

---

# **Ankle Replacement and Ankle Fusion: Surgery and Recovery**

**Daniel Thuillier, MD**

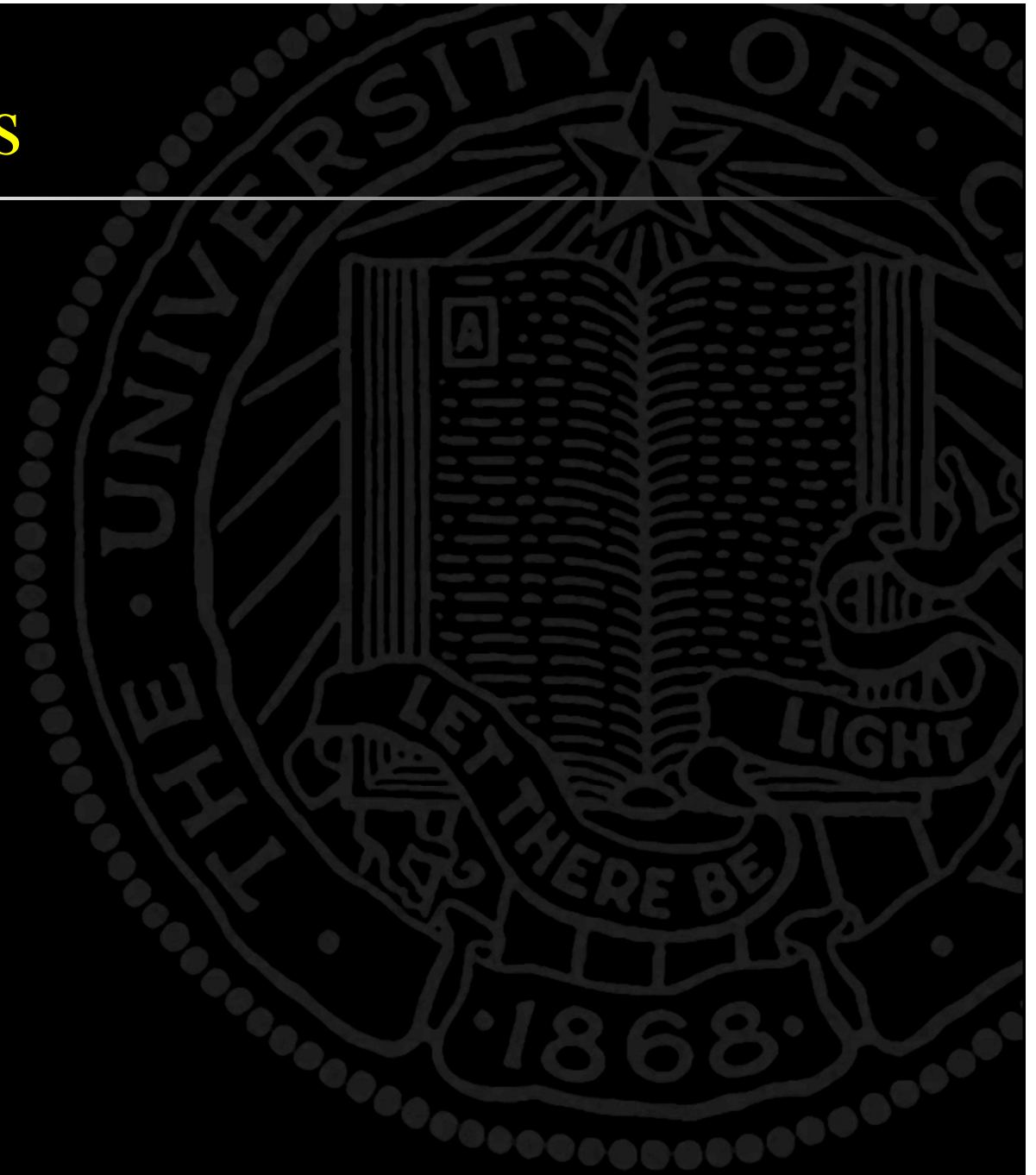
**Assistant Professor of Clinical Orthopaedics**

**University of California San Francisco**

# Disclosures

---

- **None**



- 
- <https://www.youtube.com/watch?v=VTzOS5dRh>  
m4



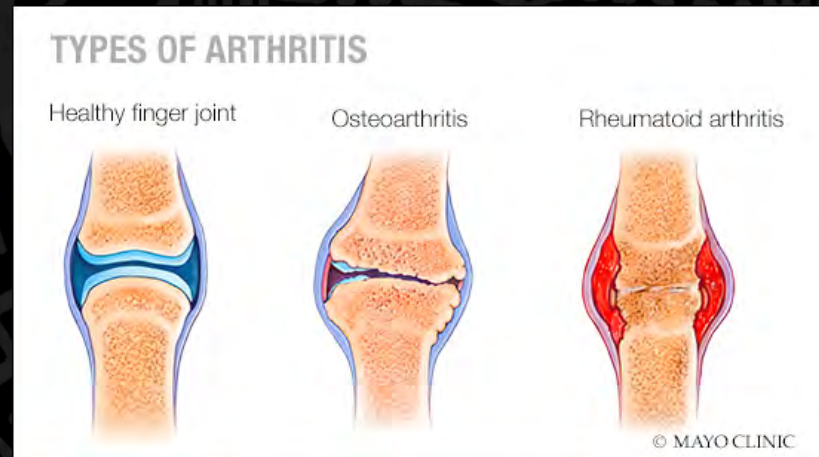
# Outline

- **Anatomy/Pathophys**
- **Etiology/Incidence**
  - **Pain Generation**
- **Non-operative Tx**
- **Surgical Treatment**
  - **Ankle Fusion**
  - **Ankle Replacement**
- **Choosing the right treatment**



# Arthritis

- **Loss of Cartilage**
- **→ inflammation**
- **→ Pain**
- **Pain usually with loading or movement of the joint**

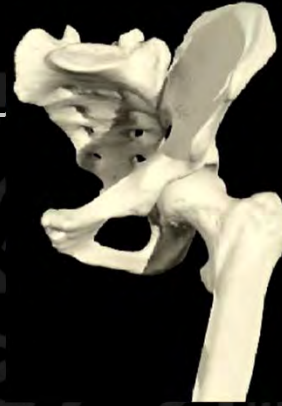


# Epidemiology

- Osteoarthritis is the most common Joint disease
- Osteoarthritis affects 50,000,000 Americans
- ~12% of osteoarthritis is the result of Prior Trauma



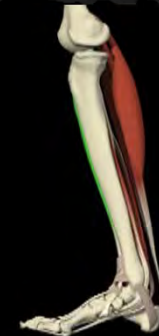
## Different Joints are different

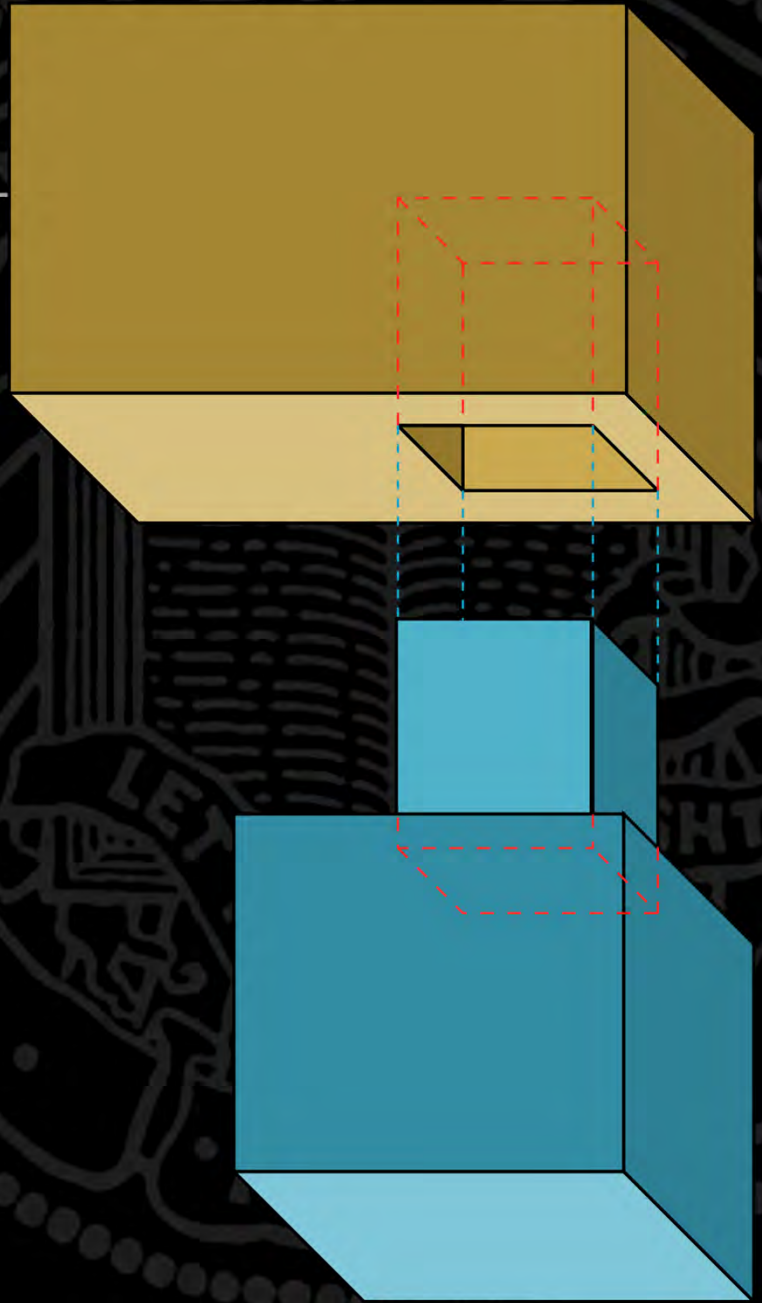


- 25% of acetabular fractures → PTA
- 6% of hip OA is trauma

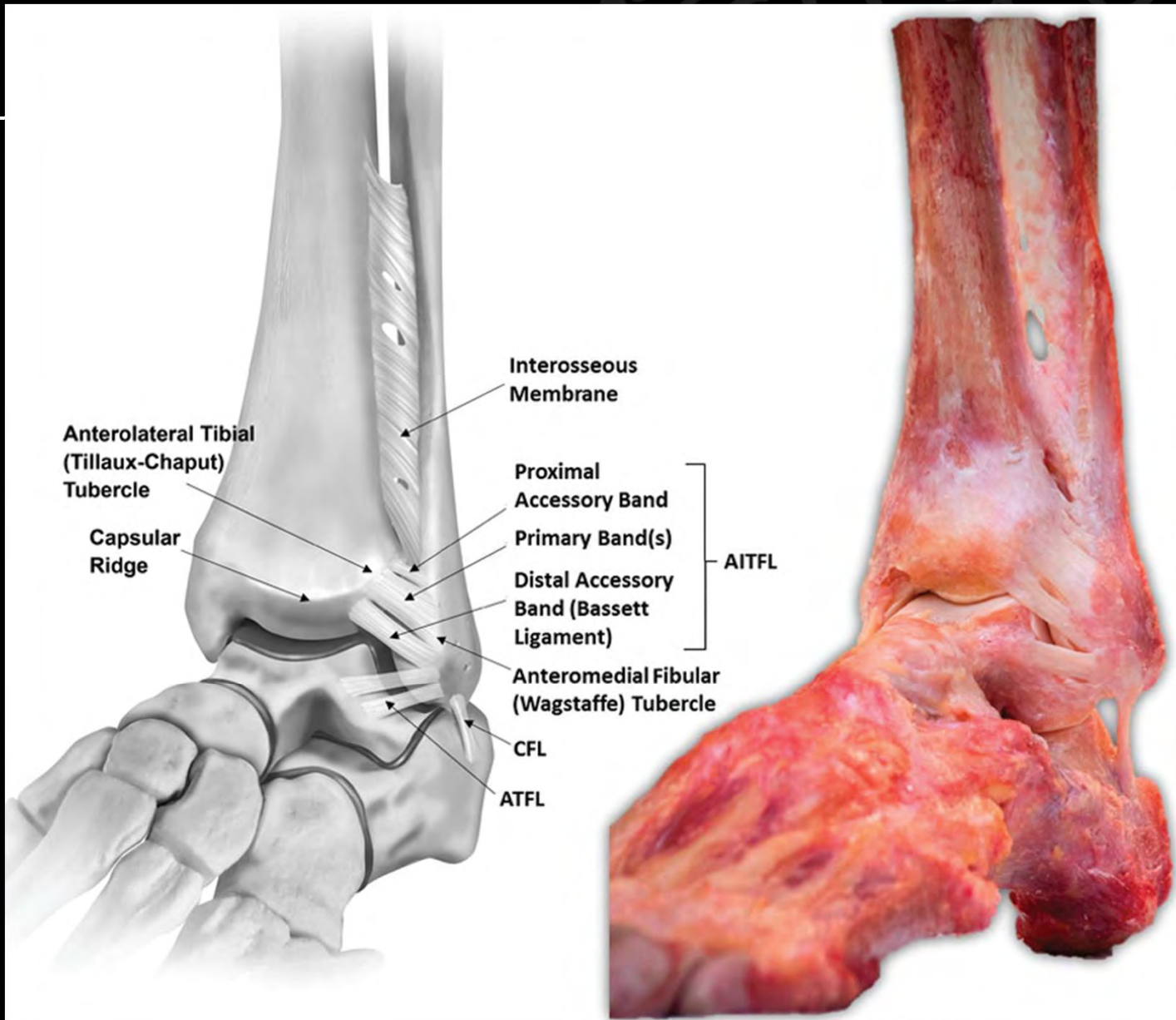
- 23-44% of tibial Plateau Fractures → PTA
- 25% of knee OA is related to Prior trauma

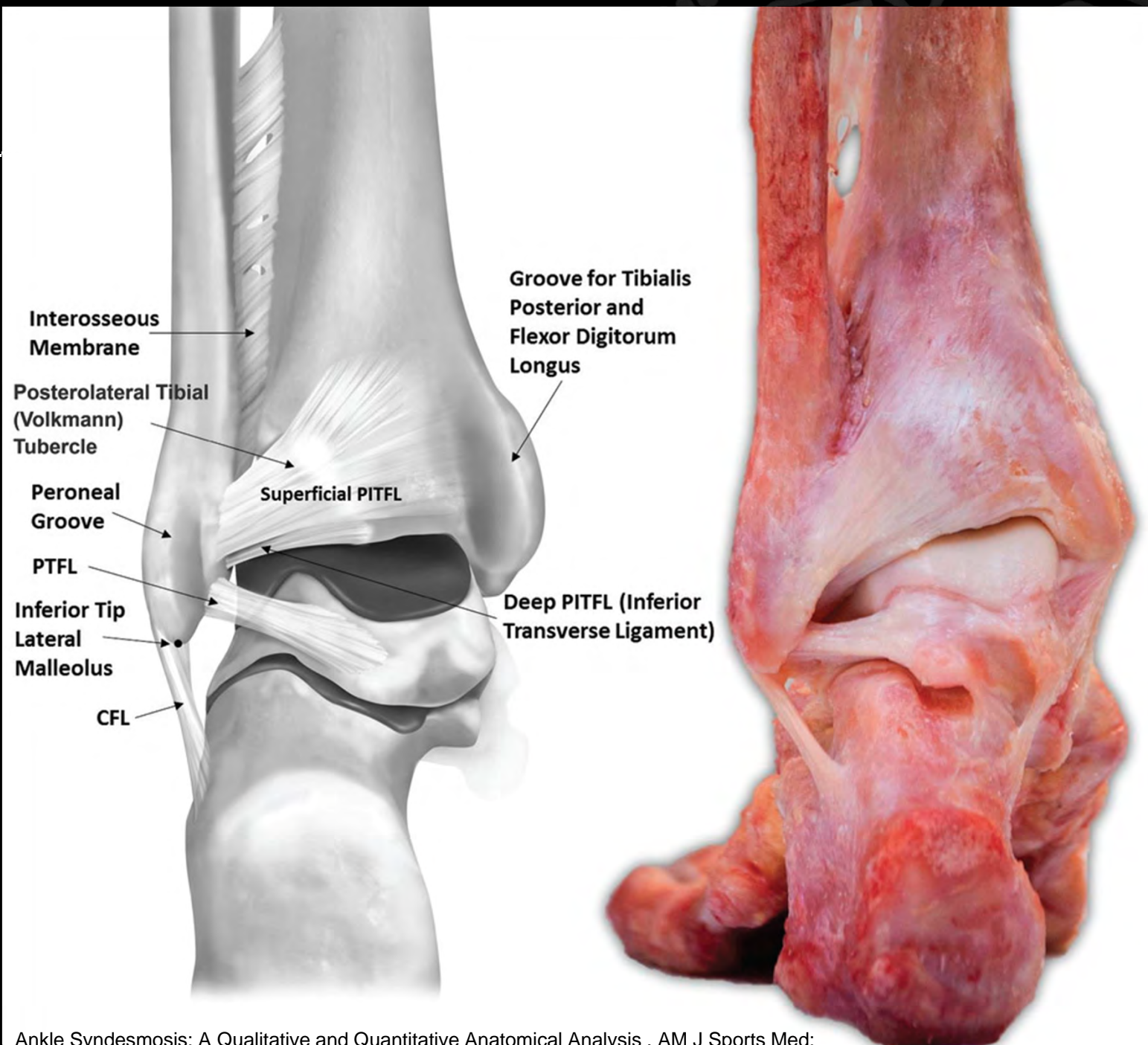
- >50% of tibial plafond fractures → PTA
- 79.5% of Ankle OA is related to prior trauma











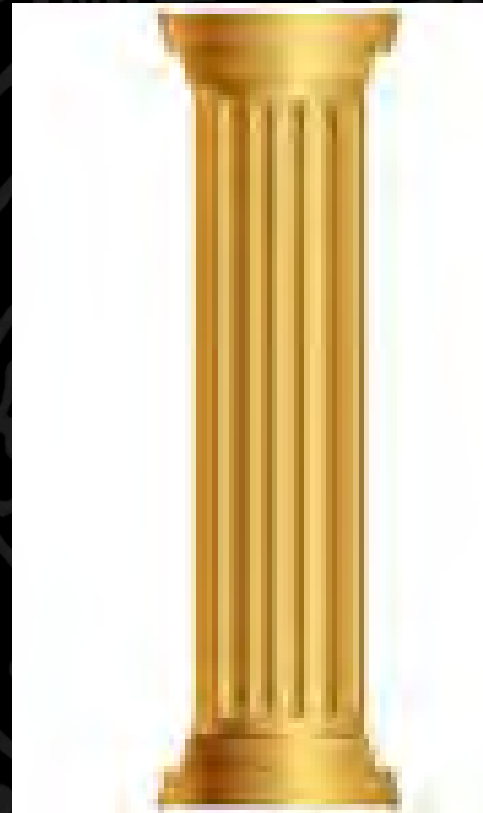
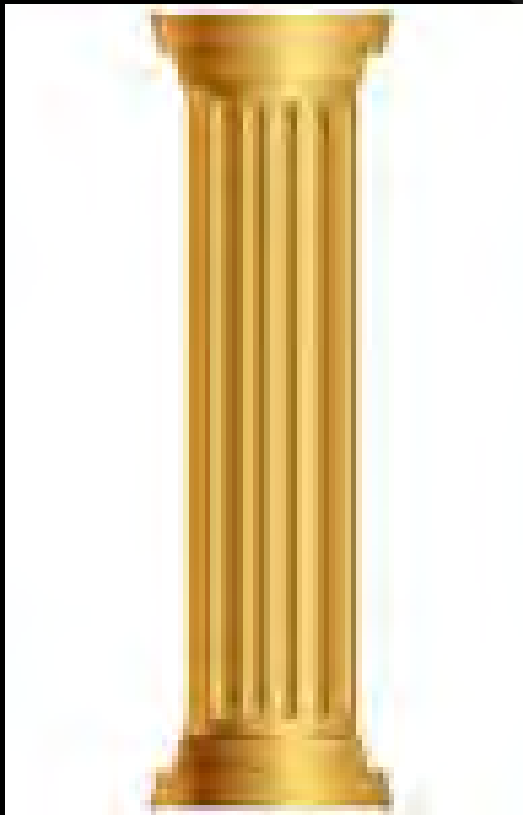
Ankle Syndesmosis: A Qualitative and Quantitative Anatomical Analysis . AM J Sports Med:

---

## Changes in tibiotalar area of contact caused by lateral talar shift

PL Ramsey and W Hamilton  
*J Bone Joint Surg Am.* 1976;58:356-357.

---



Thordarson DB, Motamed S, Hedman T, *et al.* The effect of fibular malreduction on contact pressures in an ankle fracture malunion model. *J Bone Joint Surg Am* 1997;79(December):1809-15.

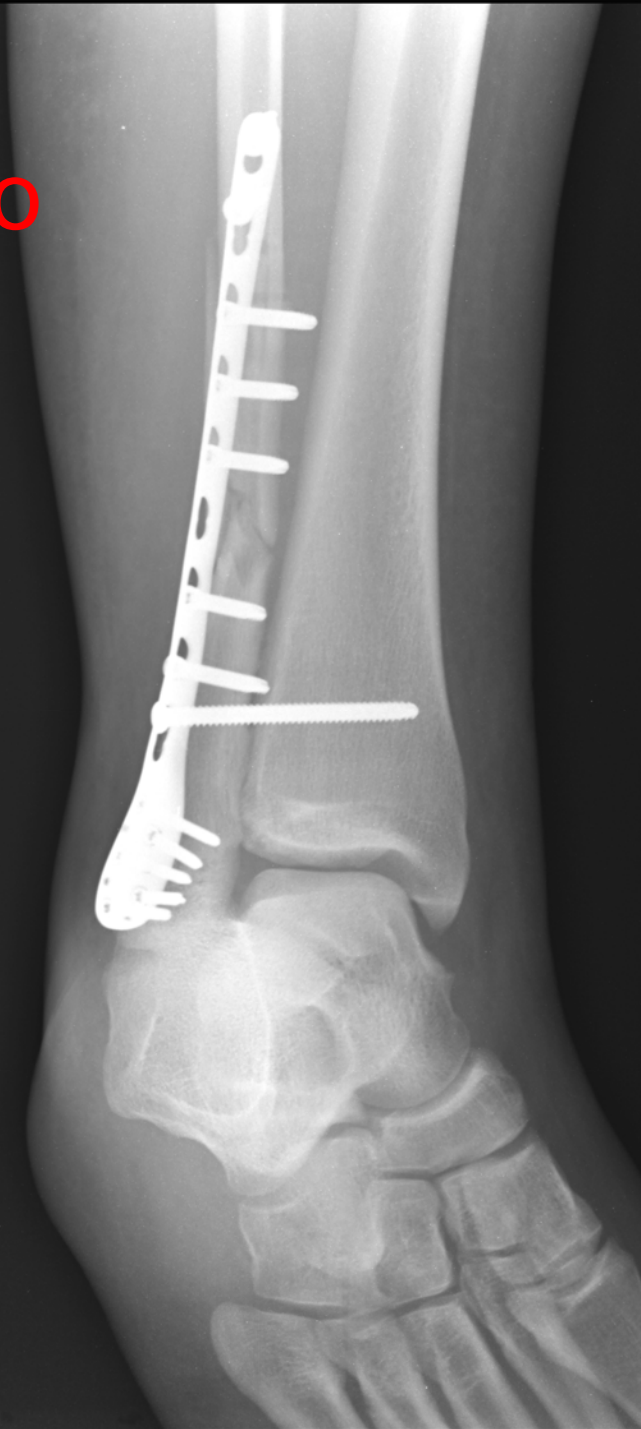
## Unstable Fractures

- If the mortise is unstable, surgery is needed to maintain congruity of joint
- Ligaments often torn, bones restored to allow ligaments to heal
- Unstable fractures often lead to arthritis



19 yo

(R)



24 yo



# Ankle Arthritis - Etiologies

- **Post-Traumatic  
(MOST COMMON  
BY FAR)**
- **Ankle instability**
- **Rheumatoid**
- **Deformity**



# Ankle Arthritis - Symptoms

- **PAIN**
- **Stiffness**
- **Swelling**
- **Deformity**



# Treatment - Symptoms

---

- NSAIDS
- Braces
- Corticosteroid Injection
  - PRP, Stem Cells – Very Expensive, no evidence they work
- Surgery





# Stem Cell Injections for Ankle Arthritis

## Promise

- Stem Cells are cells with the potential to differentiate into other cell types
- Theoretically possible to drive them to repair/replace damaged tissue

## Reality

- Very Hard to get Stem Cells to act as we want ( I know, I've Tried)
- Many small studies showing positive results, but no large good studies reproducing these results

*Expensive and Unproven – Not yet ready for primetime*

# Many Surgical Options

- **\*Debridement**
  - Reserved for Mild Arthritis, bone spurs, small lesions not widespread disease
- **\*Supramalleolar Osteotomy**
  - Deformity with minimal or no arthritis
- **Arthrodesis (Fusion)**
- **Arthroplasty (Replacement)**



*Surgery Should be Based on Individual Patient*

# Example 1 – Supramalleolar Osteotomy



# Example 1 – Supramalleolar Osteotomy



---

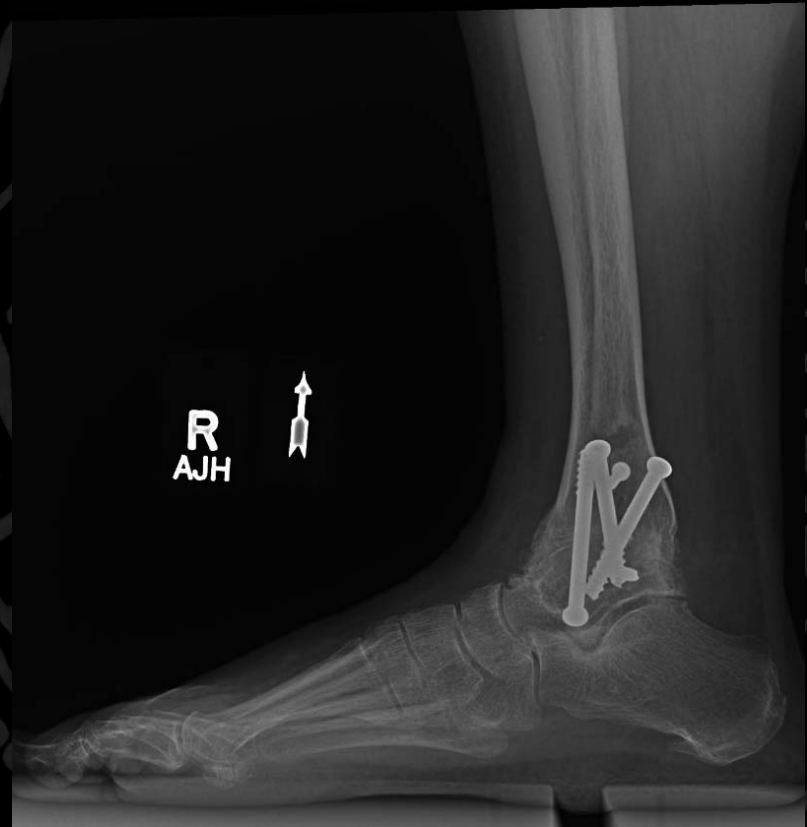
# Ankle Fusion vs Ankle Replacement

The background of the slide features a large, faint watermark of the University of Colorado seal. The seal is circular and contains the text "THE UNIVERSITY OF COLORADO" around the perimeter. In the center, there is a shield with a book and a banner that reads "LET THERE BE LIGHT". Below the shield, the year "1868" is inscribed.

# Ankle Fusion

---

- **Removing the Ankle Joint and Turning the Tibia and Talus into one solid bone**



# Ankle Fusion – Surgical Technique

---

- **Ankle Joint is opened and cartilage is removed**
- **Screws, or Plate and Screws are then placed to hold the bones together until the bond fuses**
  - **Once fused hardware not needed**
- **Bone graft may be placed in between if needed**

# Ankle Fusion – Post Op

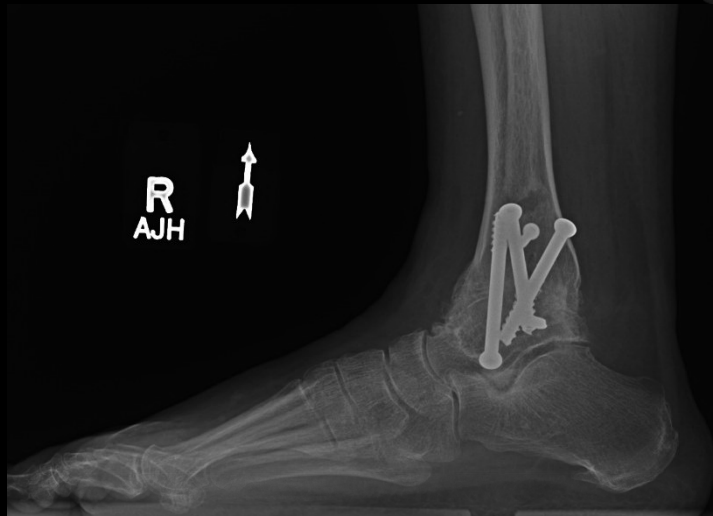
---

- **Outpatient or Overnight Stay**
- **Splint/Cast – 6-12 weeks**
- **No weight bearing 6-12 weeks**
- **Full fusion 3-6 months**

*Once Fusion Achieved then all activities, including running, jumping are possible (though impact activities unlikely)*



# Results



- **~75-85% with Good Pain Relief**
  - **~50% of people still with some pain**
- **75% loss of sagittal motion**
- **70% loss of inversion/eversion**

# Potential Complications

---

- **Non-Union ~15%**
- **Adjacent Joint Arthritis ~25-50%**
  - **5-15 years**
- **Decreased Gait Velocity**
- **Difficulty with Stairs/ uneven surfaces**

# Example 1

---

- **62 year old man with 10 years of ankle pain**
- **Migrant worker in central valley. Has been out of work for last 3 years**
- **Distant memory of ankle fracture when he was a teenager**
- **Has tried bracings, ibuprofen, nothing helping ankle pain**

# Example 1





## Example 2

69 yo man – previous trauma. Had 2 surgeries to fix, but has had continued pain within his ankle.

The syndesmosis screws were buried into the fibula and needed an osteotomy. Once the hardware was removed, there was a very large defect along the tibial plafond.

This required a osteotomy using the saw in order to shorten the tibia and allow compression onto the talus



# Intra-op

---



OEC

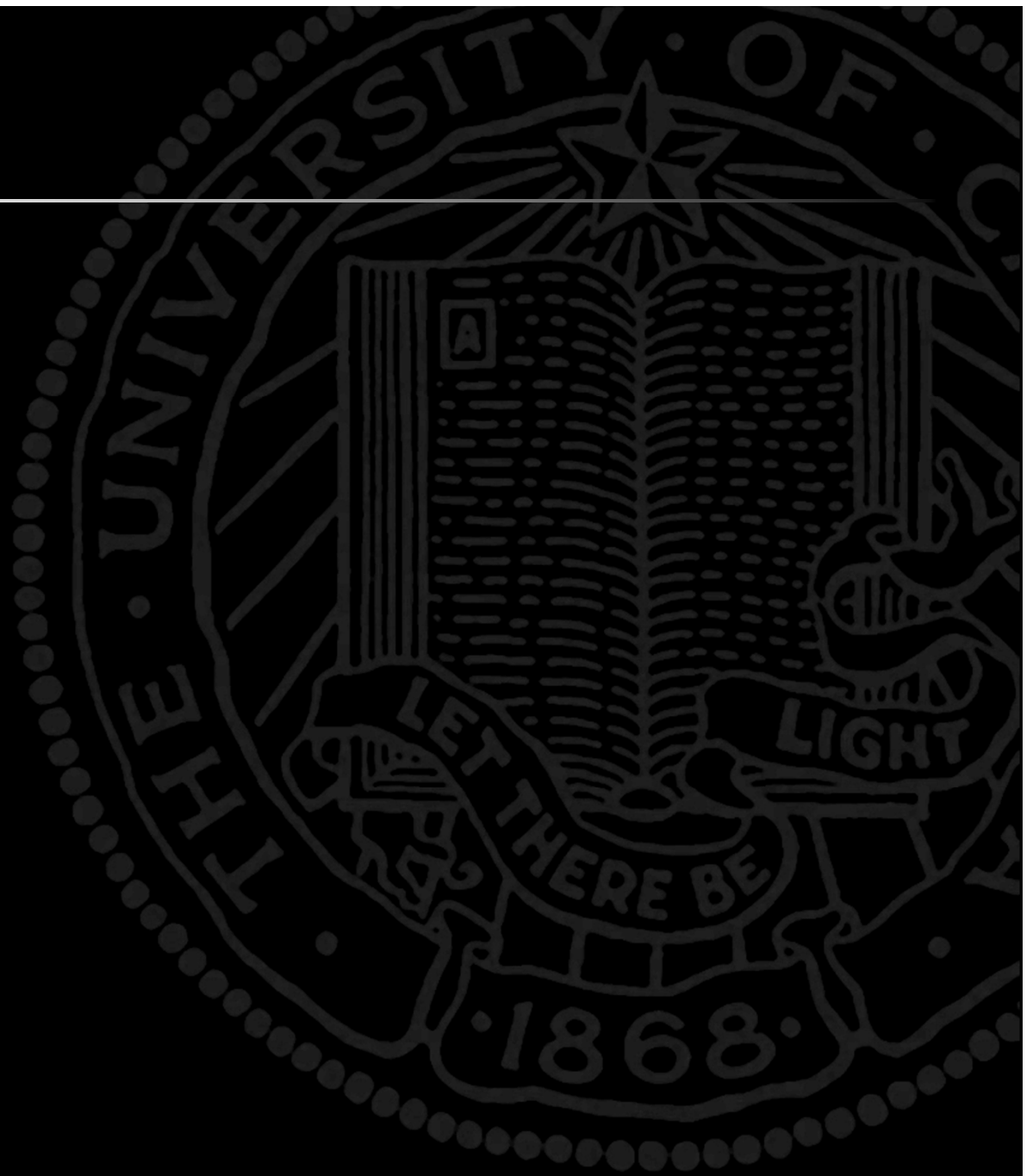


C

6 weeks







# Ankle Replacement

- **Placing an Artificial Joint (Metal and Plastic) to replace the native joint of bone and cartilage**



# Surgery and Recovery

---

- **Outpatient or Overnight in Hospital**
- **Splint for 2 weeks**
- **Non weight bearing for 2-6 weeks**
- **Weight bearing in walking boot**
- **Full recovery 3-6 months**
- **Range of Motion maintained but not improved**

*Once healed to the bone then full non-impact activities are possible  
(running, jumping activities are not advised)*

# Ankle Replacement - Complications

---

- **Loosening of the components (10-15% by 10 years)**
- **Breaking of the Plastic - 3% by 10 years (STAR)**
- **Infection 1-2%**
- **10-20% of people still with some pain**

# History

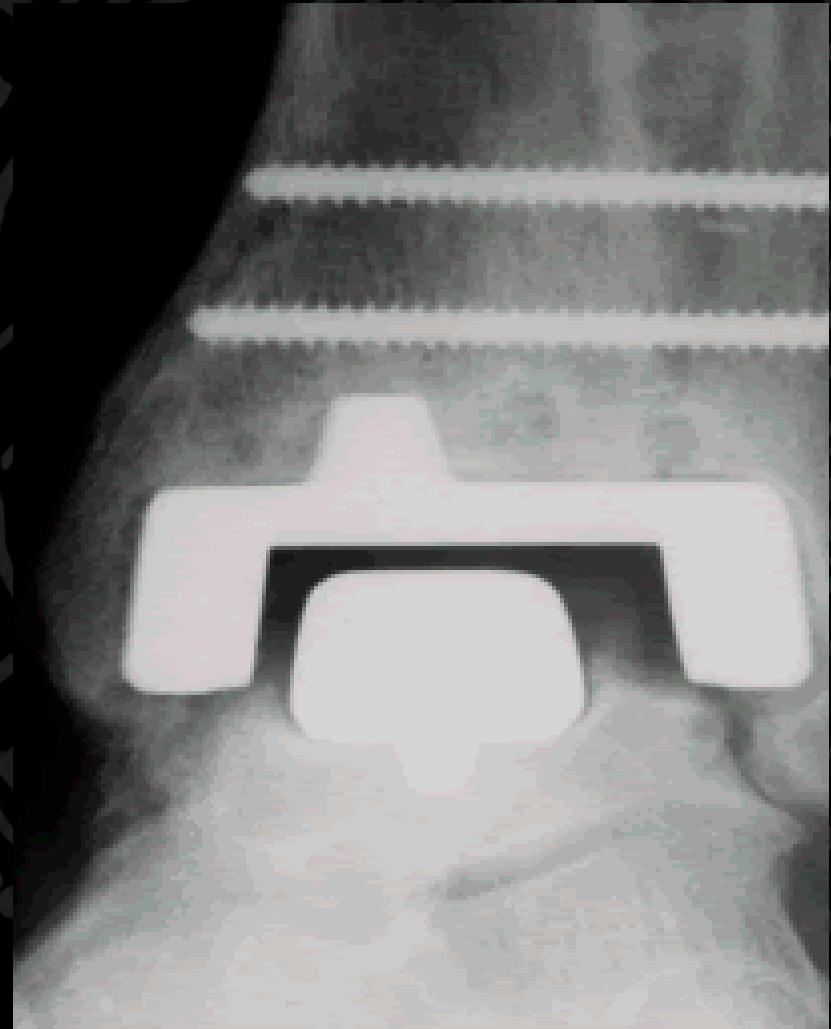
---

- **First Prosthesis was an inverted hip prosthesis**
- **Newton 1982 – results of total ankle in RA so poor that procedure contraindicated**
- **Bolton-Maggs 1985 – arthrodesis treatment of choice for arthritis regardless of underlying condition**
- **Kitaoka et al 1996 – reviewed 160 ankle replacements with 36% early failure rate requiring removal of implant**

# Early History – POOR RESULTS!!!

---

- **Poor Prosthesis design**
- **Poor Technique**
- **Poor Patient Selection**

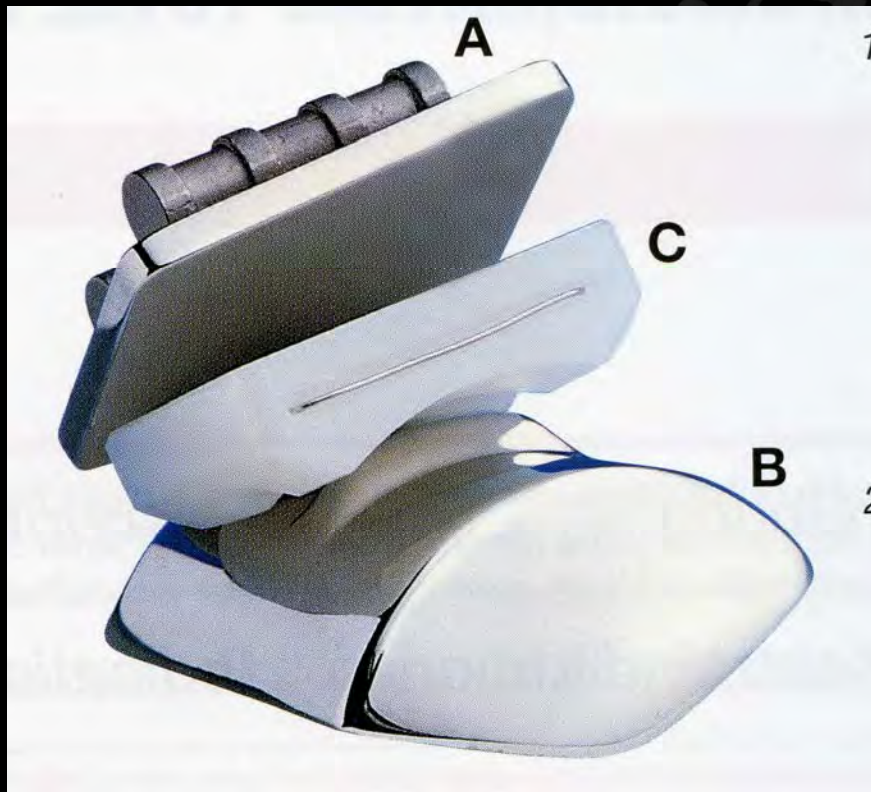


---

# Modern Total Ankle Designs

**Learning from the Mistakes of the Past**

## Three components



- **Metallic base plate fixed to the tibia**
- **Domed shaped metallic component for talus**
- **Bearing surface of ultra-high molecular weight polyethylene**

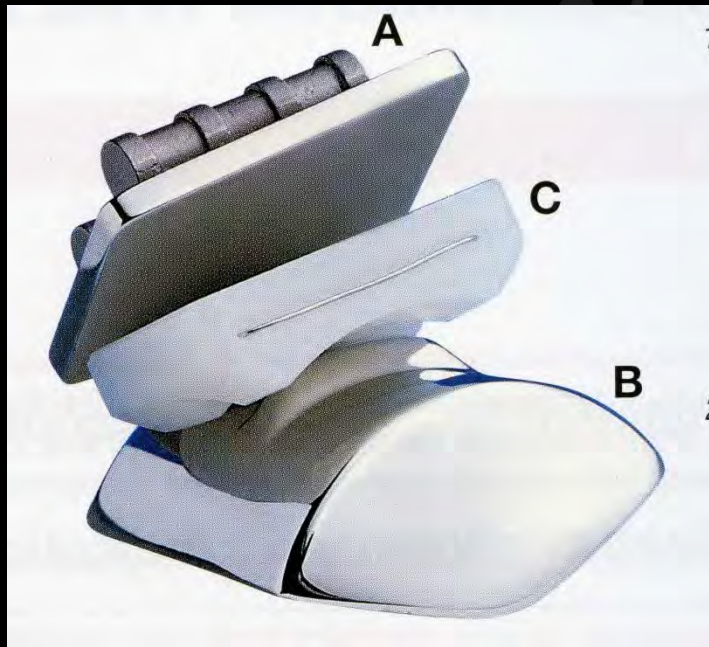


## Fixed bearing systems



- Referred to as “two-piece designs”
- Lock the polyethylene into the tibial base plate

# Mobile or meniscal bearing systems



- “three piece” designs
- No attachment of the polyethylene to either of the two components

---

# Ankle arthroplasty in the USA

- **Agility total ankle system (DePuy)**
- **Salto Talaris Anatomic Ankle (Tornier)**
- **INBONE total ankle system (Wright Medical Technologies)**
- **Infinity total ankle (Wright Medical)**
- **STAR ankle system (Stryker)**
- **Zimmer Trabecular Metal Ankle**

# STAR system

---



- **5 tibial sizes**
- **5 talar sizes**
- **Mobile bearing**
- **Up to 14 mm poly thickness available**
- **titanium plasma spray coating**
- **Extra-medullary guidance**

# STAR system

---

- **The STAR™ Ankle was used worldwide for more ankle replacements than any other device. It has a long clinical history - the current design has been in use for over 20 years.**
- **The STAR has been shown in clinical papers to have a 90% likelihood to remain implanted for 10 years**



## Two vs. three piece designs

- Some suggest that preservation of motion between the bearing surface and the other two components decreases the rate of polyethylene wear
- Others believe that the wear rate increases due to the additional metal polyethylene interface

# Two vs. three piece designs

- Clinical results do not end the controversy as to which design is optimal
- 5 year rates of survival are similar to both implants
  - ◆ 70 to 98% for 3 piece designs
  - ◆ 80 to 97% for 2 piece designs

---

## Results: STAR in U.S.

- 84 STARs in 80 patients followed prospectively
- Two surgeons
- Average follow-up 9.1 years

Mann, JA et al  
Foot & Ankle Int  
2011



## Results: STAR in U.S.

- **91% of prostheses remain implanted at 9.1 years**
- **Probability of survival was 96% at five years, 90% at ten years**
- **Average 39 point improvement in outcome scores**
- **92% of patients satisfied**

Mann JA, et al  
Foot & Ankle Int  
2011

---

## Results: STAR in the U.S.

- 82 patients evaluated
- Mean f/u 61 months
- to document the patient self-reported improvements in quality of life, function, and overall impairment scores

**Nunley, JA et al:  
J Bone Joint Surg, 2012**



# Results

---

- There were significant improvements in all outcome categories between the preoperative and postoperative evaluations
- five patients (6.1%) required the tibial and/or talar component to be removed.
- There were six polyethylene liner exchanges: three were performed because of fracture, and three were concomitant with osteophyte removal

**Nunley, JA et al:  
J Bone Joint Surg, 2012**

# Example 1

---

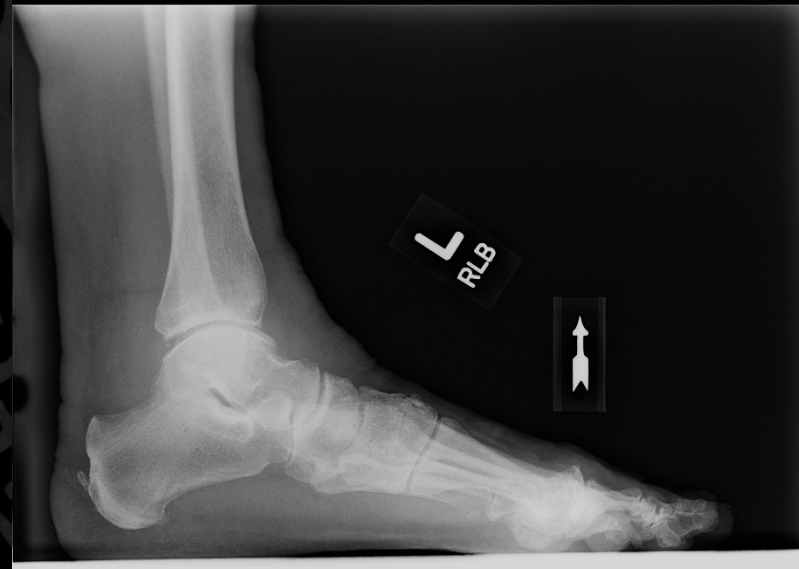
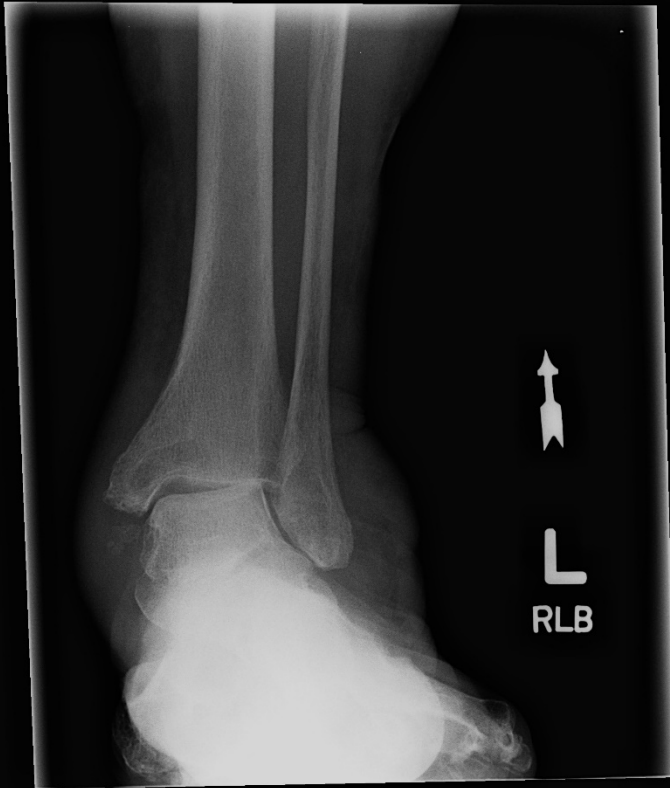
## HPI

- 87 yo woman with several years of left ankle pain
- Has tried lace up bracing with little help
- Really wants to continue to wear heels

## PhysEx

- Stands with slight valgus
- Valgus is passively correctable under fluoro

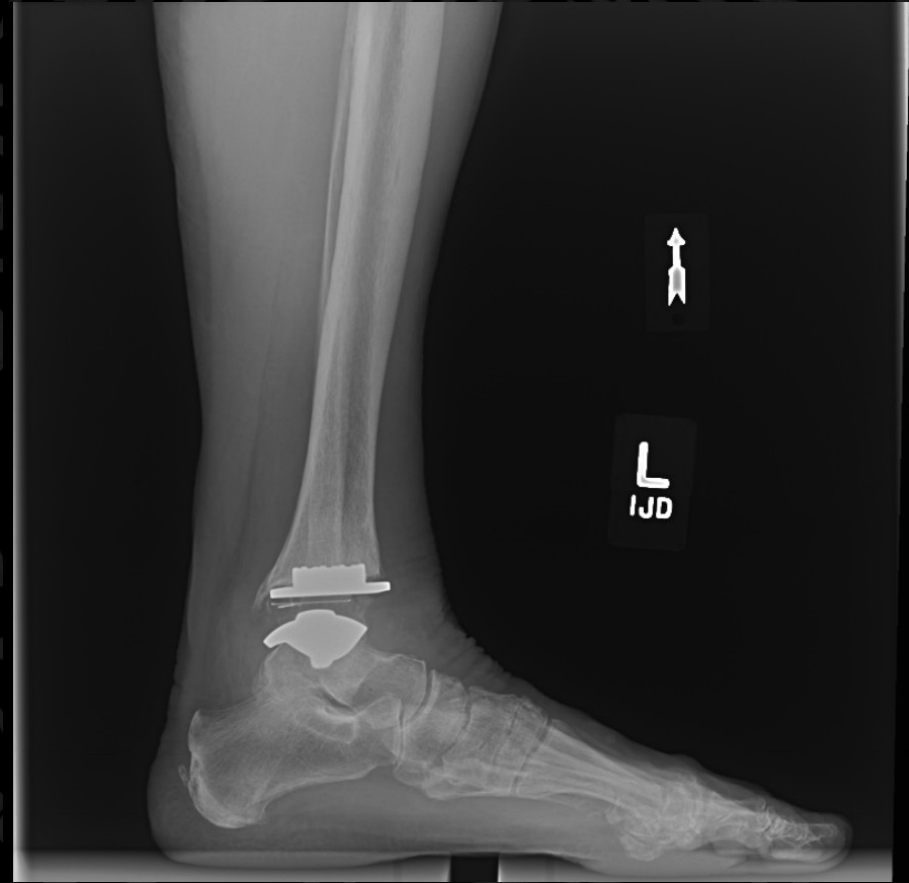
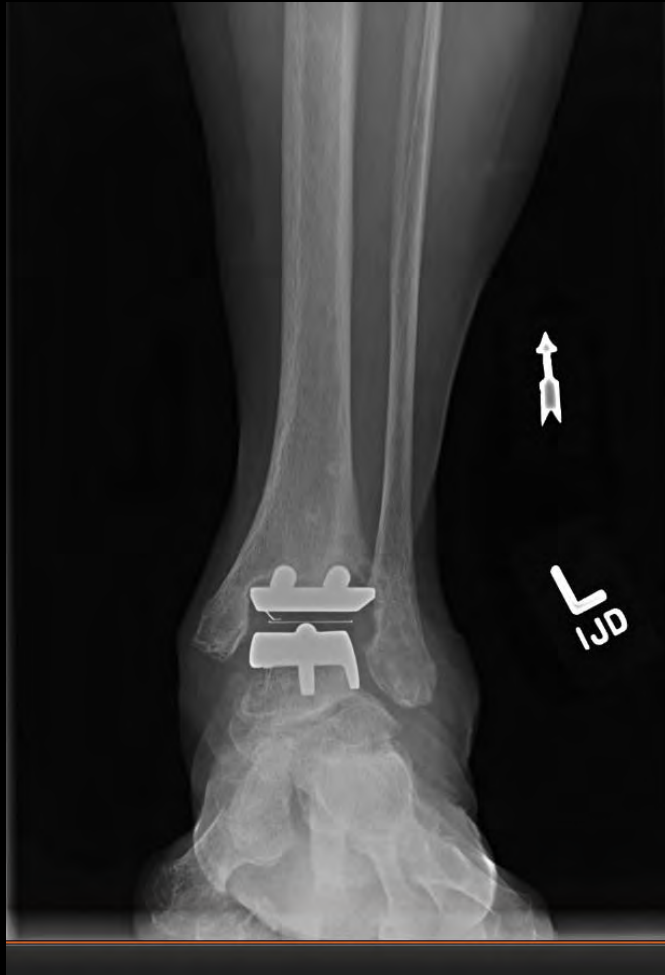
# Preop



6 weeks post op



1 year



## Example 2

---

- **70 yo man, >4 years of left ankle pain**
- **Multiple previous ankle sprains**
- **Lateral Ligament Reconstruction performed by outside podiatrist 1 year previous**
- **Almost immediate resumption of pain**







OEC

56 kVp  
0.34 mA  
6

# 6 months



Says his ankle “feels the best it has in 10 years”.

# Making a Choice

---

## **Fusion**

- Younger
- Higher Impact job or activities
- Large Deformity
- Extensive Bone Loss
- Infection

## **Replacement**

- Older
- Lower impact activities
- Minimal Deformity
- Good Bone Stock
- Arthritis of Surrounding joints

*All Things being equal?*

---

**Which One is Better?**

**Jury still Out**

**Jury still Out**

REVIEW

Open Access



# Total ankle arthroplasty versus ankle arthrodesis—a comparison of outcomes over the last decade

Cort D. Lawton<sup>1</sup>, Bennet A. Butler<sup>1</sup>, Robert G. Dekker II<sup>1</sup>, Adam Prescott<sup>1</sup> and Anish R. Kadakia<sup>1,2,3,4\*</sup>

- **Complication rates were similar, with overall complications slightly higher in Fusion**
- **Reoperation slightly higher in replacement**
- **Slightly better gait mechanics with replacement**
- ***Recommend individualized care for patient***

# Summary

---

- *Good outcomes are possible with both Fusion and Replacement*
- *Choice should be individualized to the individual patient's anatomy and goals*
- *All things being equal – Replacements seem to do a little bit better (more active, walking faster, a little less pain) – though this has not yet been definitively proven*

Thank You

