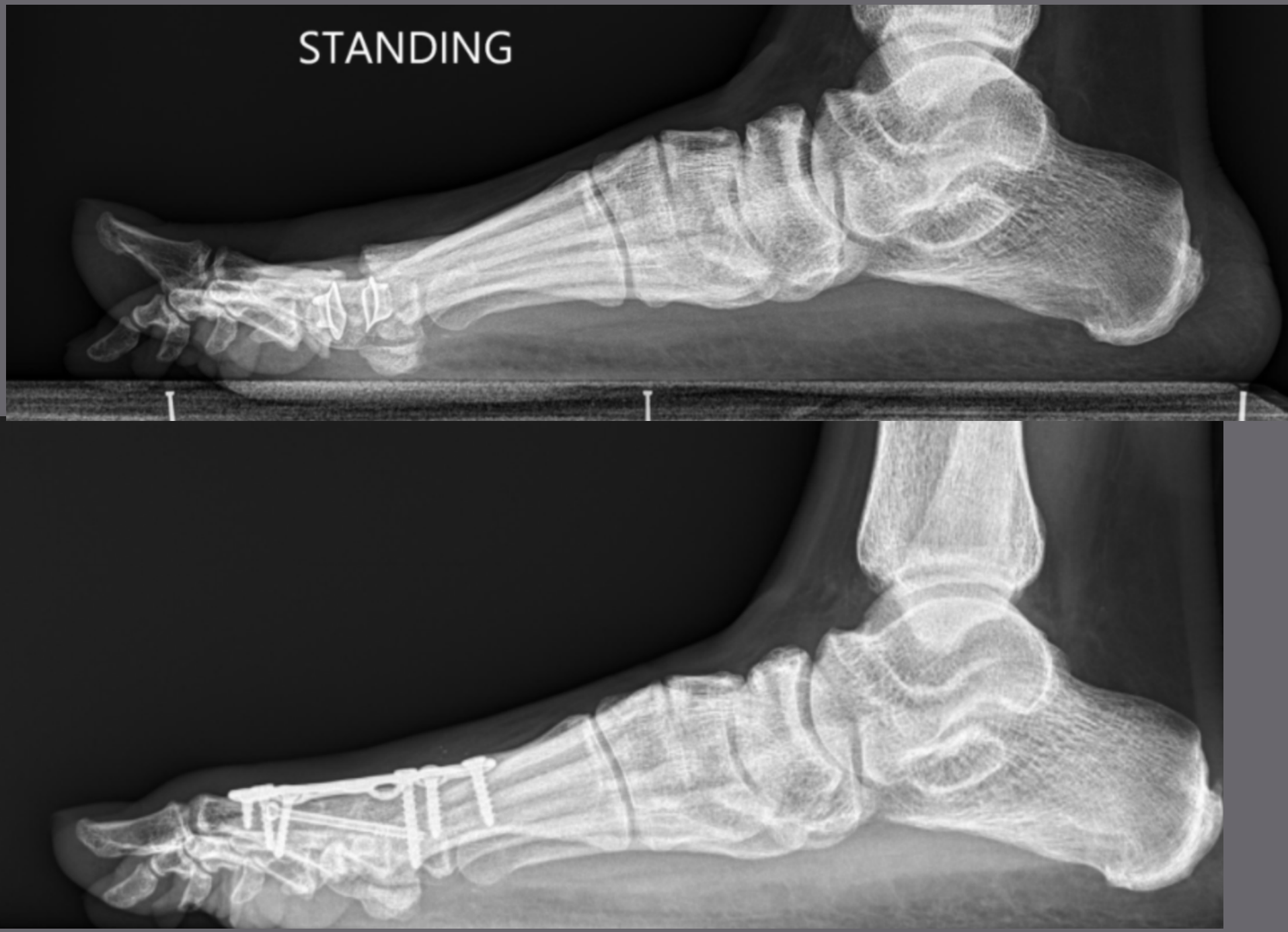
First MTP arthroplasty

- Many implants available
- Most are hemi
- Silastic and metal
- Unproven
- Unable to correct deformity
- Preserves some motion
- Preserves length?

55 yof


R
TR


ING

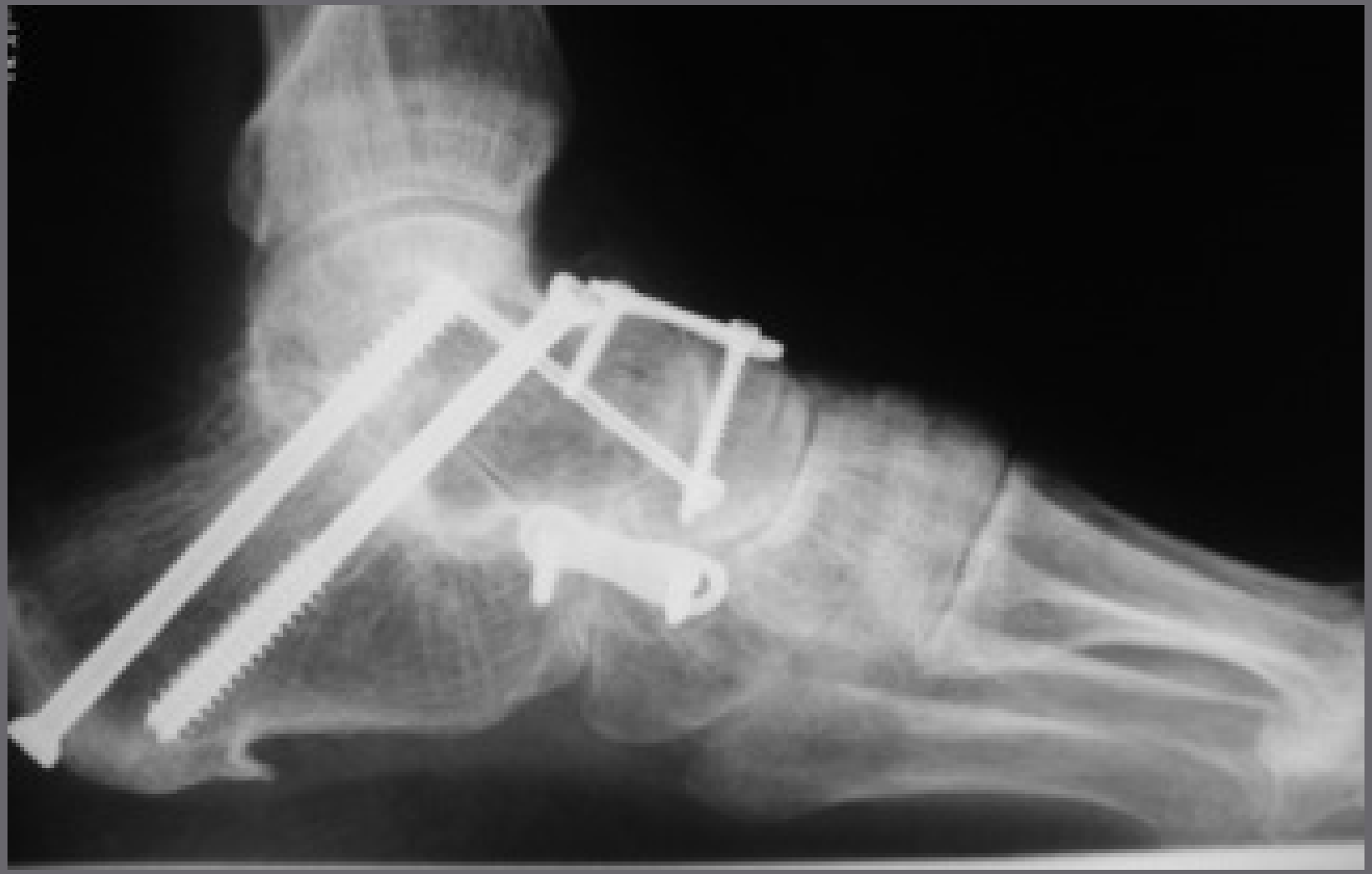

STANDING

Many Other foot/ankle joints

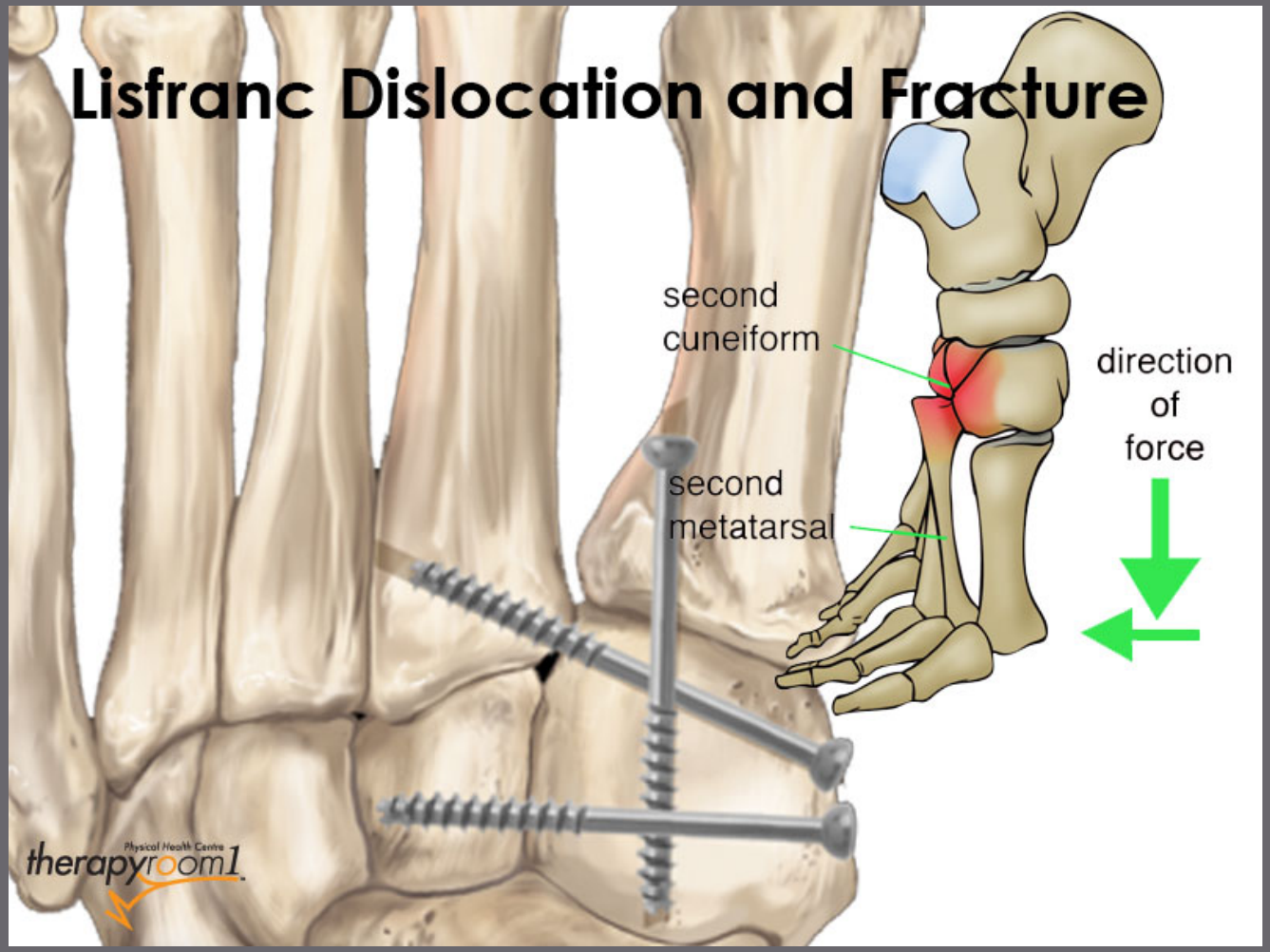
JOINTS	TREATMENT
Subtalar	Fusion
TN and CC joints	Fusion
1-3 TMT joints	Fusion
NC joint	Fusion
4-5 TMT joints	Resection arthroplasty

Subtalar joint

TN and CC joints

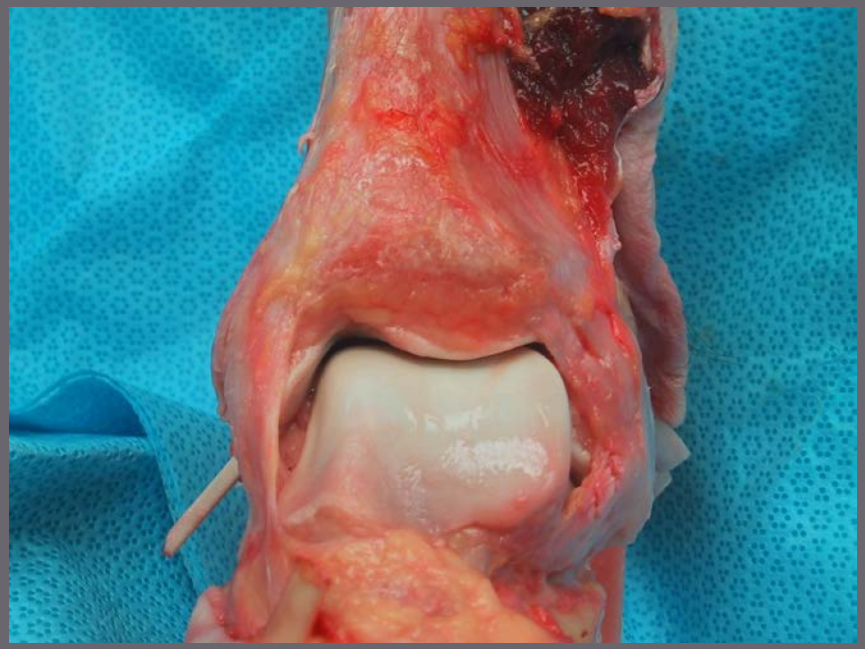


TMT joints

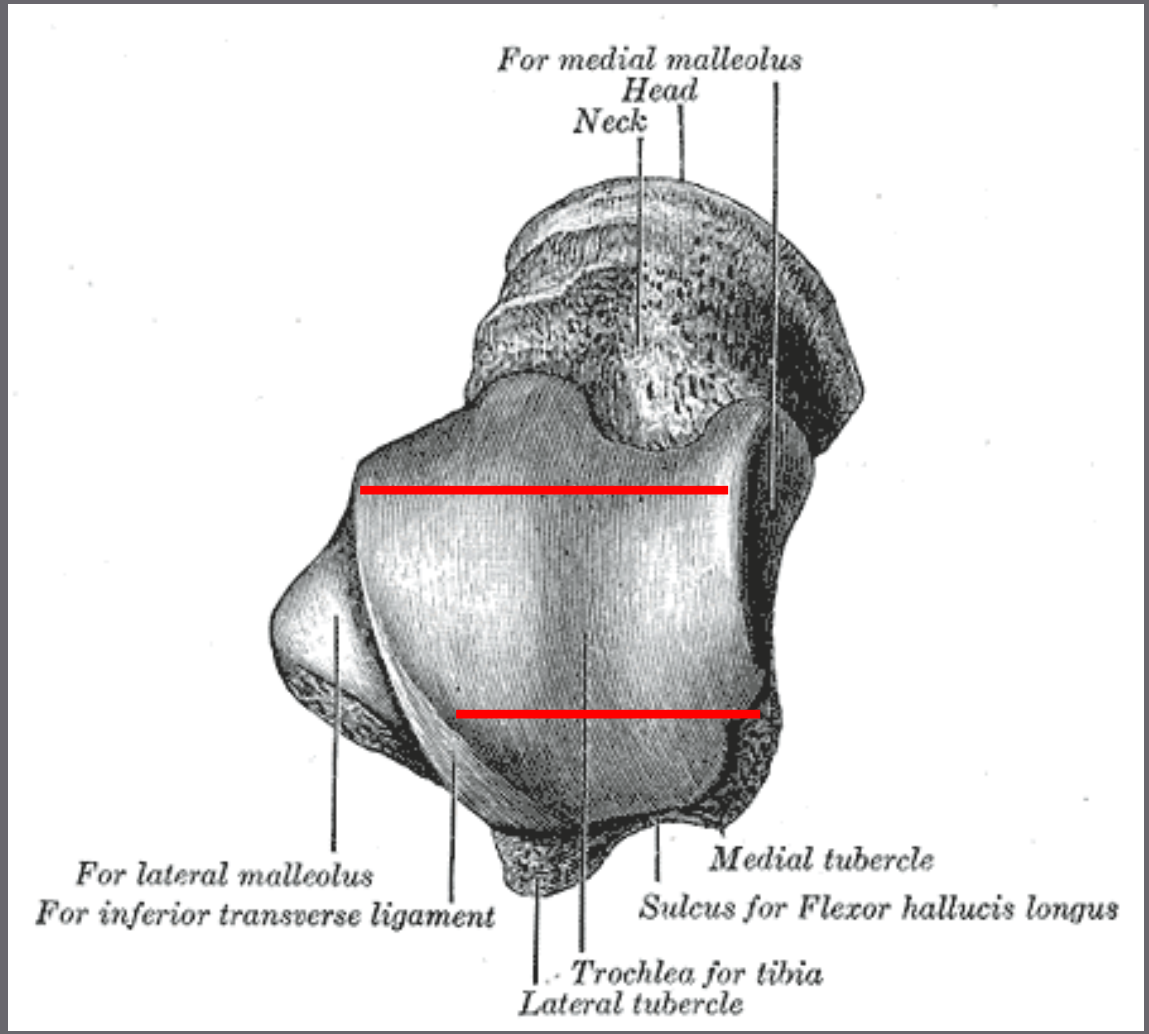

Lisfranc Dislocation and Fracture
second cuneiform
second metatarsal
direction of force
Physical Health Centre
therapyroom1

Ankle Joint

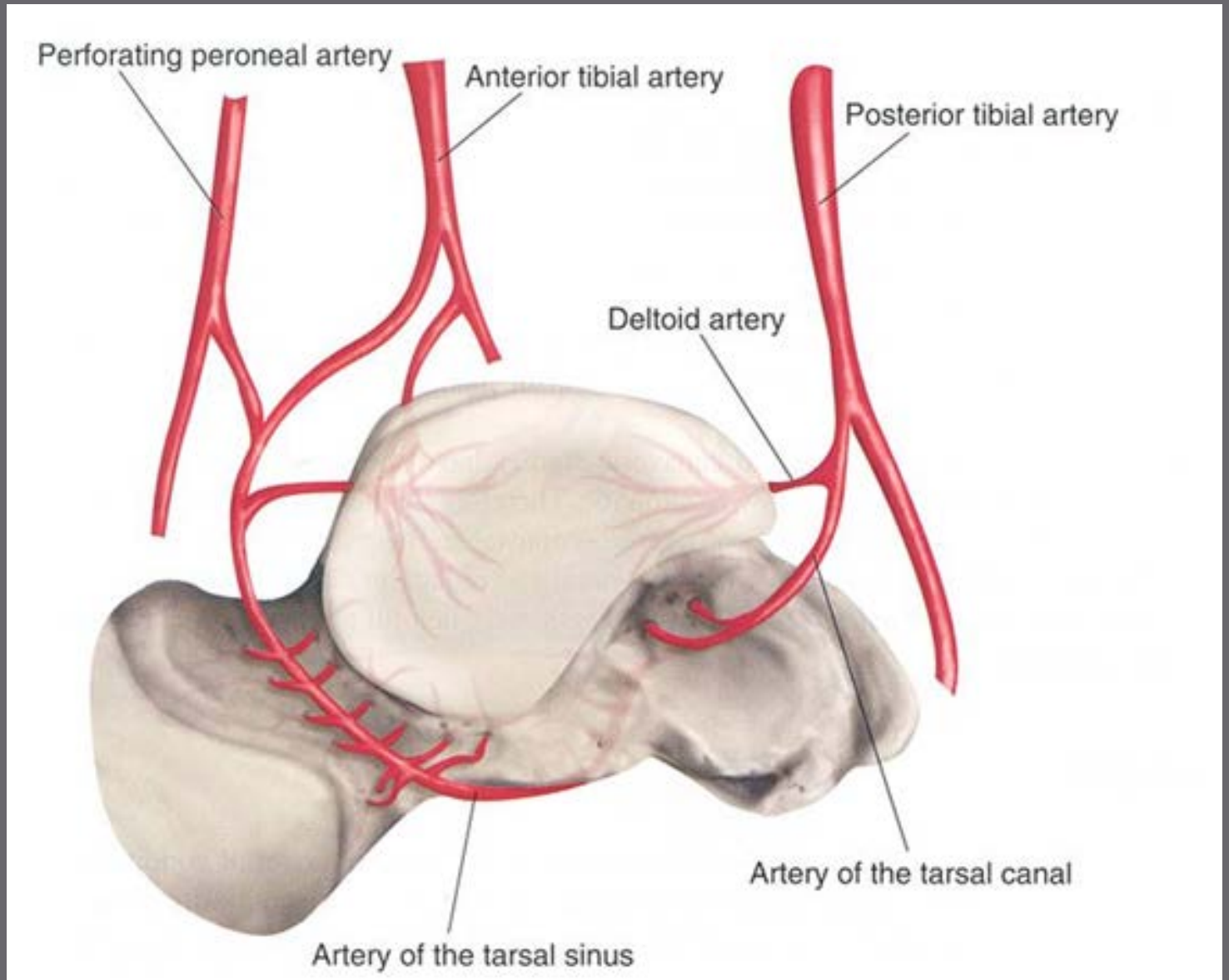
- Most common joint of foot ankle for arthroplasty
- Arthrodesis still considered by some to be gold standard
- Shift in treatment



Ankle Joint Structure



Talar blood supply

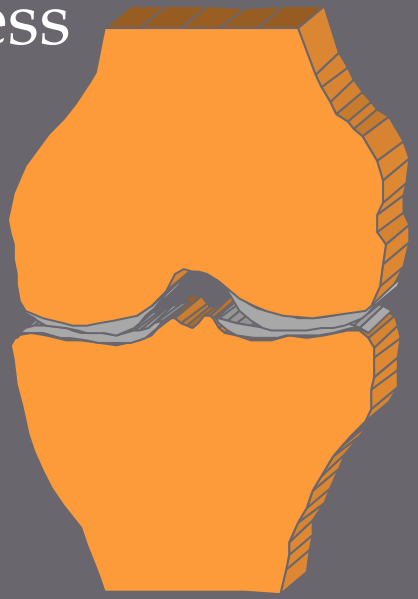


Ankle Joint Contact Area

- When loaded, smaller than the knee or hip
  - Ankle = 350 mm^2
  - Knee = 1,120 mm^2
  - Hip = 1,100 mm^2

Ankle Articular Cartilage

- Thickness

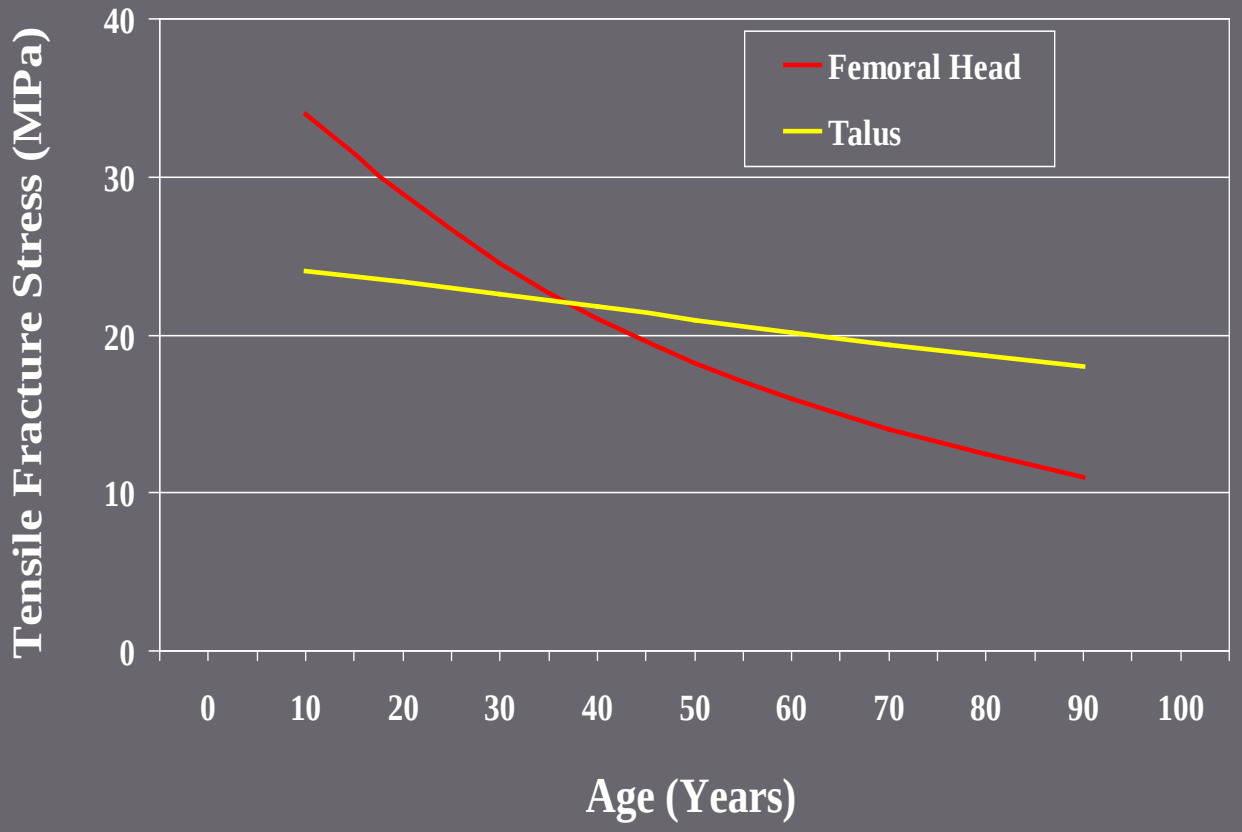


- Knee - from 3mm to 6 mm
- Ankle - from < 1mm to 1.7mm

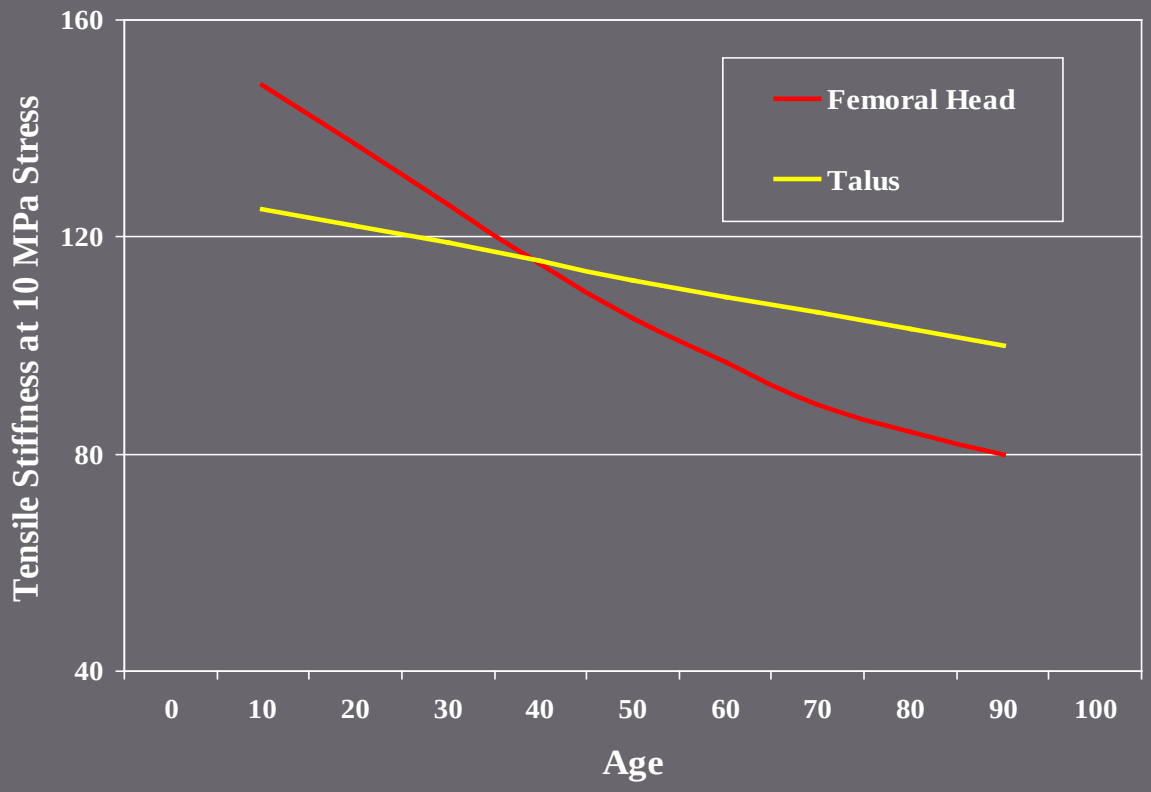
Distinct Metabolism

- Decreased inhibition of proteoglycan synthesis by interleukin-1 in ankle articular cartilage chondrocytes compared with knee articular cartilage chondrocytes
- Interleukin-1 receptor antagonist is more effective in ankle articular cartilage chondrocytes
- mRNA for neutrophil collagenase (MMP-8) detected in knee chondrocytes, but not in ankle chondrocytes

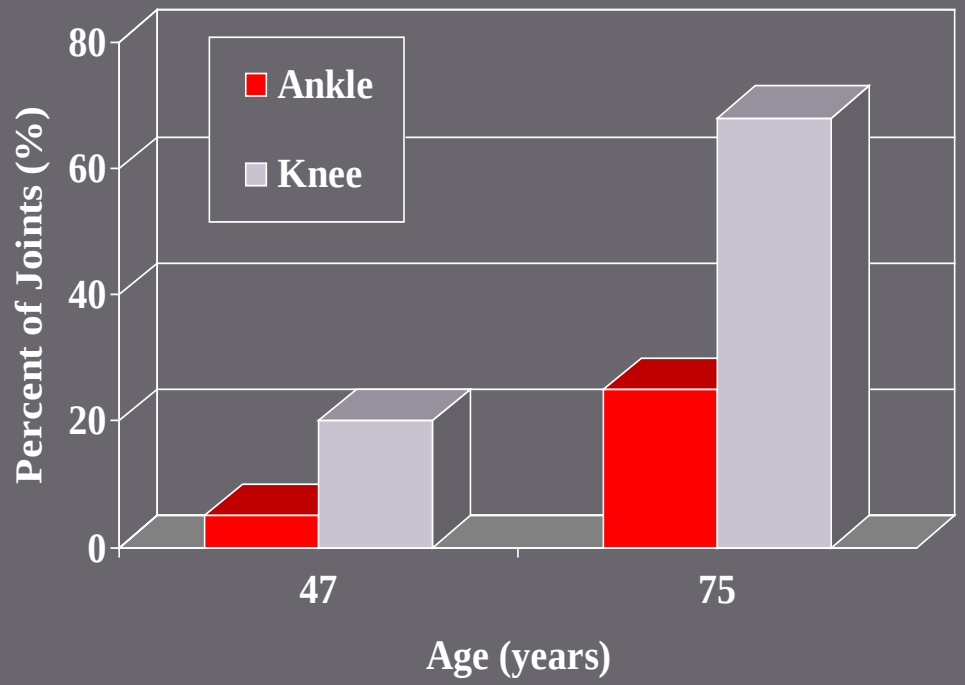
Articular Cartilage
Superficial Layer Tensile Strength



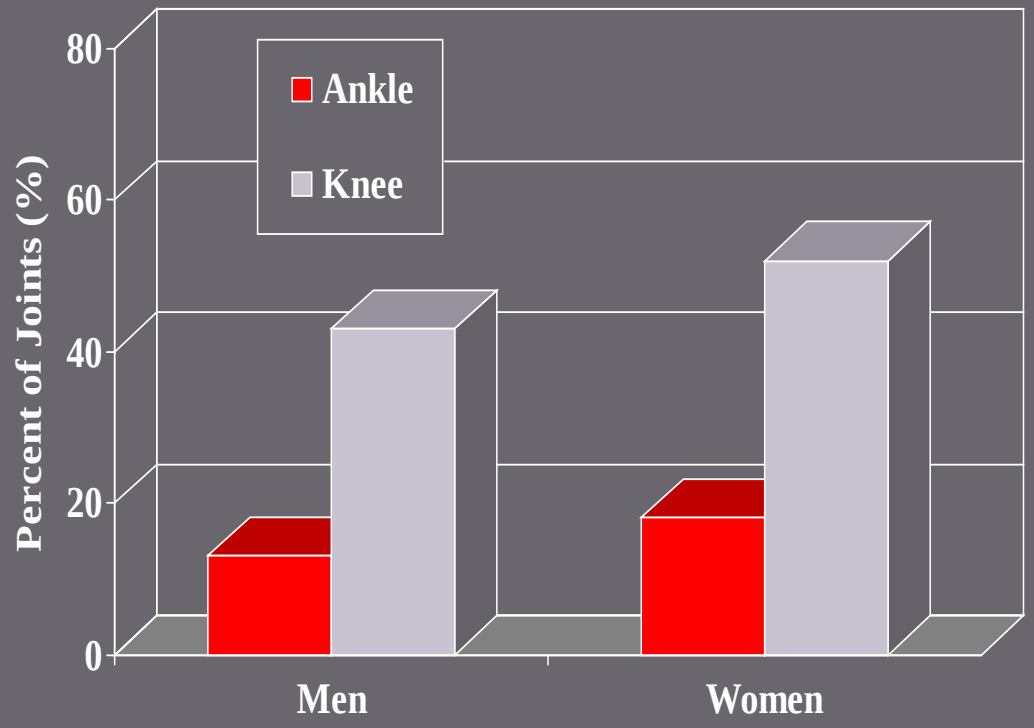
Articular Cartilage
Superficial Layer Tensile Stiffness



Prevalence of Ankle & Knee Articular Surface Degeneration Versus Age (Autopsies)



Prevalence of Ankle & Knee Degenerative Changes Versus Age (Radiographs)



Unique Epidemiology of Ankle Arthritis

- Less prevalent than other major lower extremity joints
- Ankle is more resistant to age related degeneration
- Usually the result of ankle trauma

1999 Prevalence of OA-U Iowa Ortho Clinic

	Hips	Knees	Ankles
Total	167	424	48
Primary	109 (65%)	347 (82%)	9 (19%)
Post-traumatic	14 (8%)	53 (13%)	26 (54%)
Rheumatoid	3 (2%)	15 (3.5%)	7 (15%)
Neuropathic	0	3 (0.7%)	3 (6%)
Dysplastic	18 (11%)	2 (0.5%)	3 (6%)
AVN	18 (11%)	2 (0.5%)	0

1992-1999 Etiology of Ankle Arthritis in a Referral Practice

	Ankles
Total	**386**
Primary	47 (12%)
Post-traumatic	**250 (65%)**
Rheumatoid	34 (9%)
Neuropathic	25 (6%)
Gout	5 (1%)
Hemophilic	7 (2%)
Septic	4 (1%)
AVN	4 (1%)
Other	10 (3%)

Distinctive Characteristics of Ankle OA

- Ankle joint more resistant to degeneration?

- Symptomatic ankle OA most commonly the result of ankle injury (articular surface injuries or bony & ligamentous injures that lead to instability).

Approach to Ankle DJD

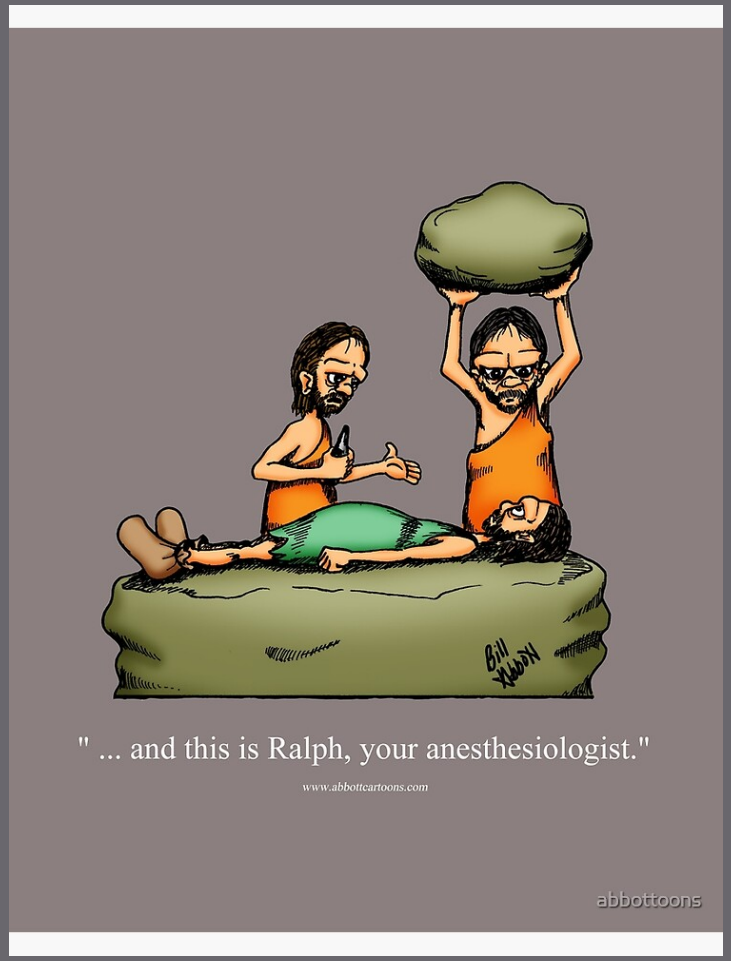
- History:
  - Previous trauma? Even ankle sprains that seemed minor
  - RA, gout, DM, osteopenia/osteoporosis
  - What causes pain?
    - Uphill (ant impingement, TN joint), downhill (post impingement), uneven ground (subtalar joint)
- Injections? Have they helped?

Surgical approach to hip DJD

- Failed non-op?
  - THA, THA, THA
- Can ignore the knee, leg, ankle, and foot.
- Only major thing to decide is sizing and templating

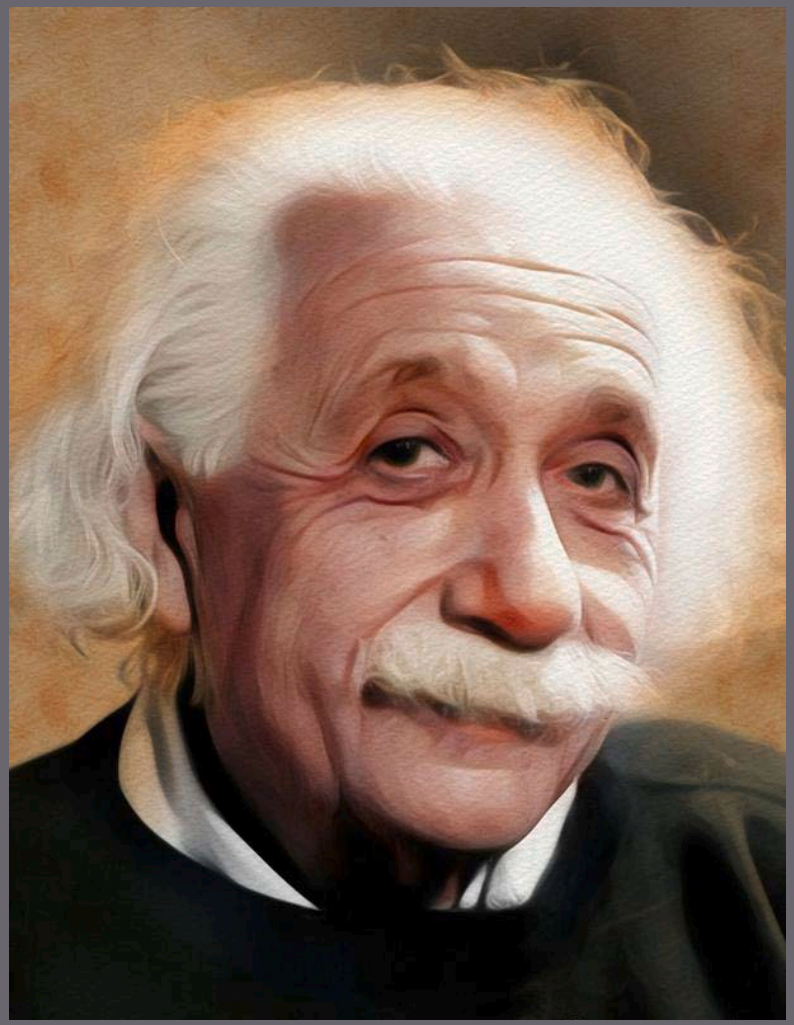
Surgical approach to knee

- Failed non-op?
  - TKA, TKA, partial TKA, TKA, maybe HTO, TKA
- Sizing and deformity done at surgery
- Little to no attention typically paid to hip, leg, ankle or foot other then getting knee alignment straight



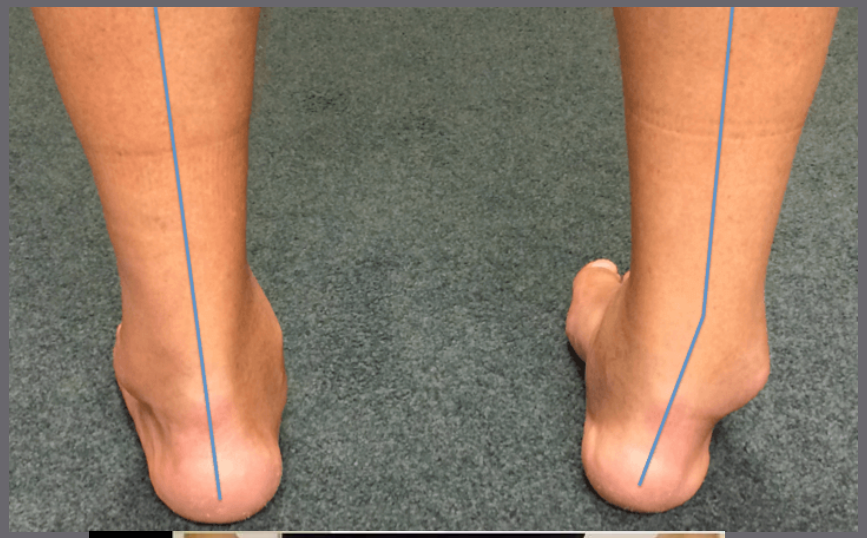
Surgical approach to total ankle

- Genu varum/valgus?
- Femur deformity?
- Tibia deformity?
- Distal tibia articular angle
- Previous trauma
- Previous incisions
- Ligament instability?
- Cavovarus?
- Pes planus?
- Retained hardware?
- Osteoporosis?
- Transmalleolar rotation?
- Equinus contracture?
- Sagittal plane?
- Ankle contractures?
- Mobile vs fixed bearing?
- Blood supply to talus/AVN
- Adjacent joint disease?
- Cement or no cement
- Neuropathy present?
- Vascular disease?
- Diabetic?
- Obese?
- Activity level?



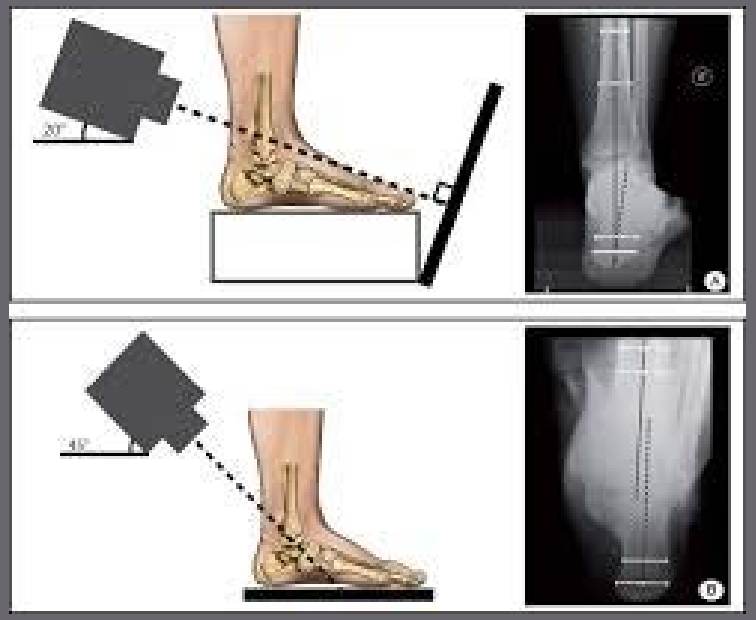
PE

- Alignment with pt weight bearing
- Gait (early heel rise or back knee gait)
- Inspection of skin, NV status
- Passive and active ROM of ankle/subtalar joint
- Strength around ankle
- Stability of ankle/hindfoot/midfoot



Imaging

- Ankle series
  - Hindfoot alignment view
- Foot xrays
- Long leg films
- CT
- MRI (rarely)




R
SG/CAK
STANDING

Non op treatment

- Braces
- Injections
- Medications
- Activity modifications

Non fixed supportive braces

Cloth lace up

Plastic hinge

Fixed Supportive Braces

Posterior splint

Circumferential

Operative Treatment Options

Arthrodesis

Distraction

Periankle Osteotomies

Joint replacement

Ankle Fusion

- Very reliable to reduce or eliminate ankle pain
- Newer techniques = better fuison rates and success
- Can be done open or arthroscopic with similar success rates
- “Ideal” patient is younger, active male, laborer

Ankle fusion

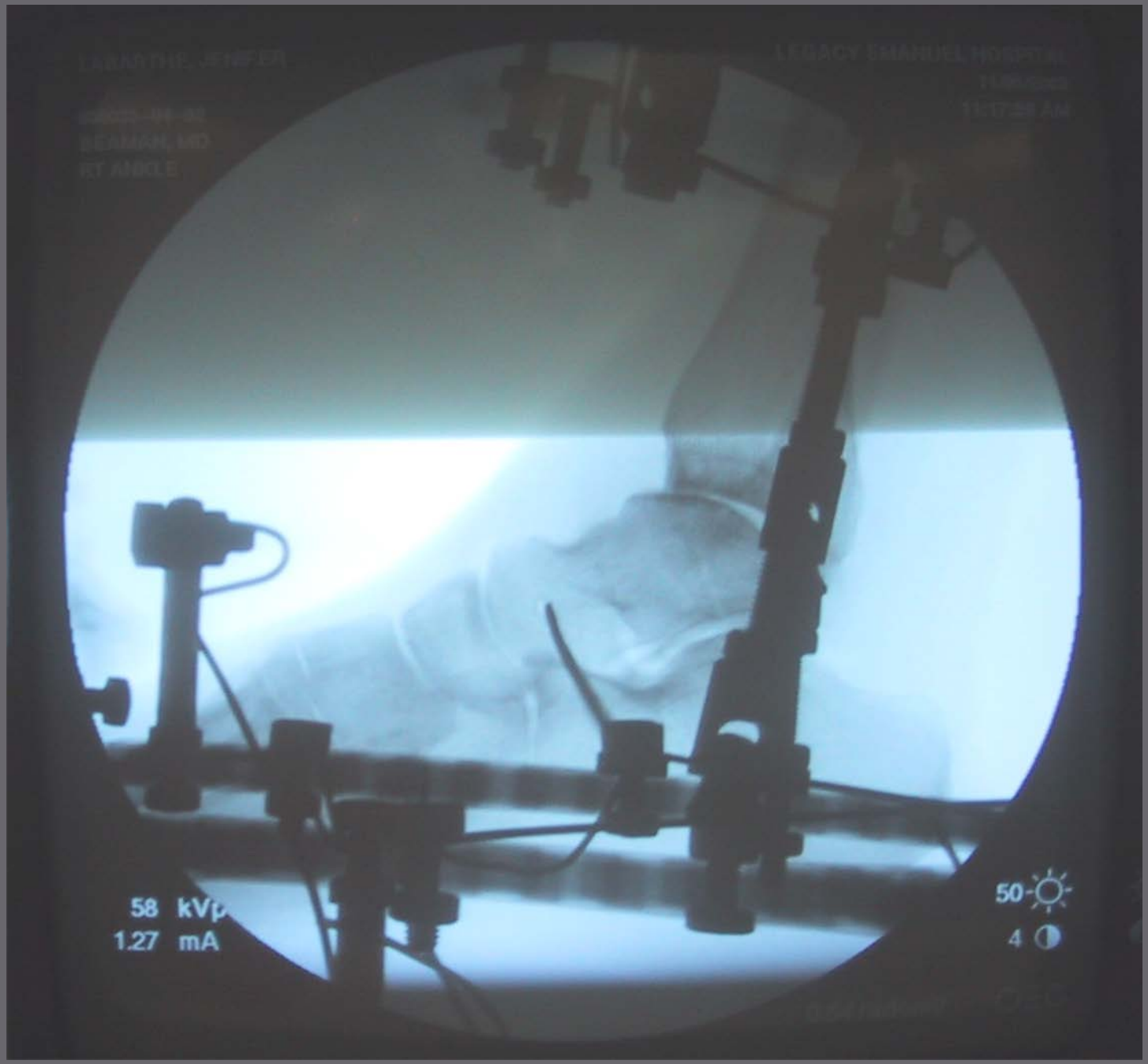
- Nonunion a problem
- Functional limitations even after successful fusion
- May need to modify shoes (SACH, rocker bottom)
- Many patients get adjacent joint disease

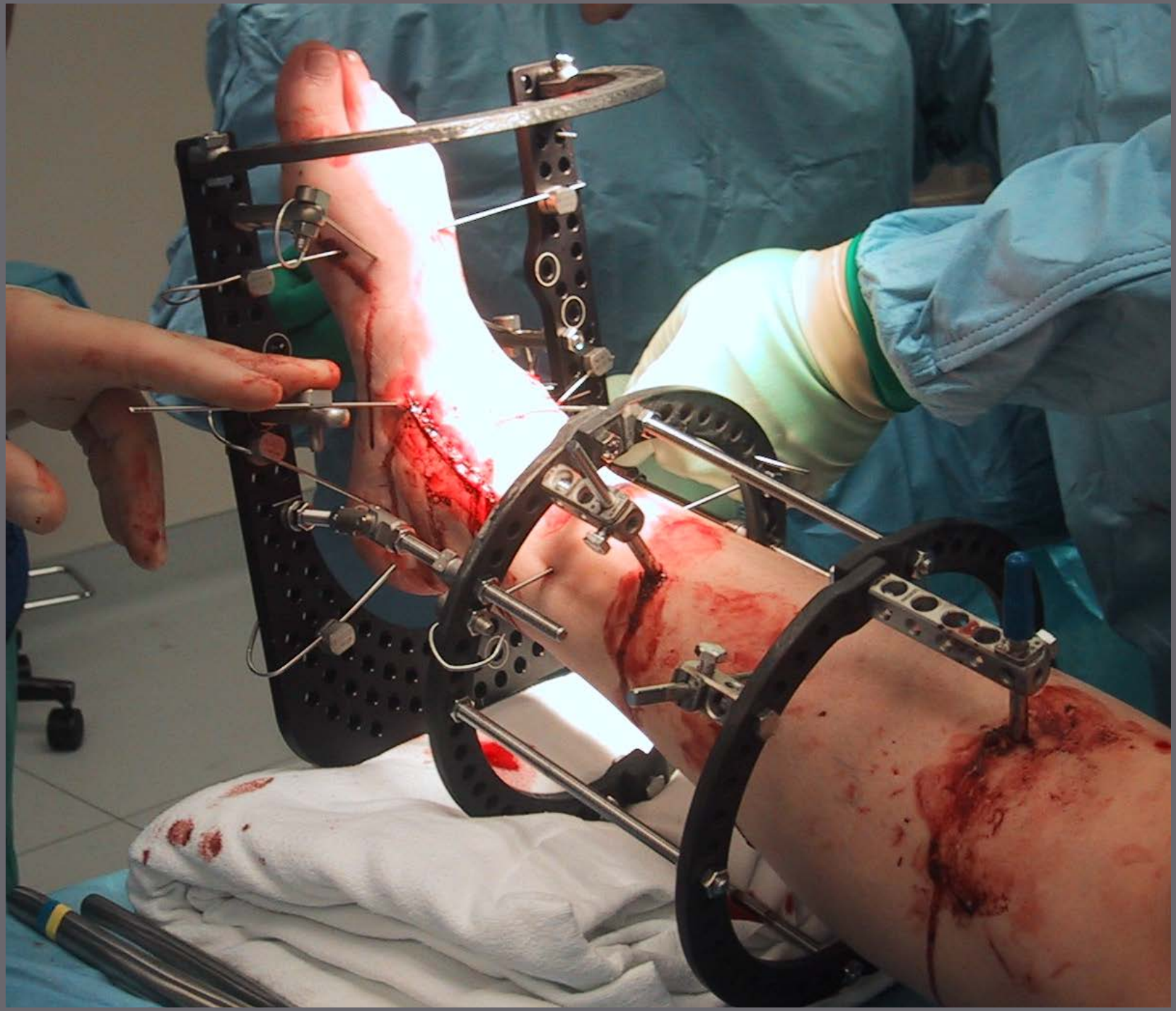
Functional Limitations after Ankle Fusion for 28 Highly Satisfied Patients

D. Muir, Amendola, Saltzman

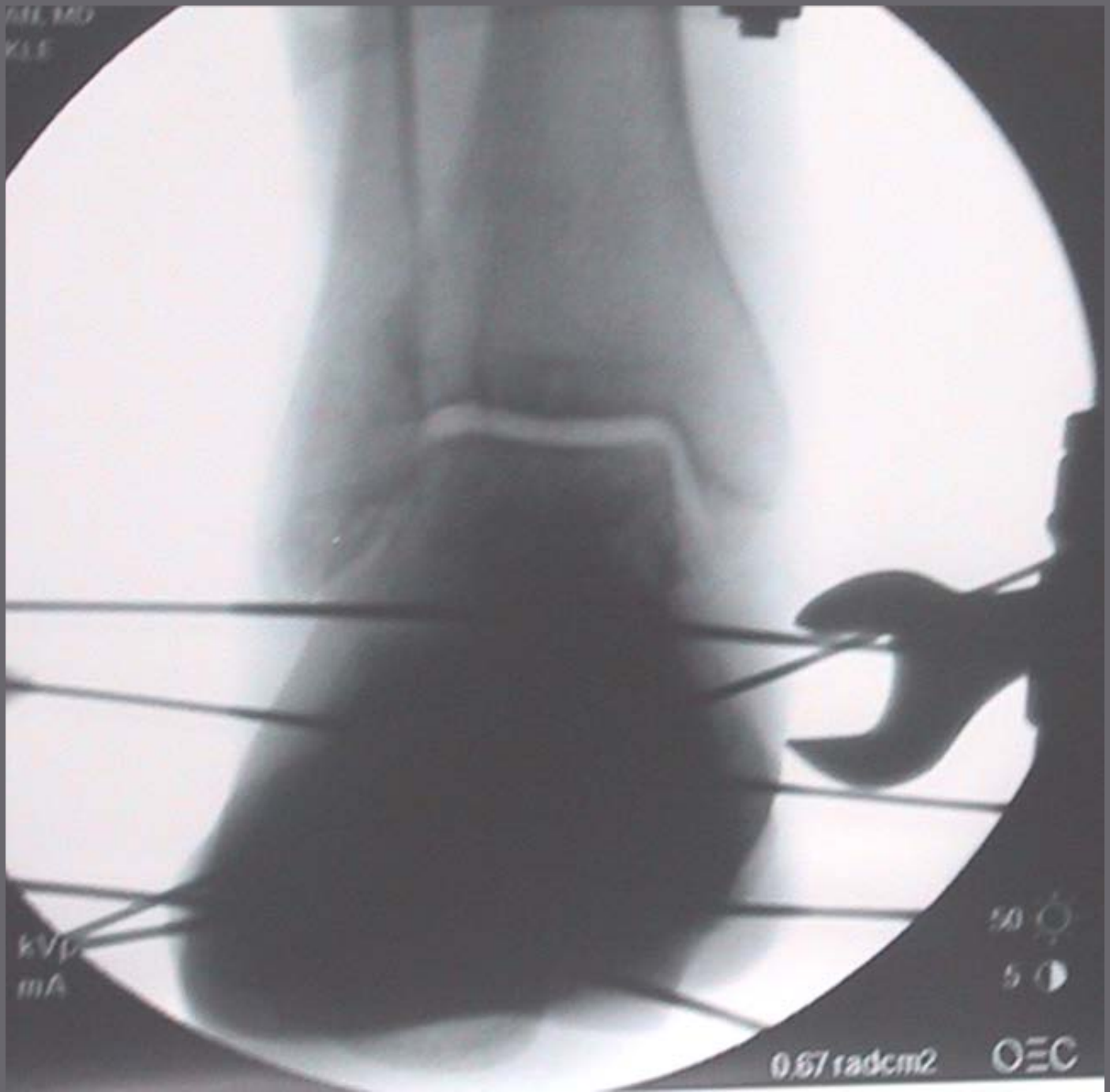
Tasks	#	%
Walking on uneven ground	22	79
Difficulties with stair ascent or descent	21	75
Modify the way they pick objects up off the floor	20	71
Altered use of driving pedals	20	71
Aching with prolonged standing, working or walking	18	64
Difficulty putting on boots	10	36
Getting out of a bath	6	21
Difficulty sleeping in prone or supine	5	19
Swimming	3	11

Change in bone density correlated with improved results


58 kVp
1.27 mA
50
4




RT ANKLE
63 kVp
1.60 mA
49
2


kVp
mA
0.67 rad/cm2
OEC

Periankle Osteotomies

- Calcaneal
- Tibial

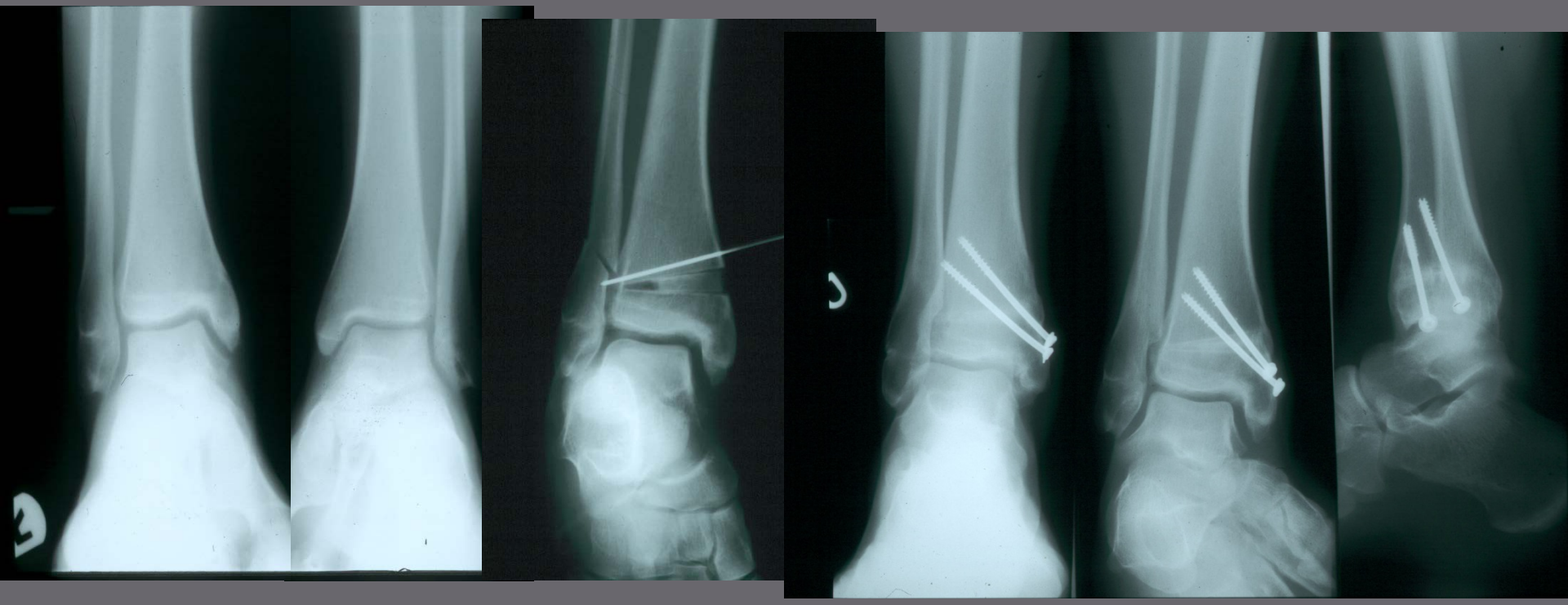
- Goals of Osteotomy
  - Shift mean peak stresses from abnormal cartilage surface to “normal” surface

Periankle Osteotomies

- **Varus** ankle joint : opening medial wedge tibial osteotomy

- **Valgus** ankle joint : closing medial wedge tibial osteotomy

OA Ankle : Tibial Osteotomies




11/17/2
3:40:20
UNIV
48
0
ARY
848798
ALTZMAN
ANKLE
kVp
mA
60 kVp
1.40 mA

OA Ankle : Osteotomies

OA Ankle : Osteotomies

What about Total Ankle Arthoplasty (TAA)?

- Viable alternative for selected patients
- Preserves motion at ankle and may help reduce stress seen at adjacent joints
- Not a good choice for active young patients?
- Increasing in prevalence

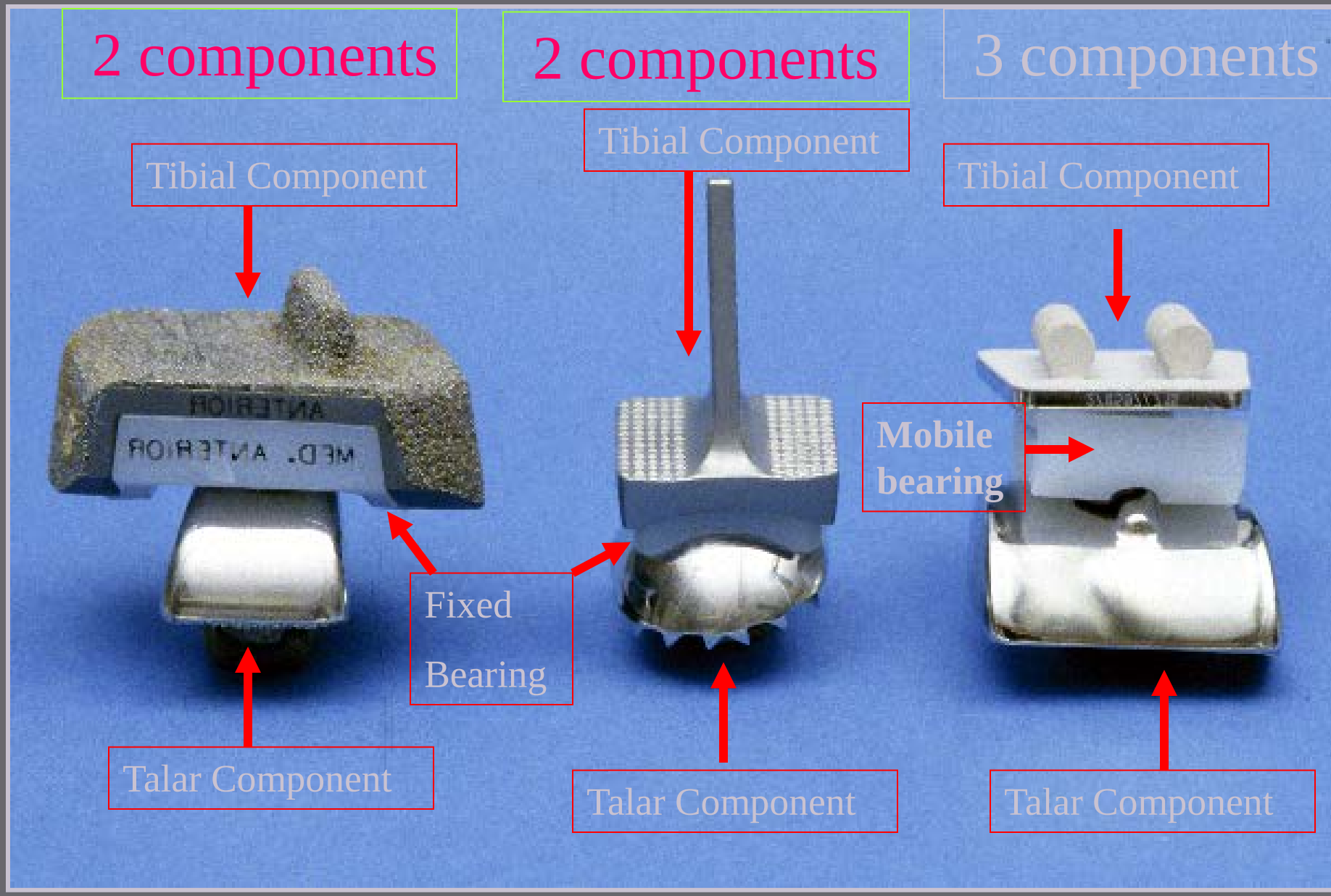
Total Ankle Replacement

- Resurgence of interest
  - Better designs
  - Dissatisfaction with ankle fusion
    - Functional concerns
    - Incomplete pain relief
    - Nonunion/malunion
    - Long-term effects on adjacent joints

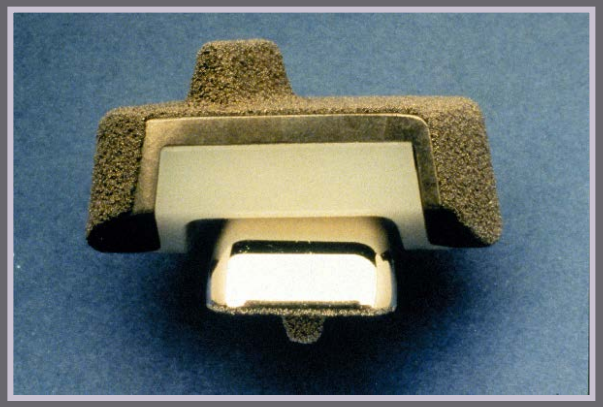
7 years	50% DJD
22 years	90% DJD

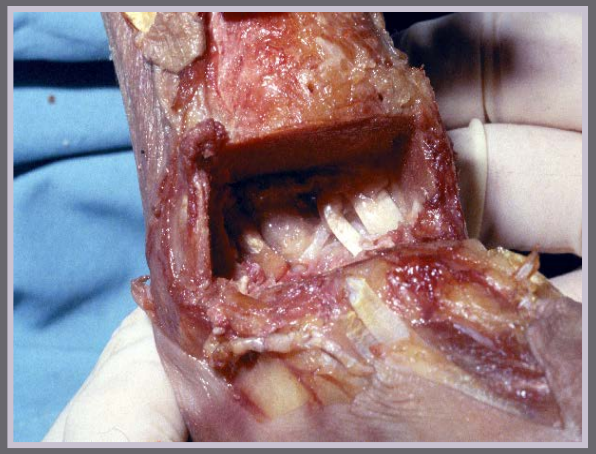
Early TAA

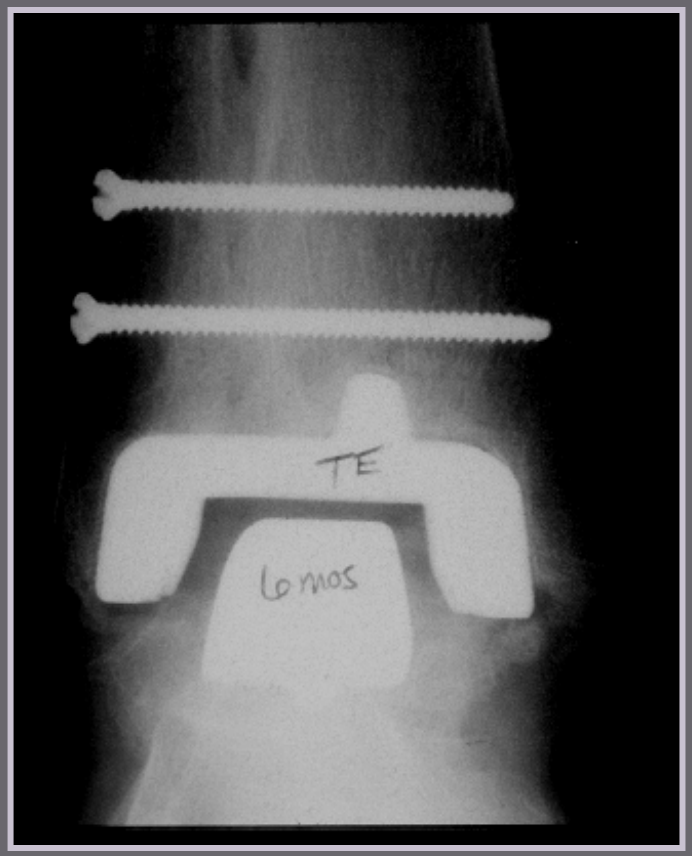
- Pt satisfaction ranged from 19-81% in early series
- Loosening rates 22-75%
  - Early implant designs were cemented and highly constrained
- High rate of wound problems in elderly pts, RA, DM


2 components
2 components
3 components
Tibial Component
Tibial Component
Tibial Component
Mobile bearing
Fixed Bearing
Talar Component
Talar Component
Talar Component

Agility

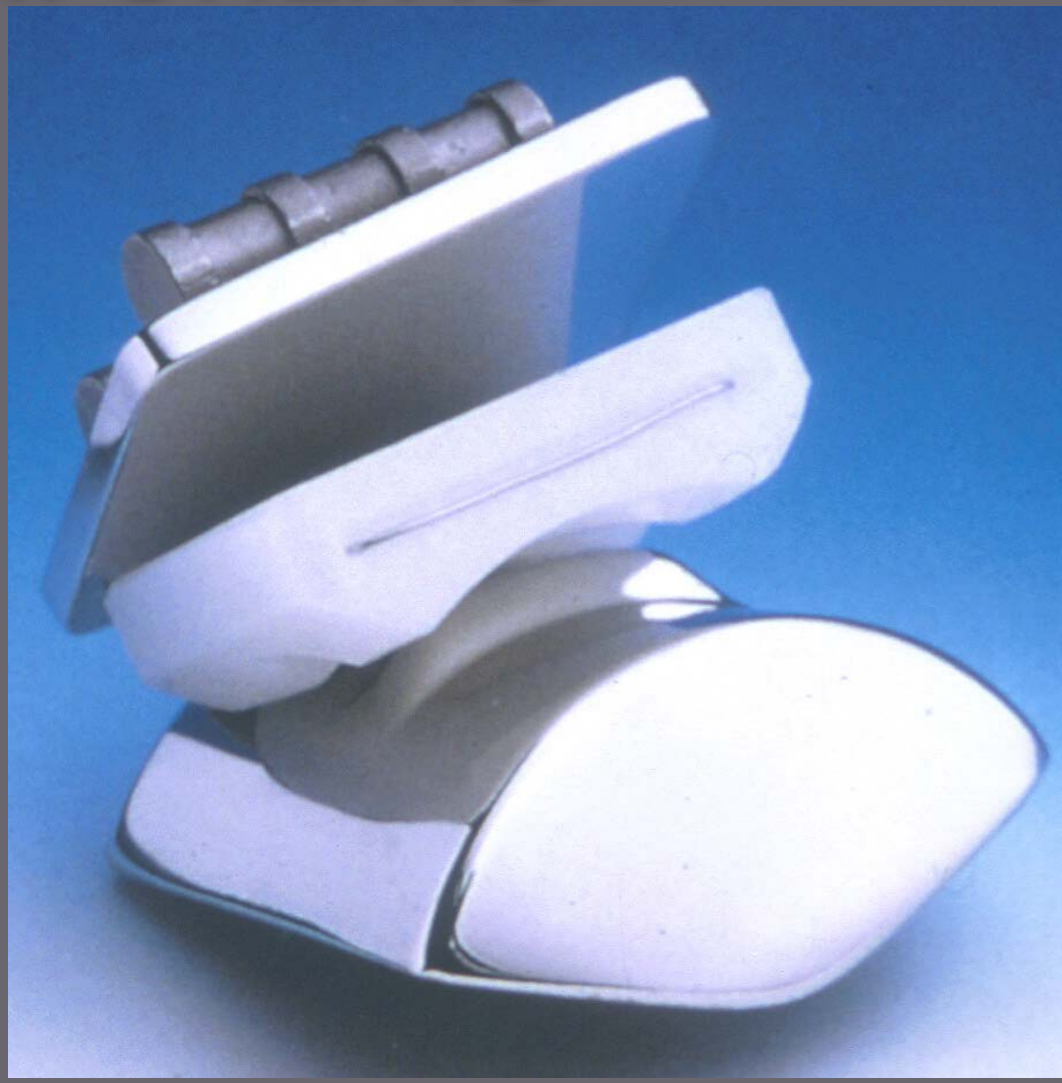






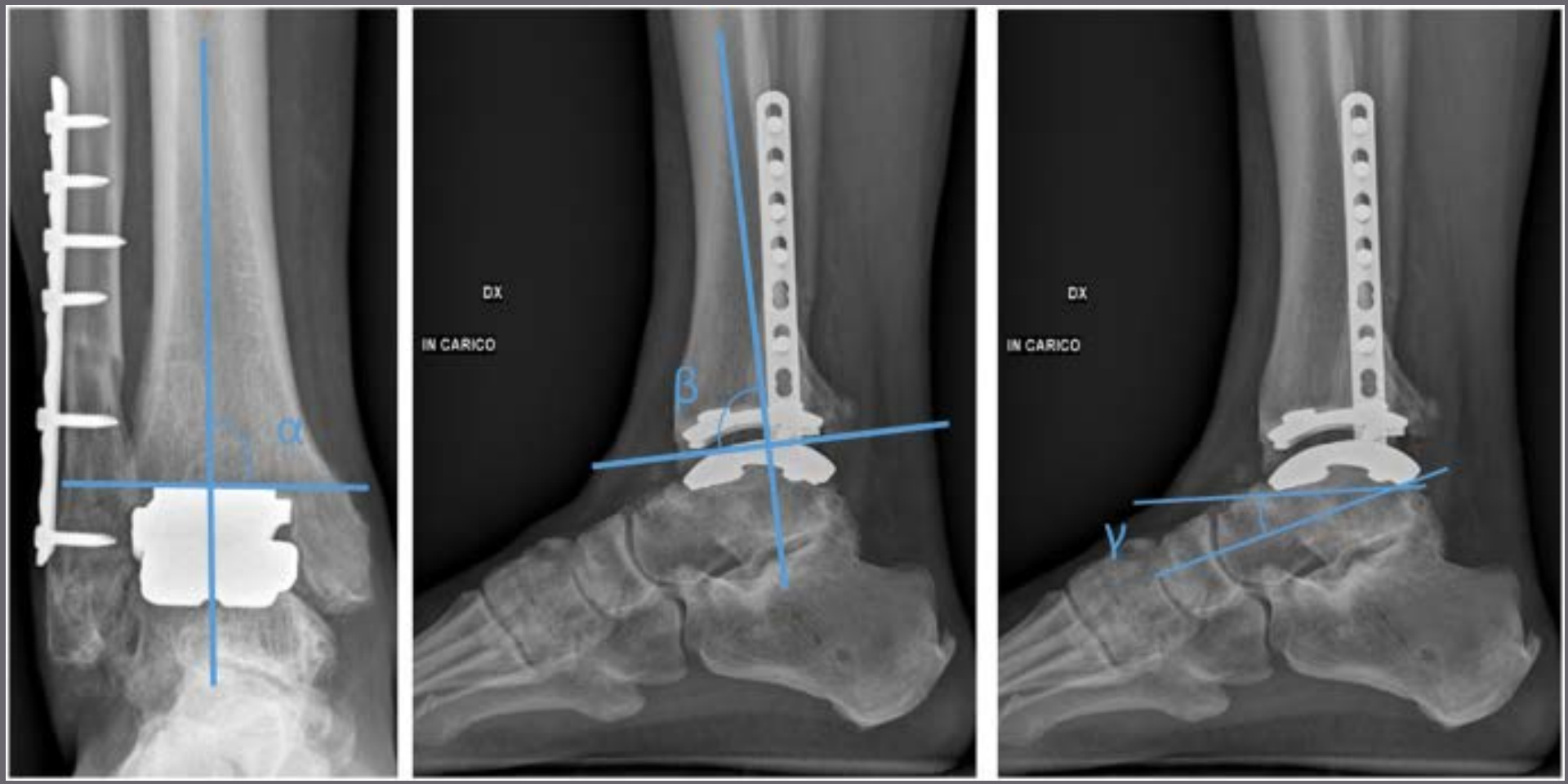
STAR
3 COMPONENTS

- TIBIAL TRAY
- MOBILE BEARING POLYETHYLENE
- TALAR CAP



Salto

Zimmer TAA



Infinity

Inbone

Many others…

JBJS, 2013

- **Ankle arthroplasty and ankle arthrodesis: gait analysis compared with normal controls**
  - **17 fusion and 17 TAA pts and 10 controls**
  - **Evaluated >1 year after surgery with gait analysis**
  - **TAA group had a more "normal" gait**
  - **No difference in self-reported outcomes**

  - J Bone Joint Surg Am. 2013 Dec 18;95(24):e191(1-10). doi: 10.2106/JBJS.L.00465

INT Orthop, 2012

- **Total ankle arthroplasty versus ankle arthrodesis. Comparison of sports, recreational activities and functional outcome**
  - **21 fusion pts and 20 TAA pts examined 3 yrs after surgery**
  - **# of pts participating in sports decreased in fusion cohort (not statistically significant)**
  - "Our study revealed no significant difference between the groups concerning activity levels, participation in sports activities, UCLA and AOFAS score"

AOFAS annual meeting

AOFAS Annual Meeting 2017

Comparing Sports Activity Following Total Ankle Replacement Versus Ankle Arthrodesis

Seth Richman, MD, Tyler Rutherford, BS, Timothy Rearick, MD, John T. Campbell, MD, Rebecca Cerrato, MD, Clifford Jeng, MD

Results: The SF-12 physical score both groups significantly increased postoperatively from 33.18 ± 10.37 to 43 ± 10.32 for AA's and from 32.88 ± 9.44 to 45.81 ± 12.94 ($p < 0.001$) for TAR's. The FFI scores showed a significant increase in both groups ($p < 0.001$). In the AA group, 88% of patients returned to work and would repeat the surgery, compared to 92% of patients in the TAR group. In terms of satisfaction and pain, the TAR group was more satisfied (1.78 vs. 1.44) and had less postoperative pain (1.32 vs. 2.56 $p < 0.05$). The AA group reported a significant increase in six activities including: golf ($p < 0.05$), weight lifting, and walking ($p<0.001$), while the TAR group reported significant increase in 15 activities, including hiking, tennis, and yoga ($p<0.001$).

Conclusion: Our study revealed a significant increase in general physical function, foot function, and activity level in both groups. The TAR group was able to perform a wider range of activity and sports compared to the AA group. Overall, TAR patients were significantly more satisfied with their procedure compared to AA patients.

Overview

- Ankle DJD usually post-traumatic
- Still some controversy that exists over proper surgical management
- Swing towards TAA over fusion as implant designs have improved
  - Spare bone
  - Less constrained
  - Bone ingrowth, not cemented
- Long-term f/u still needed to see

Ankle Replacement

- **Evolution of my thinking**
  - *Disclaimer: 8 years of practice

- Do them on elderly with mild deformity
- Do them in low demand patients and with some deformity being ok
- Do them on medium/higher demand patients regardless of deformity
- Now I have to really convince myself not to do it in someone of any age

Things to consider…

- Genu varum/valgus?
- Femoral deformity?
- Tibia deformity?
- Distal tibia articular angle
- Previous trauma
- Previous incisions
- Ligament instability?
- Cavovarus?
- Pes planus?
- Retained hardware?
- Osteoporosis?
- Transmalleolar rotation?
- Equinus contracture?
- Sagittal plane?
- Ankle contractures?
- Mobile vs fixed bearing?
- Blood supply to talus/AVN
- Adjacent joint disease?
- Cement or no cement
- Neuropathy present?
- Vascular disease?
- Diabetic?
- Obese?
- Activity level?

GENU VARUM

70 yom with Right ankle pain post polio


R
RV


R
SG/GAK
STANDING

PRE TKA

POST TKA

PRE TKA

POST TKA

PRE TAA

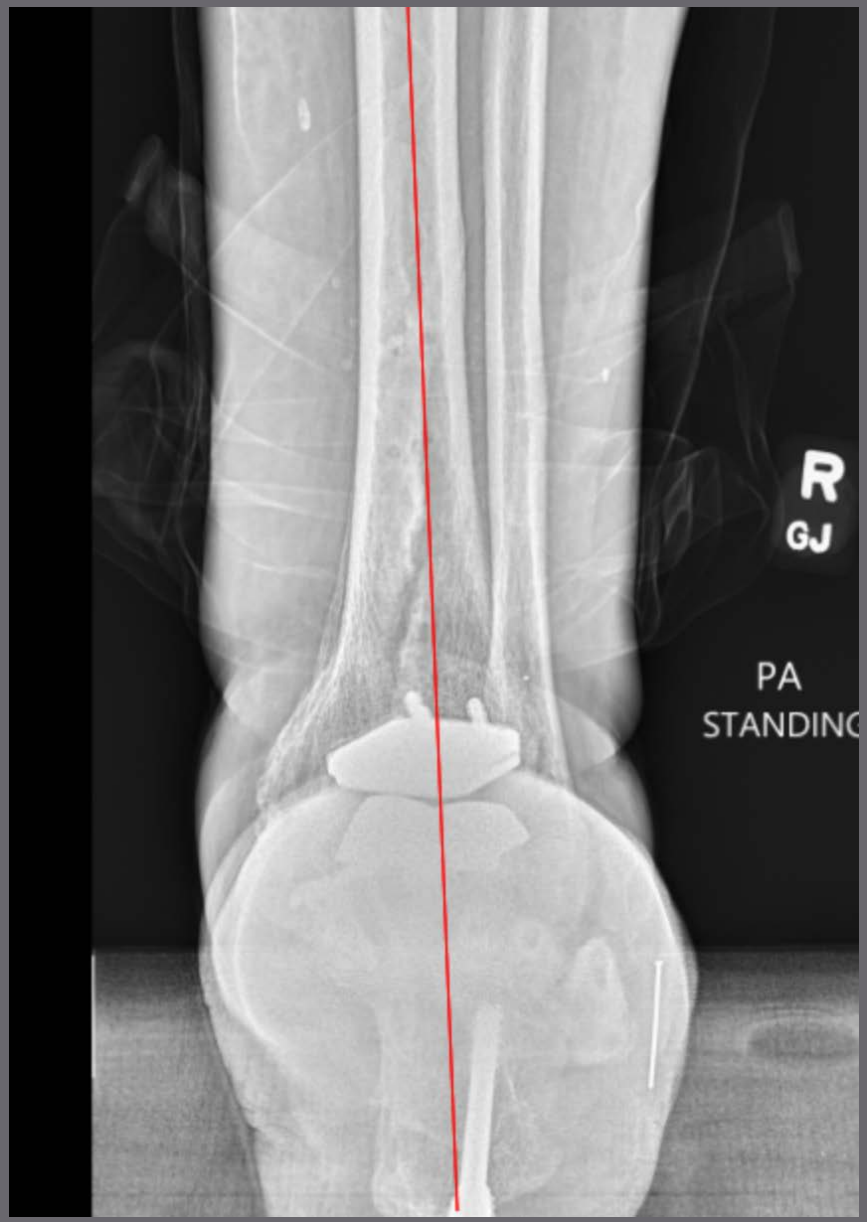
POST TAA

PRE TKA

POST TAA

PRE TKA

POST TAA



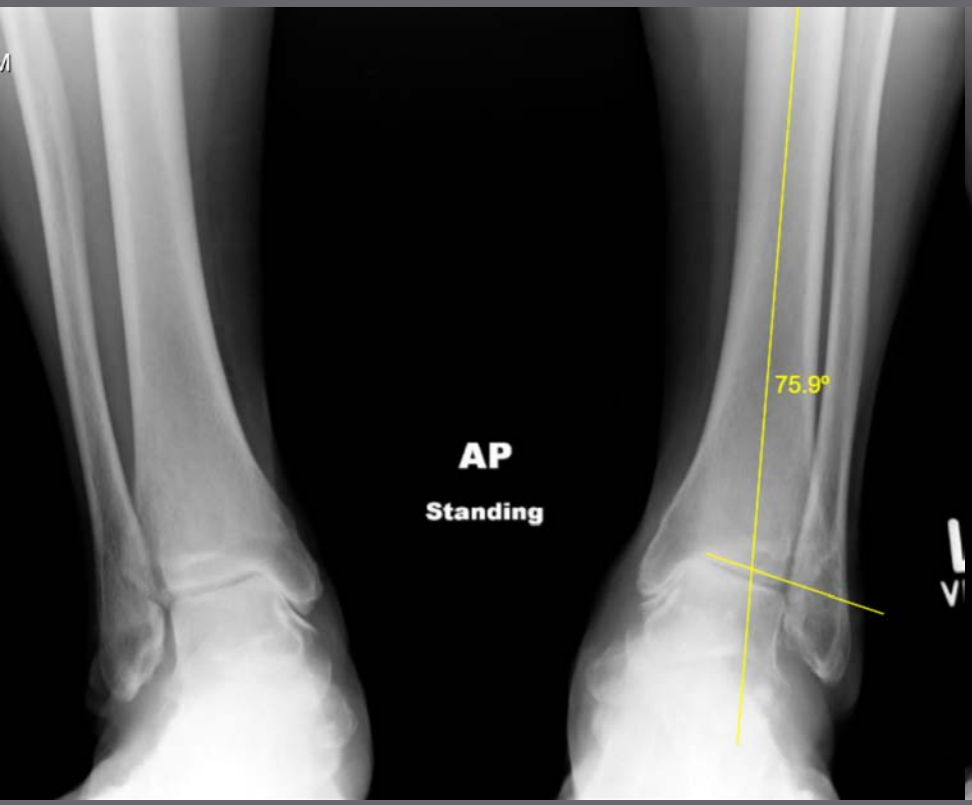
PRE TKA

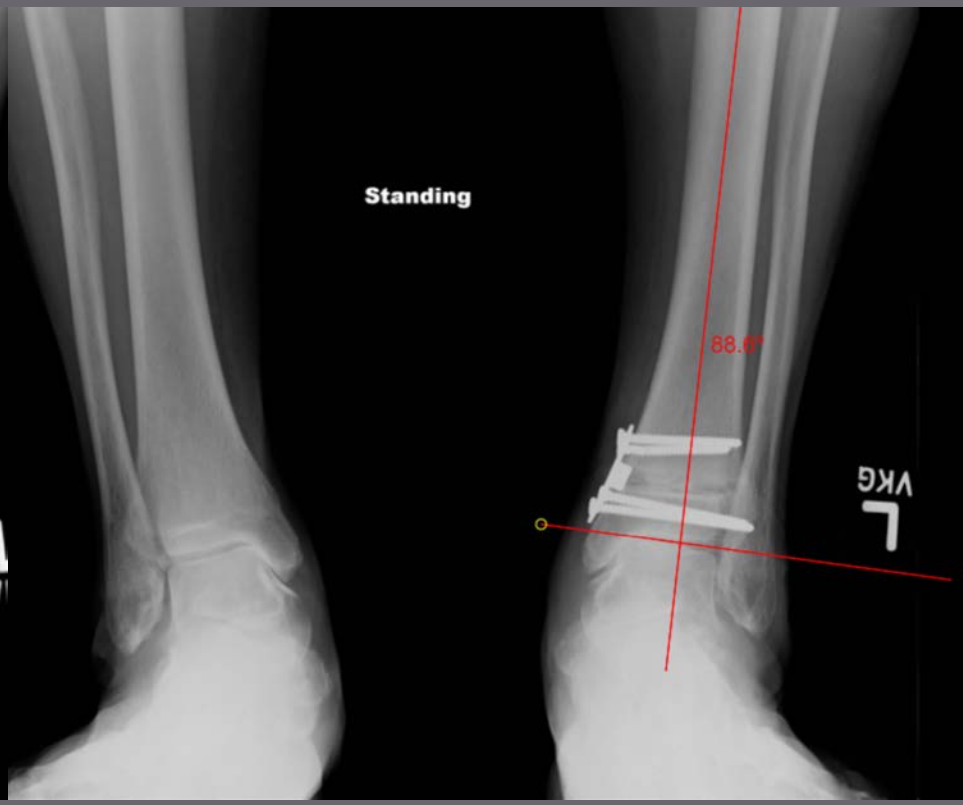
POST TAA

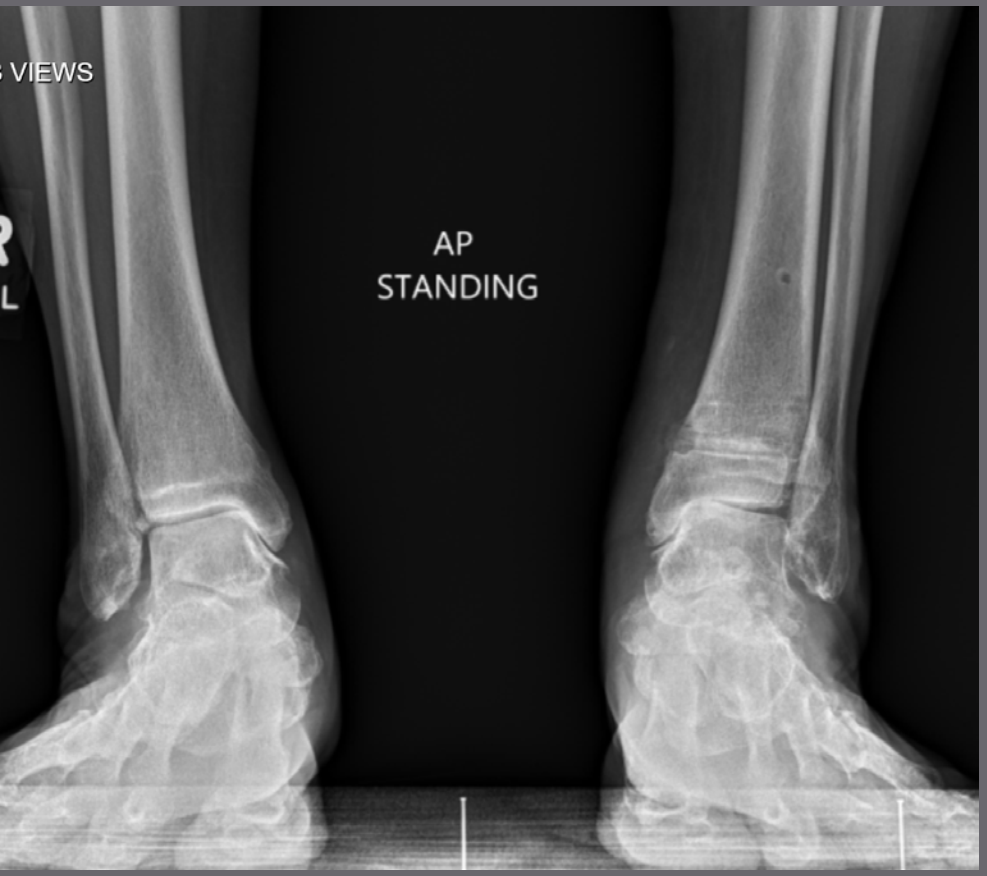
TIBIAL DEFORMITY

75 yof

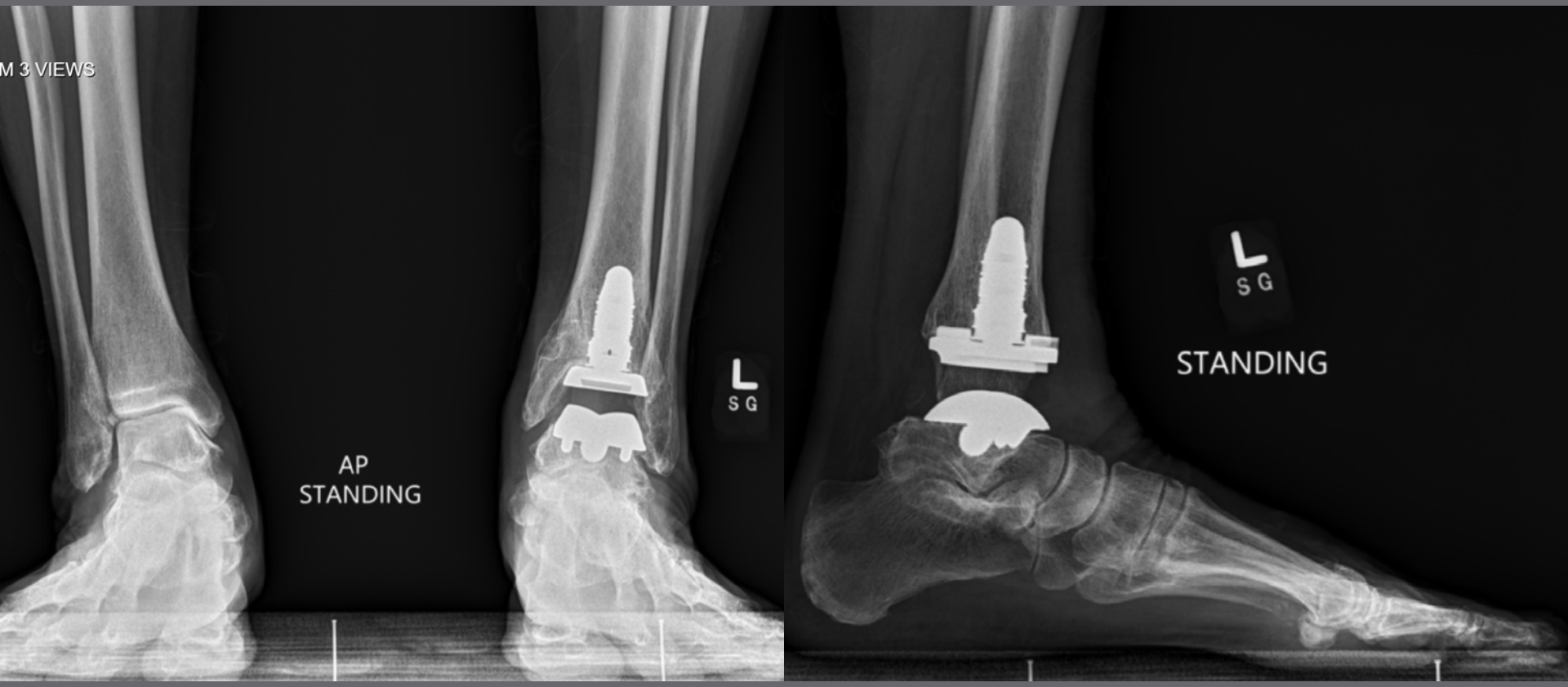
Tibial bone quality for implant?

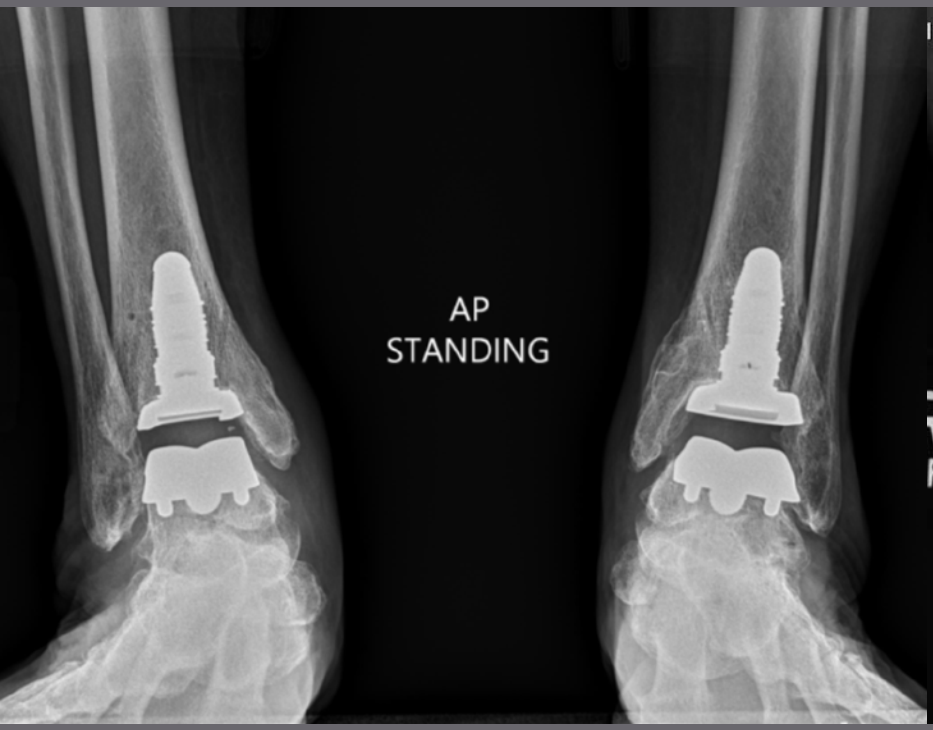


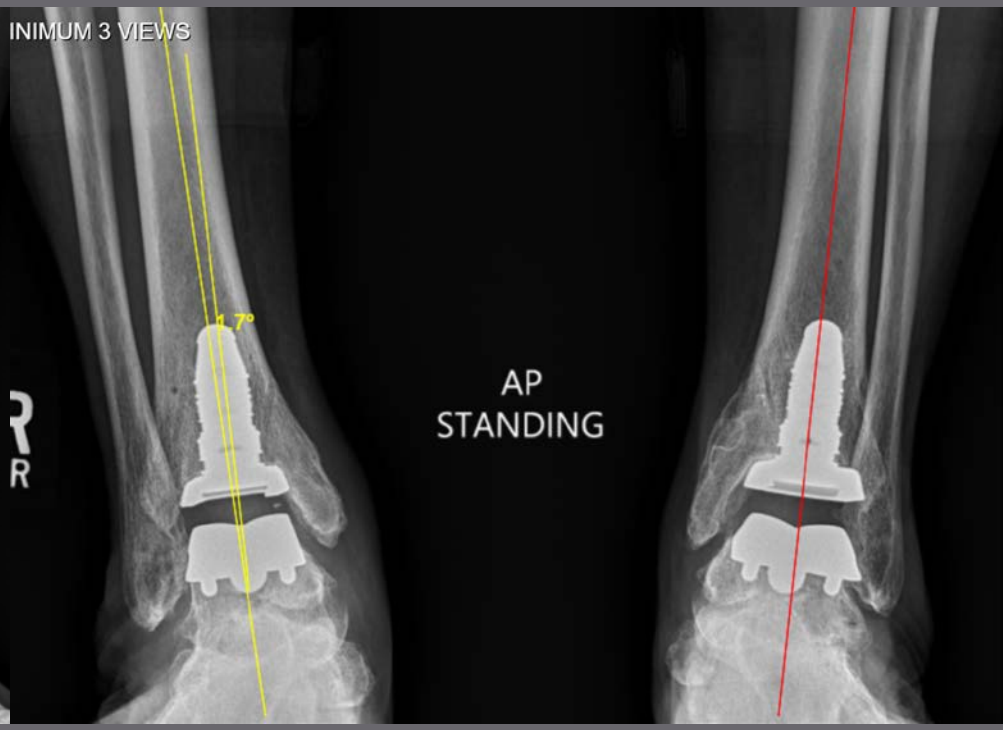



VIEWS
AP
STANDING

1 year post op




AP
STANDING

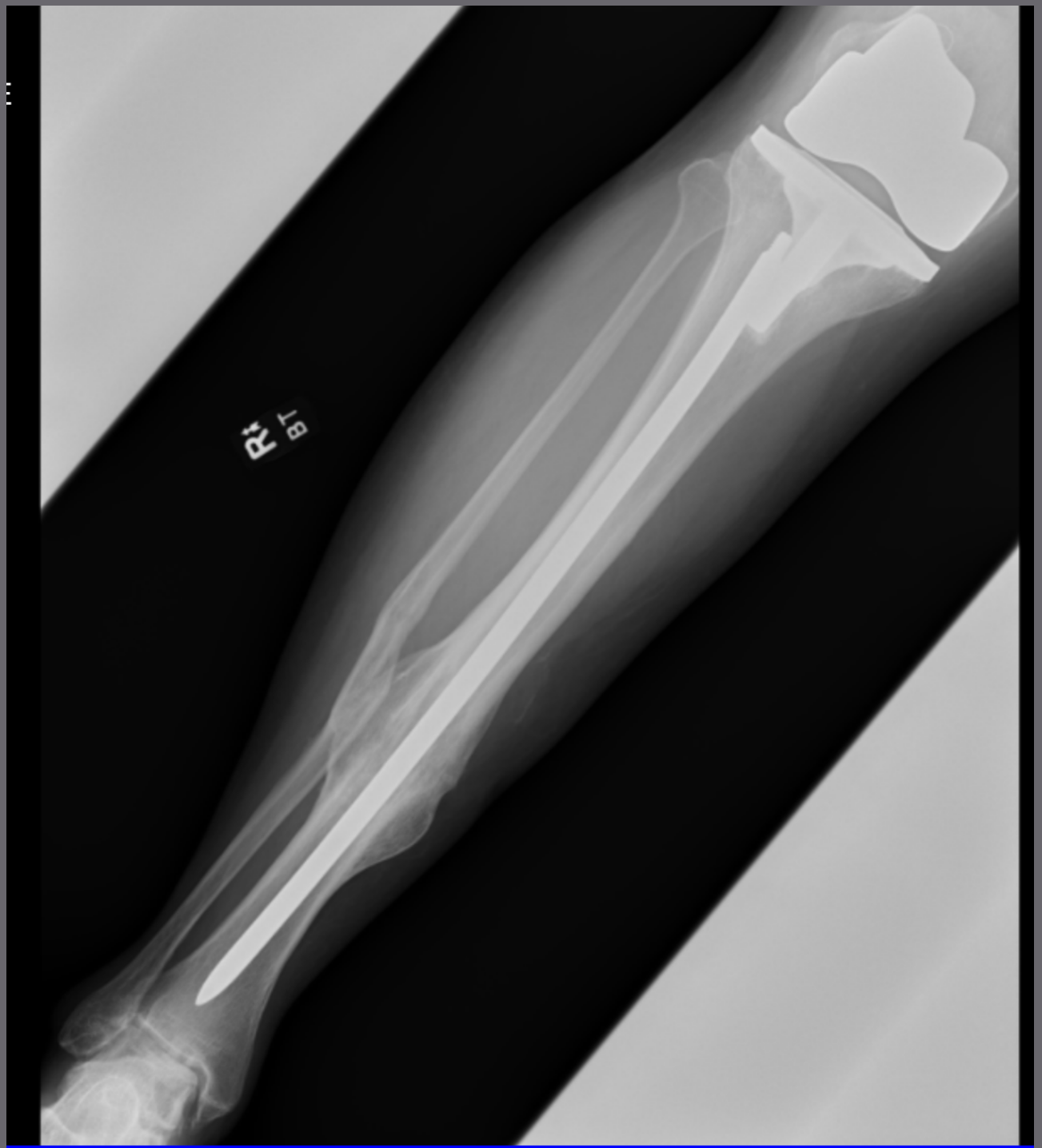

INIMUM 3 VIEWS
1.7°
R
AP
STANDING


R
JR
STANDING
MAX DORSIFLEXION


STANDING
X PLANTARFLEXION

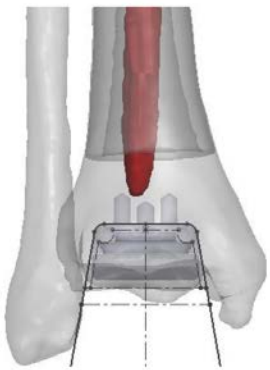
PREVIOUS TRAUMA

65 yom

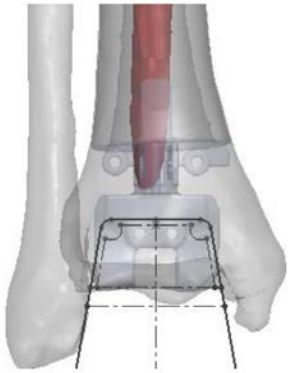

RT

PSI with pre op planning

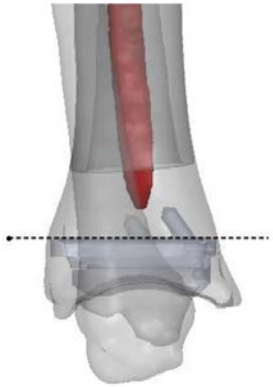
- The tibia pegs are within 3mm of the hardware colored red.



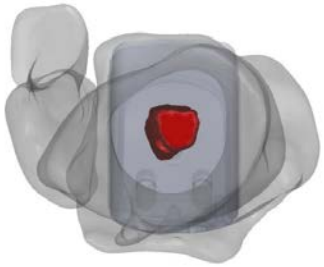
Anterior view



Anterior view – alignment guide

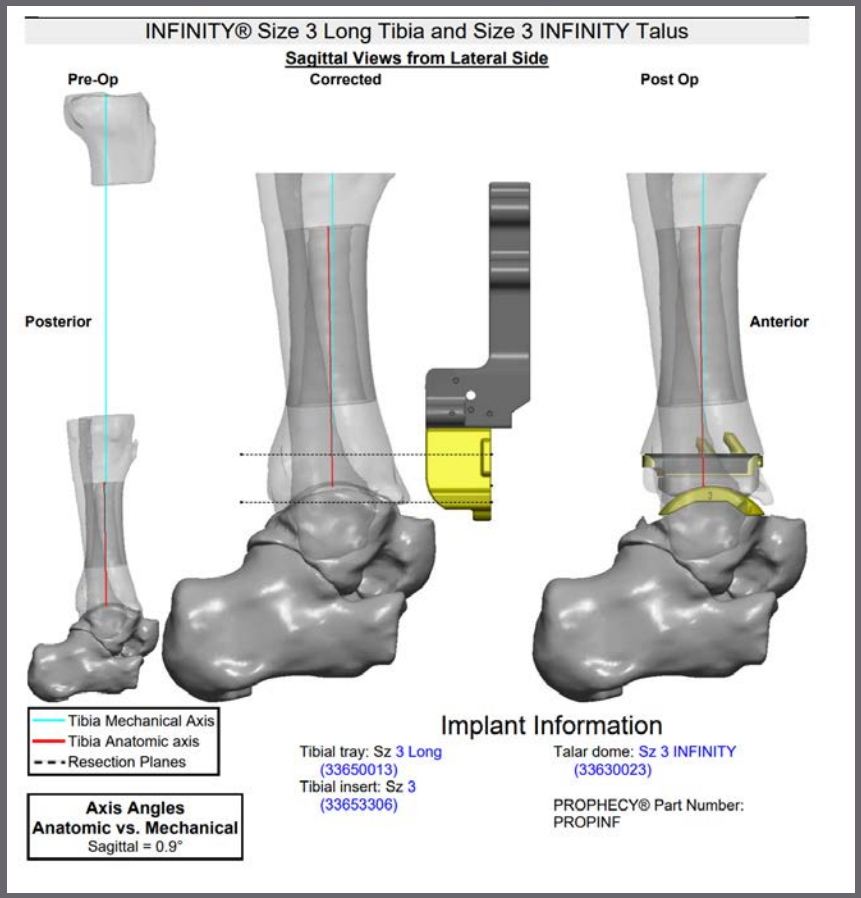


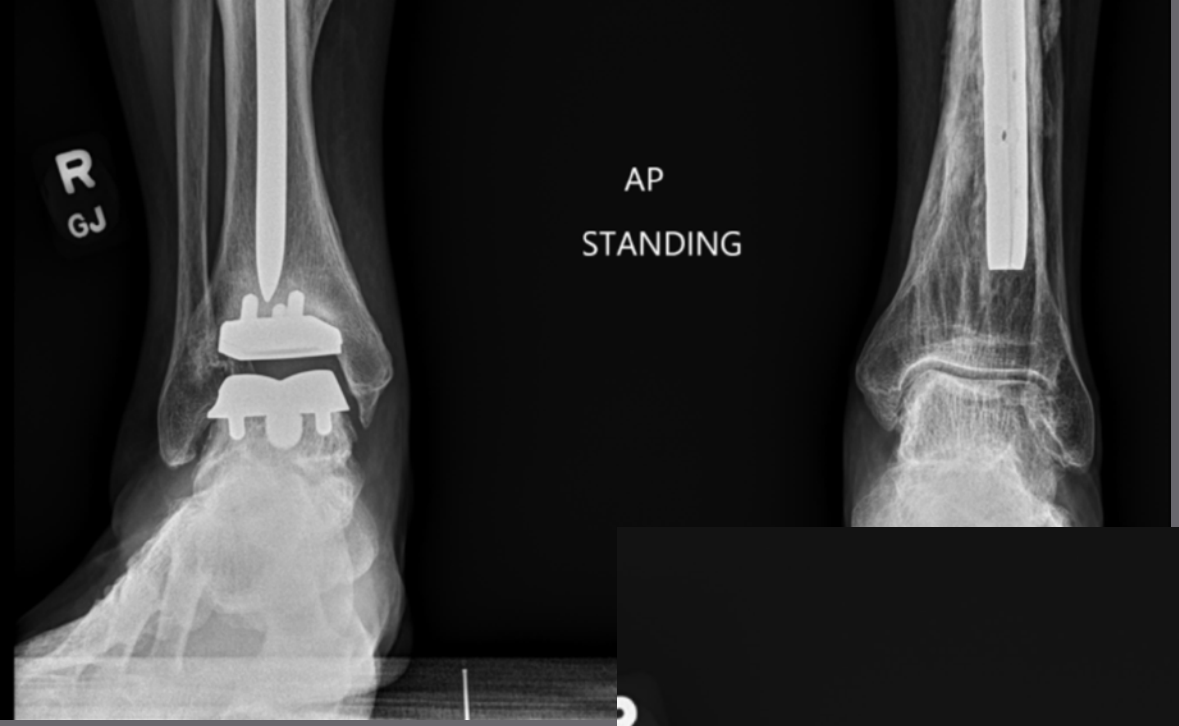
Sagittal view



Proximal view

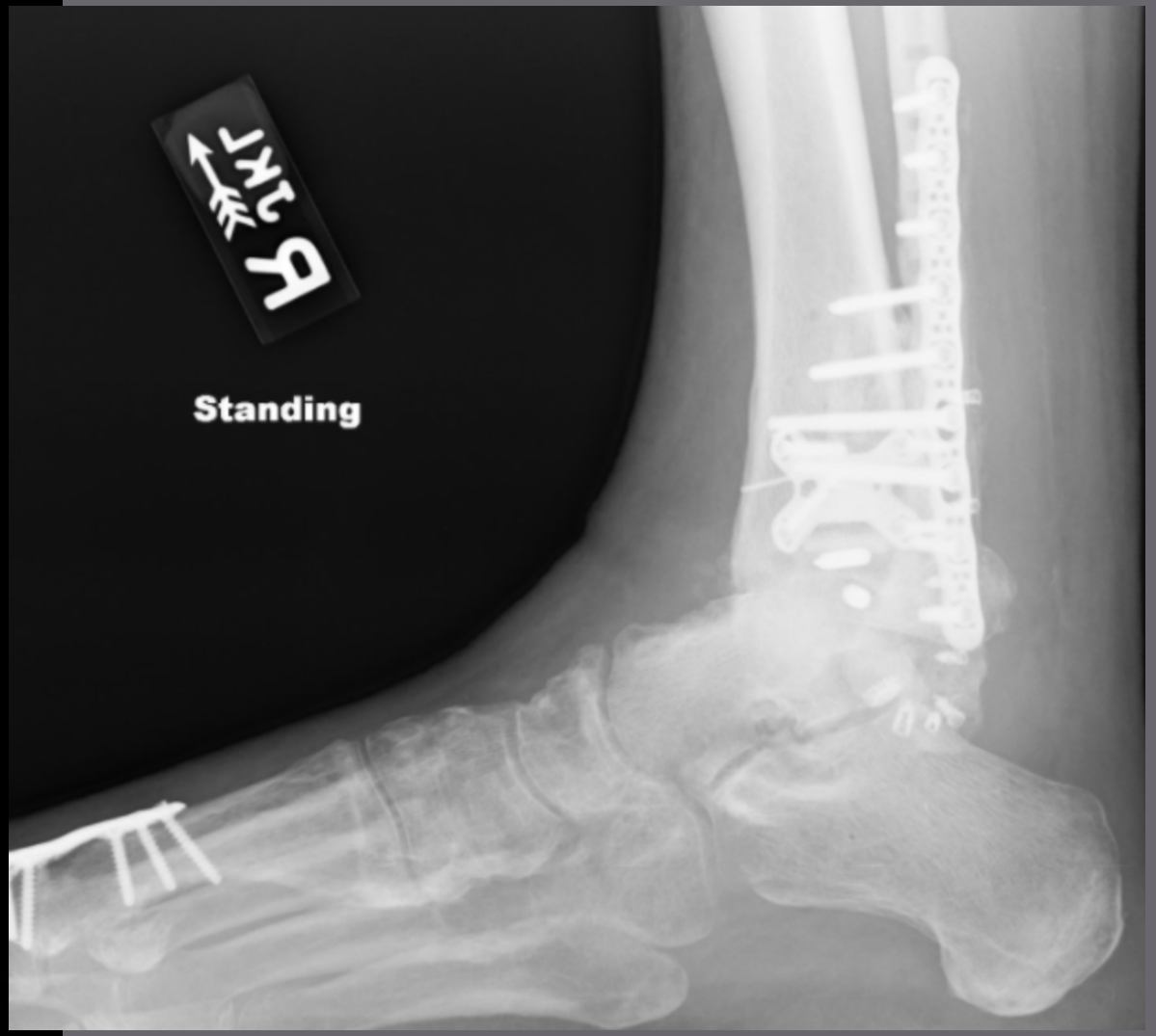
Confidential




R
GJ
AP
STANDING


STANDING

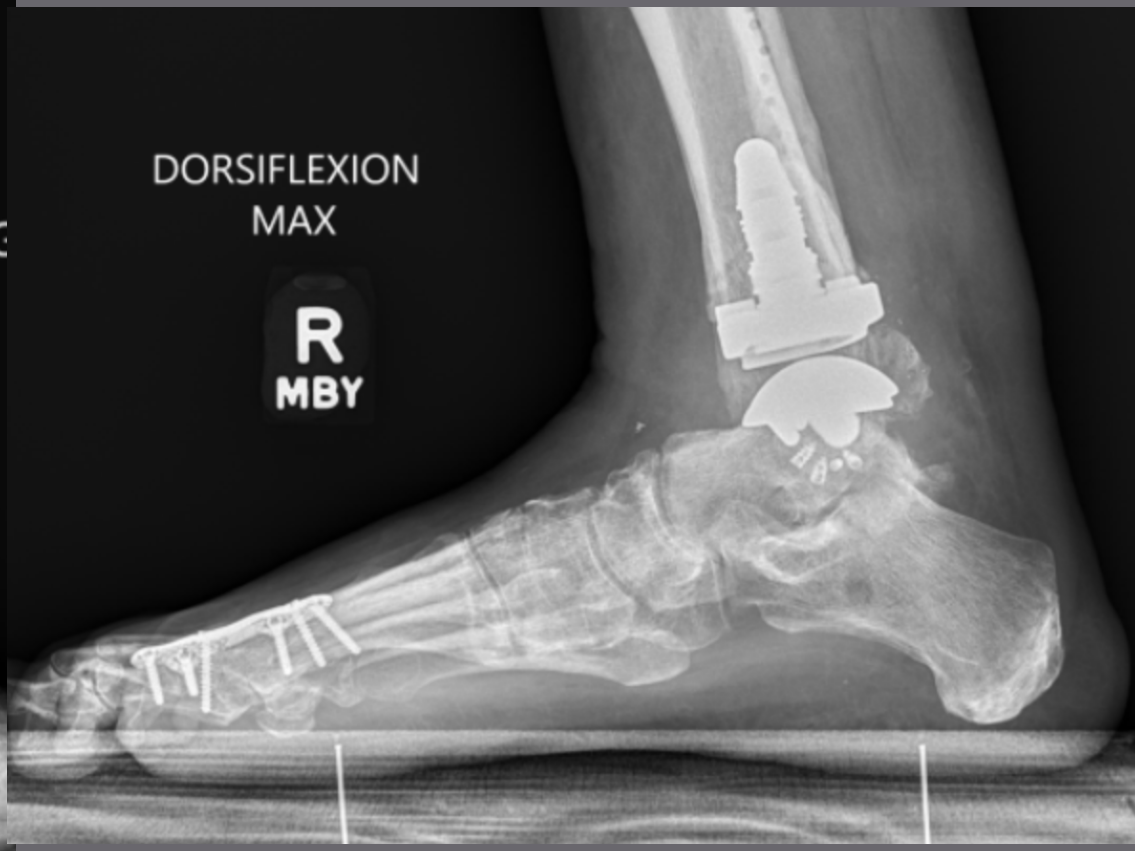
62 yom




anding
R


R
ding

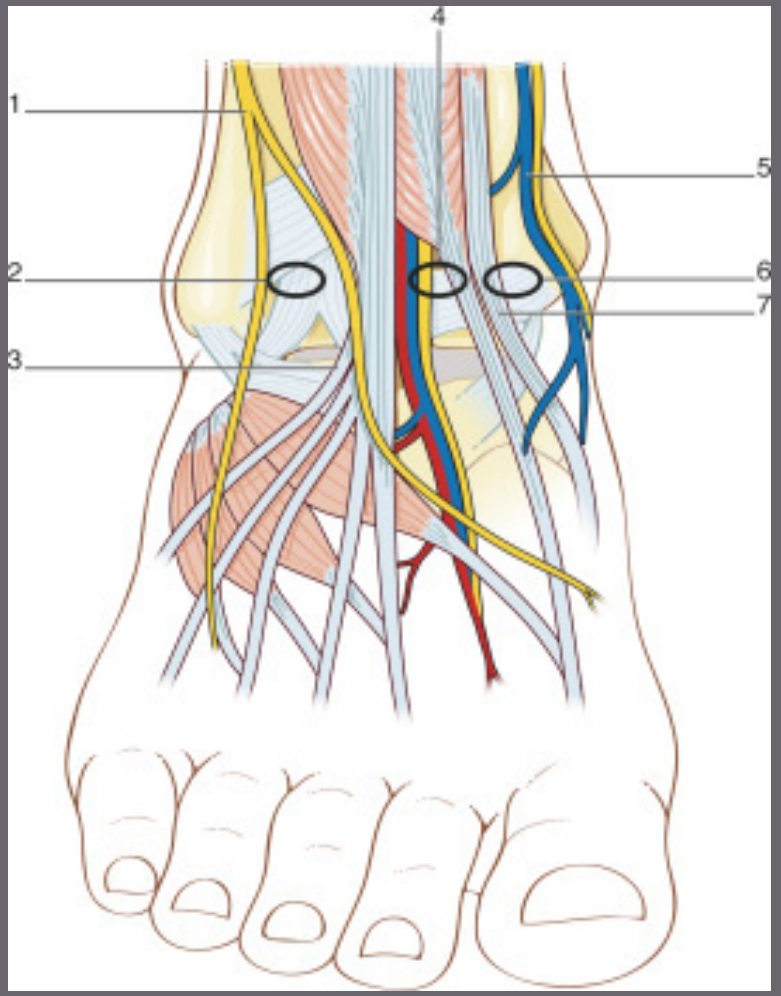
2 years out



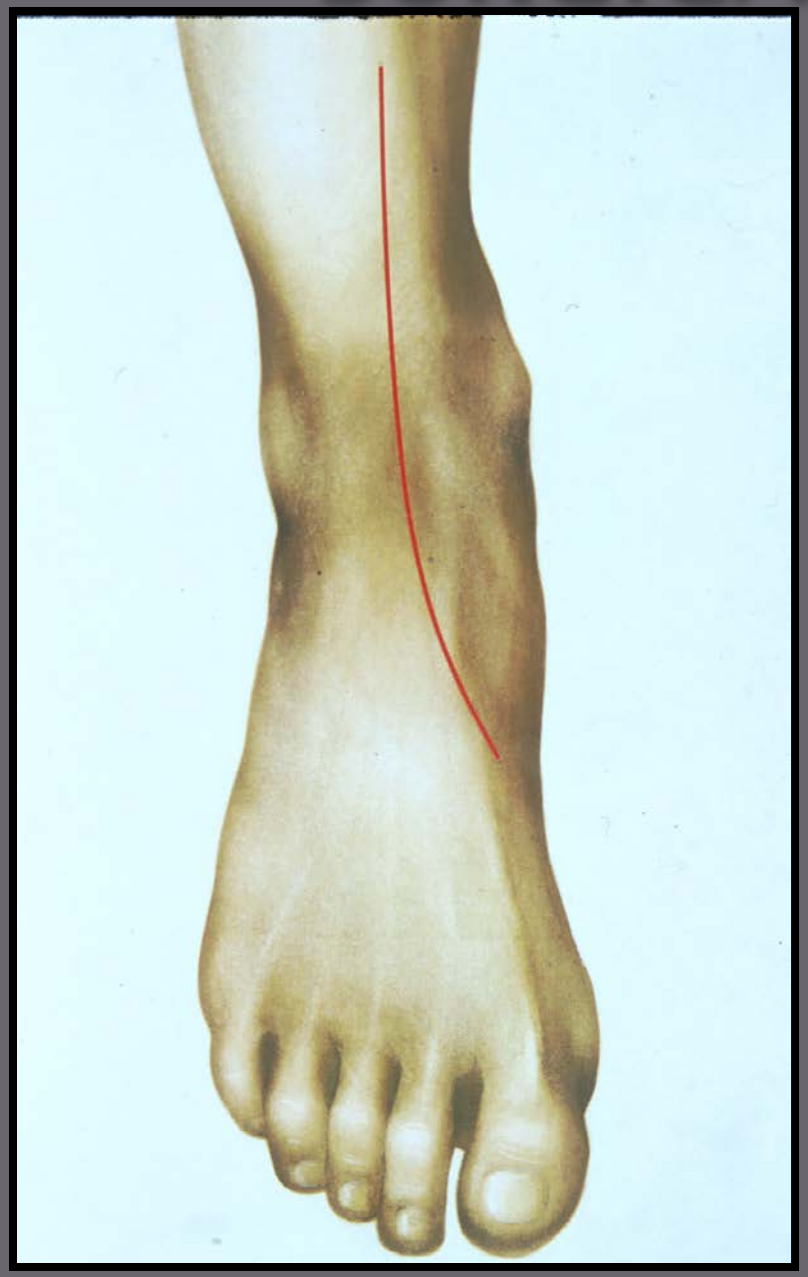
PREVIOUS INCISIONS

For pilon fxs

- Consider using direct anterior incision if possible
- Between Tib ant and EHL to avoid NV bundle
- Can put on anterolat plate or anteromedial fixation if need be



SURGICAL EXPOSURE



CAVOVARUS/LIGAMENT INSTABILITY

60 yom

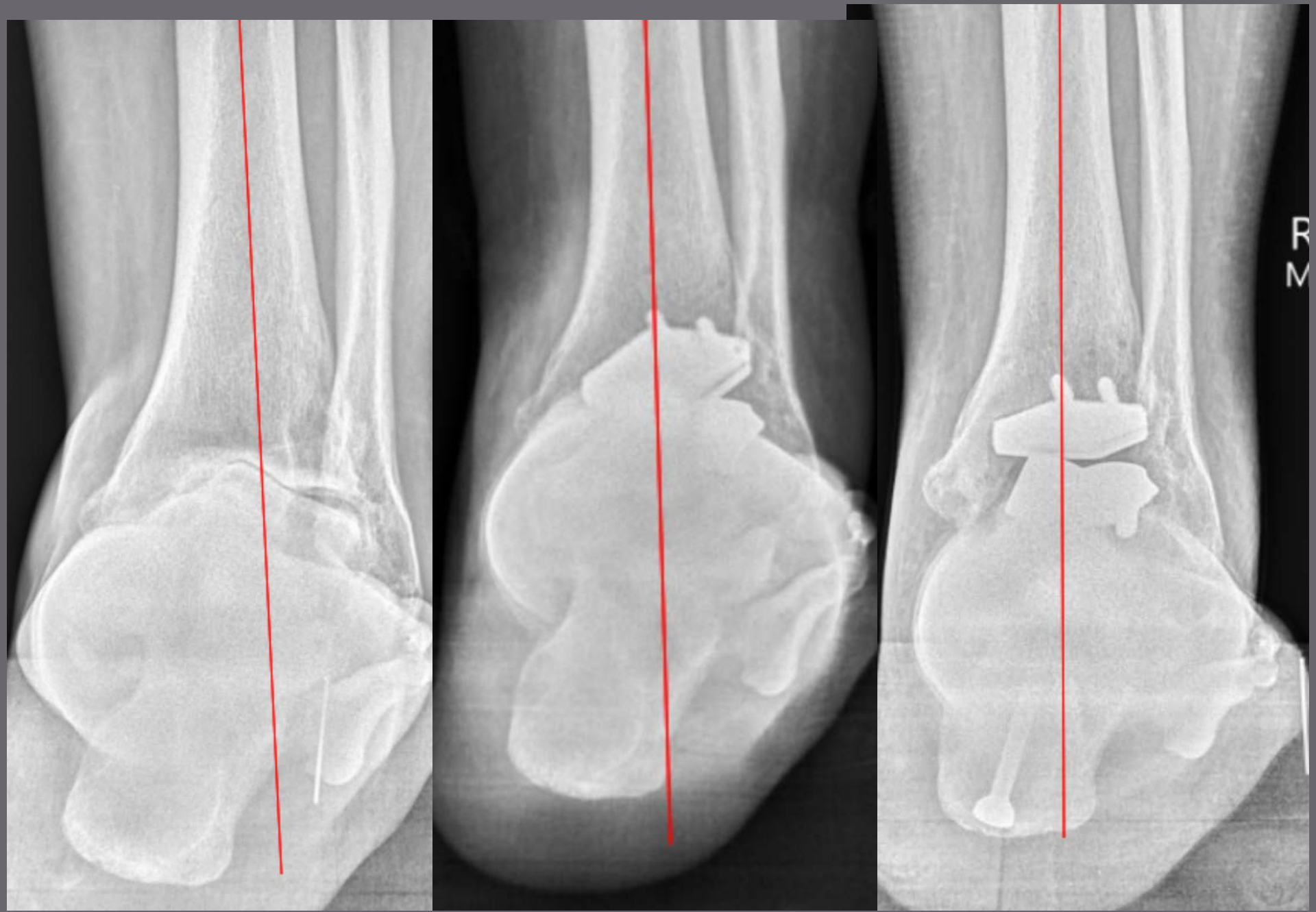
60 yom


TANDING


R
CDP
AP
STANDING
R
CDP


AP
STANDING


R CAW
STANDING

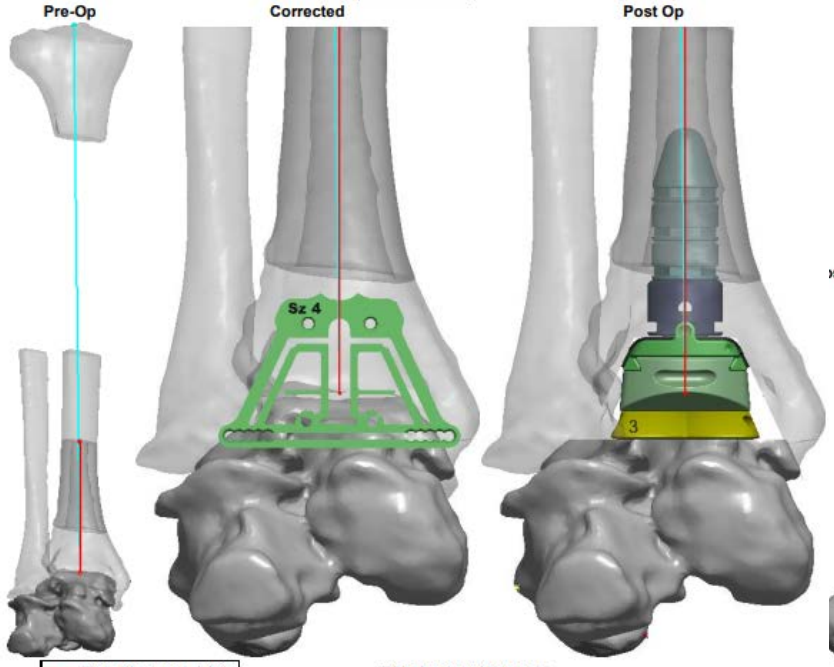


PES PLANUS

63 yom with previous triple

INBONE™ II Size 4 Long Tibia & Size 3 Talus

Anterior Views



Tibia Mechanical Axis
Tibia Anatomic axis

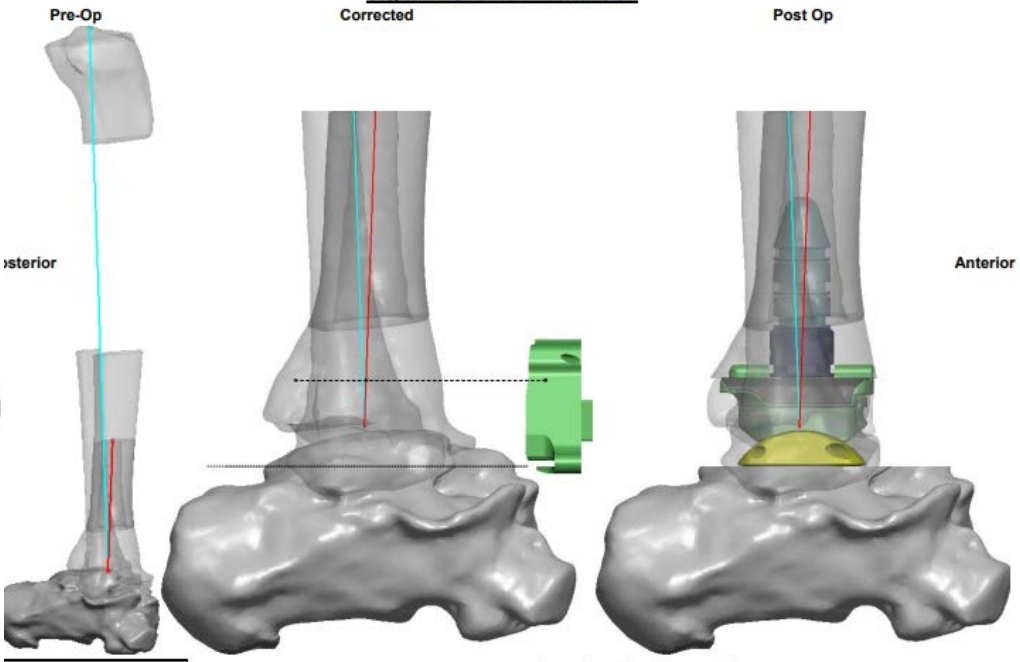
Axis Angles
Anatomic vs. Mechanical
Coronal = 0.6°

Tibia Implant Alignment
- Coronal Plane: Anatomic Axis
- Sagittal Plane: Anatomic Axis

Medial/Lateral placement is set:
- to Bisect gutters
- to ensure the stem implants fall within the tibial canal
- Medial malleolus at implant corner: 11.4 mm.

INBONE™ II Size 4 Long Tibia and Size 3 Talus

Sagittal Views from Lateral Side



Tibia Mechanical Axis
Tibia Anatomic axis
Resection Planes

Axis Angles
Anatomic vs. Mechanical
Sagittal = 3.9°

Implant Information

Tibial tray: Sz 4 Long (220222904)
Tibial insert: Sz 3 Plus (220224310E)
Stem Components:
Top: 16 mm (200011902)
Middle: 16 mm (200010902)
Middle: 16 mm (200010902)
Base: 18 mm (200009902)

Talar dome: Sz 3 (220220903)
Stem: 10 mm

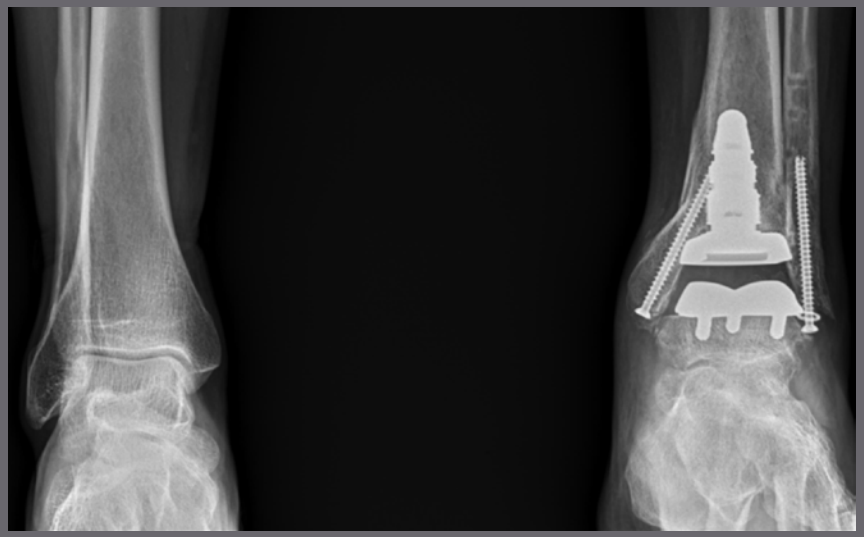
PROPHECY™ Part Number: PROPINB


R
AJM
M WB
AP


TARFLEXION
SIM WB

SAGITTAL PLANE

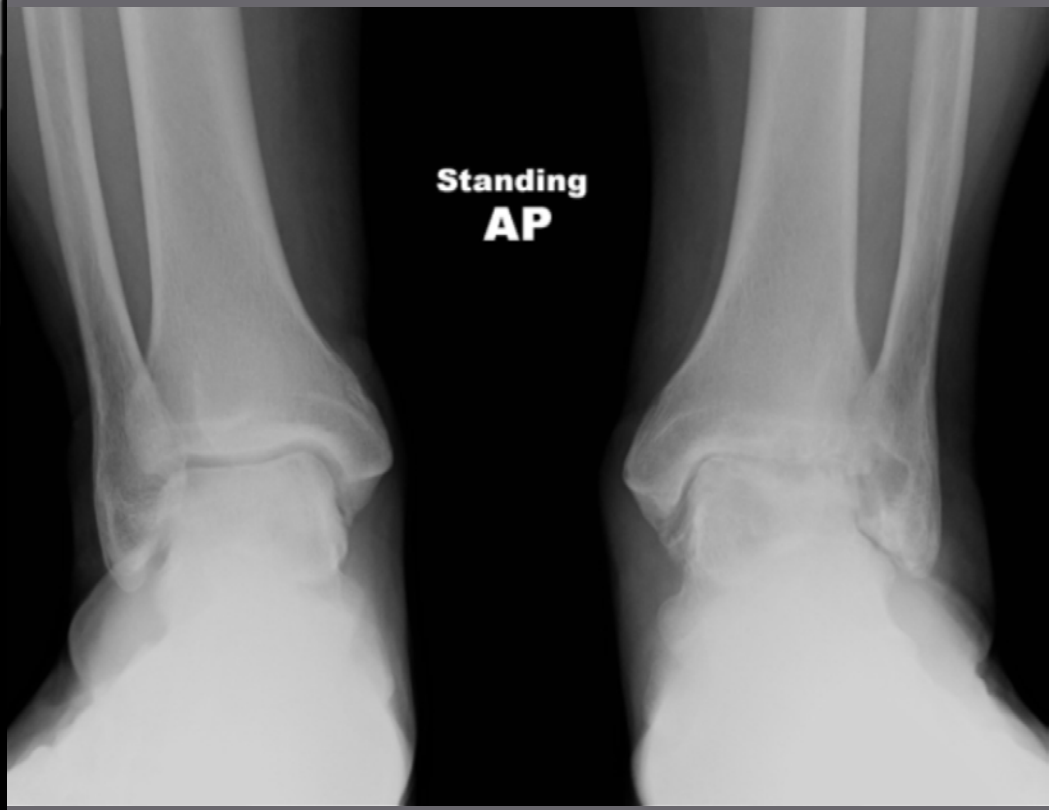
60 yom




NWB
L
SBH

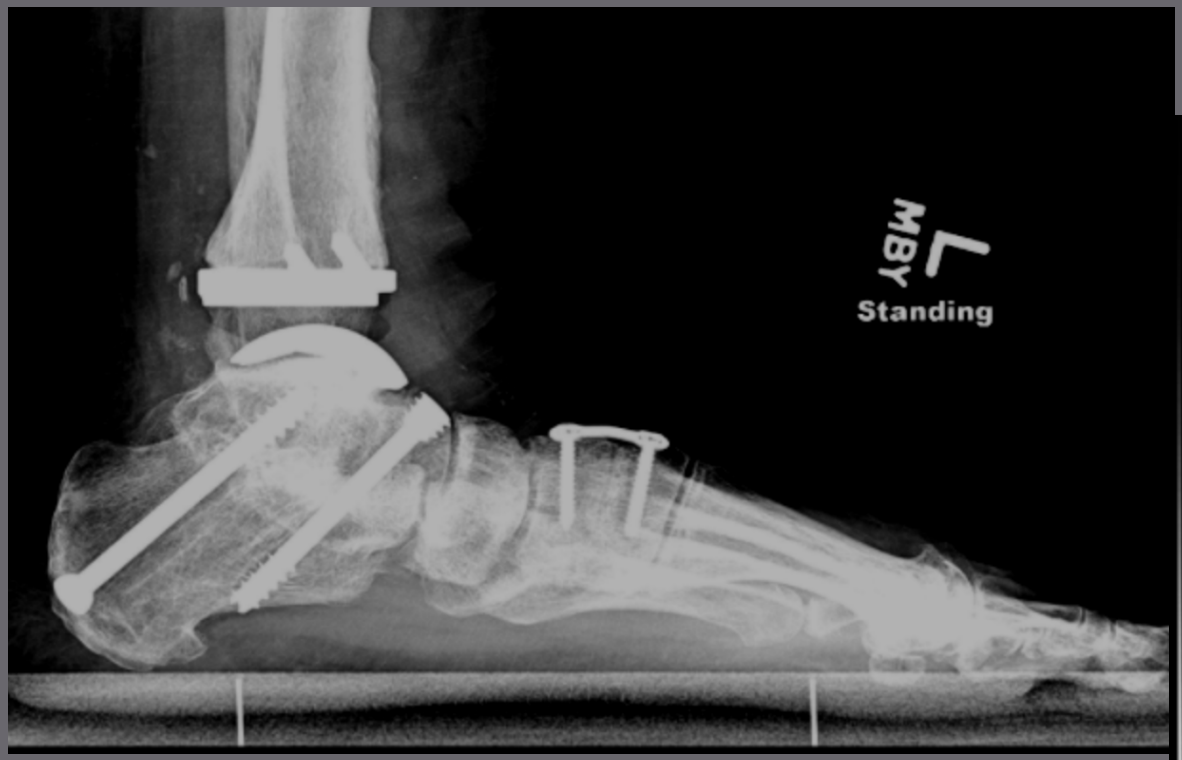
ADJACENT JOINT DISEASE

65 yom ankle and ST DJD



Staged flatfoot/TAA

TAA with revision ST joint



MISERABLE MALALIGNMENT

72 yof

TALAR AVN

29 yom with open talus fixed elsewhere 2018


AP
STANDING


R
GD
STANDING

3 D printed using contralateral talus CT scan has several size options and ability to fix/fuse the ST joint


R L R
STANDING


AP
STANDING

NOT 100% SUCCESSFUL…

Still learning

NEUROPATHY

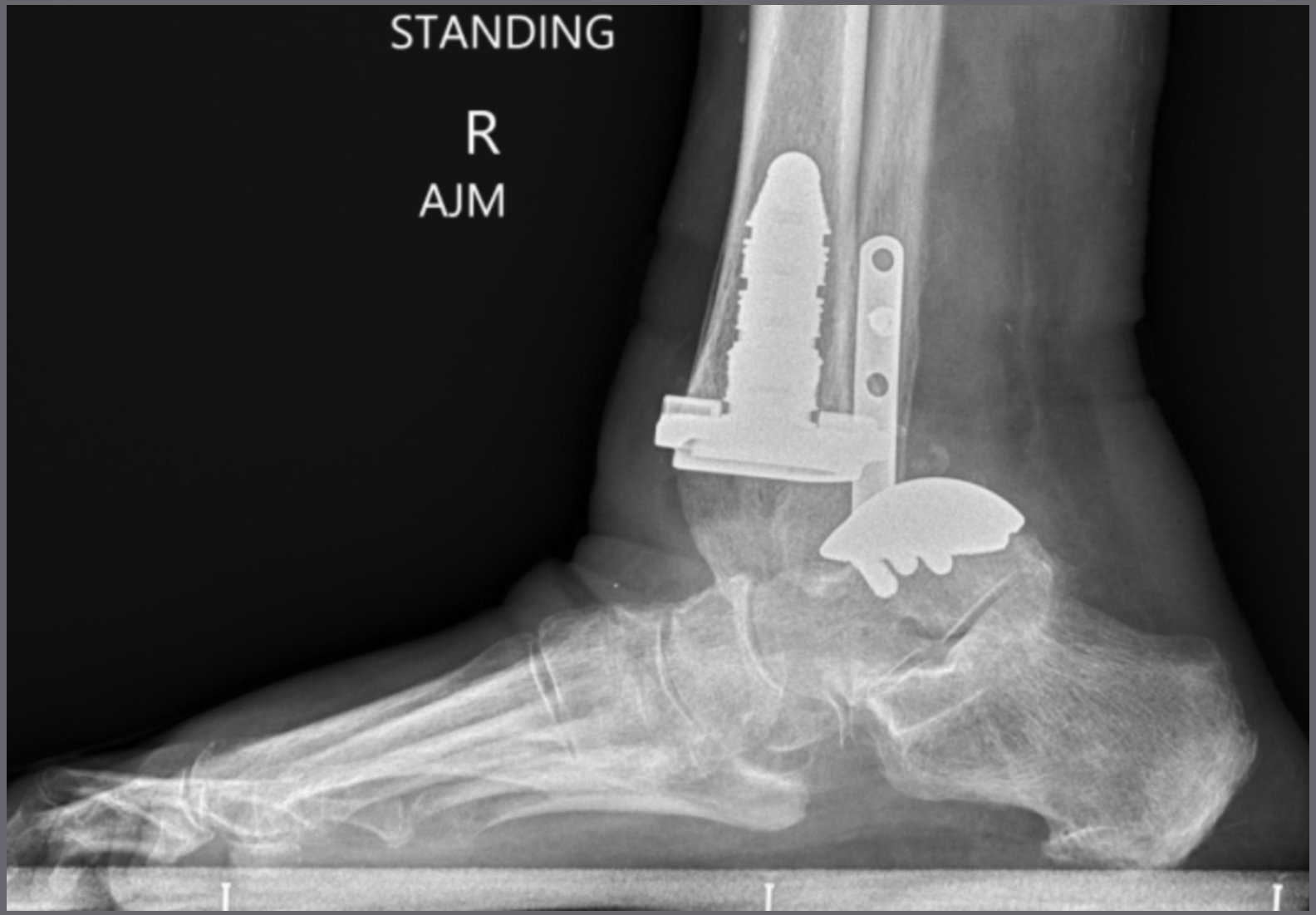
72 yof non-diabetic ORIf done elsewhere

1 year later


R
GJ


R
GJ
NWB

3 months out
No pain, FWB

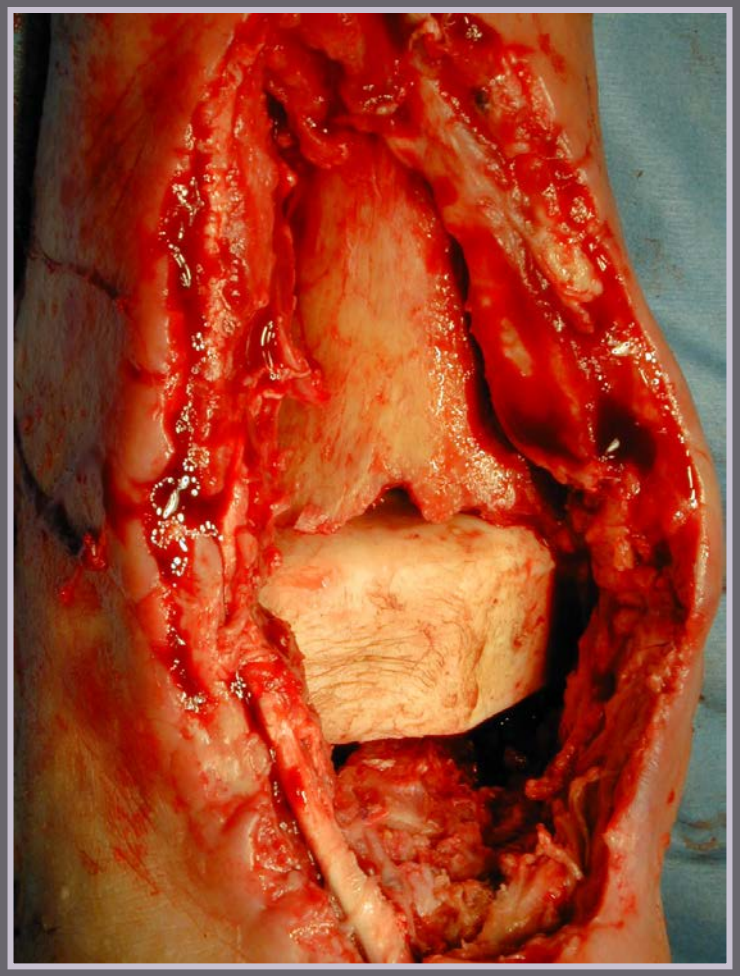


Revised, but started to fail at 6 months


kVp
mA

Revision

- Most common causes are
  - Poor implant design
  - Aseptic loosening
  - Infection
  - Malalignment
  - Pain (gutters)
  - Wear
  - Poor ligament balance



Agility TAA done 20 years prior

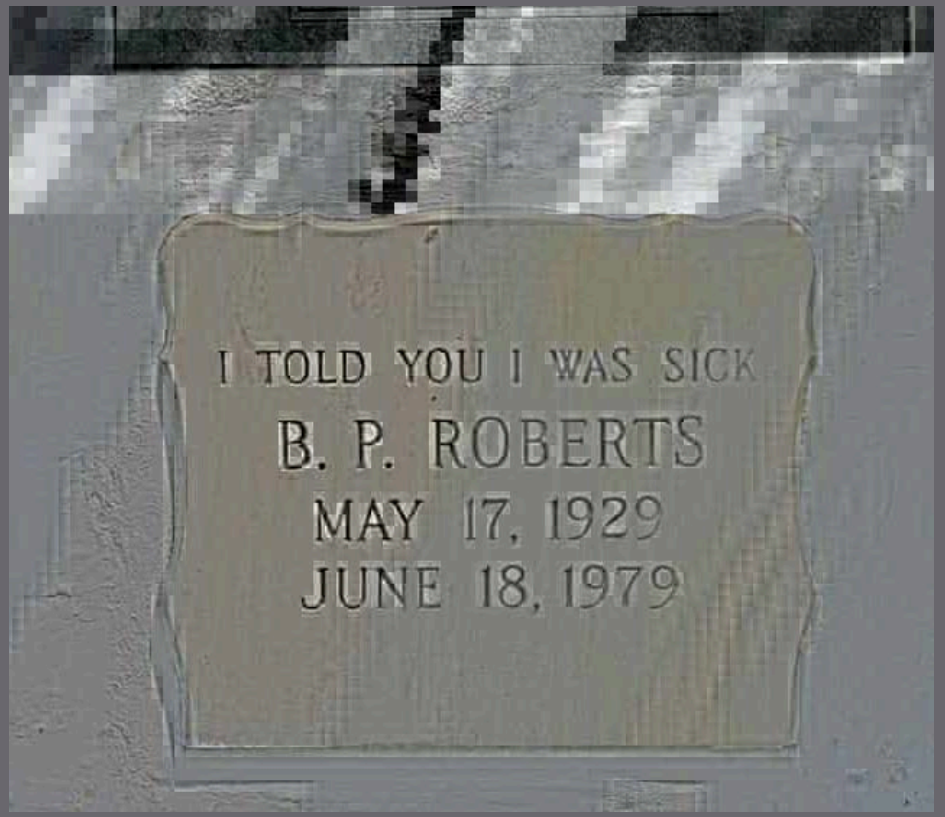

R
SVK


R
SVK
STANDING


SVK
STANDING

Ankle is fused… too late?

- Fusion take down to total ankle is being done
- Early outcomes are promising
- Narrow indications in my opinion
- Typically done due to gait problems, ST DJD




R
SAS


R
SAS
STANDING


3502437994
26-XR-23-020862
5:41:18 P
31
34
56 kVp
0.81 mA
OEC


OEC

Recovery

ANKLE REPLACEMENT

- NWB 3 weeks in boot with ROM PT
- WBAT in boot weeks 3-6 weeks
  - aggressive ROM
  - Sometimes PT
- Wean out of boot week 6
- Improvements in gait and pain 6-12 months

ANKLE FUSION

- NWB in cast 6 weeks
- Advance WB in boot at 6 weeks
- Full WB at 10 weeks
- Wean out of boot 12-16 weeks
- Improvements in gait and pain up to 1 year

Ankle Replacement

- Wound may have trouble healing
- Infections are concern with all joint replacements
  - Will require antibiotics with any procedure
- Parts may wear over time
- Good outcomes require surgeon skilled in this procedure
- Maintains more normal gait
- Less stress on surrounding joints

Take home points

- Don't remove lateral mal
- Direct anterior incision if possible
- Many tools in tool box
- Joints are meant to move, not fuse
  - Limits options if fuse
- More replacements of other joints in future

THANK YOU

https://orthoarizona.org/foot-ankle/

OrthoArizona
Foot and Ankle Institute