Fragility Fractures

Dave Goodspeed
University of Wisconsin

Acknowledgements

- Slides/cases from Gerald Lang, MD
  - –University of Wisconsin
- OTA fracture lecture series (Ken Egol, Ken Koval, Laura Tosi)

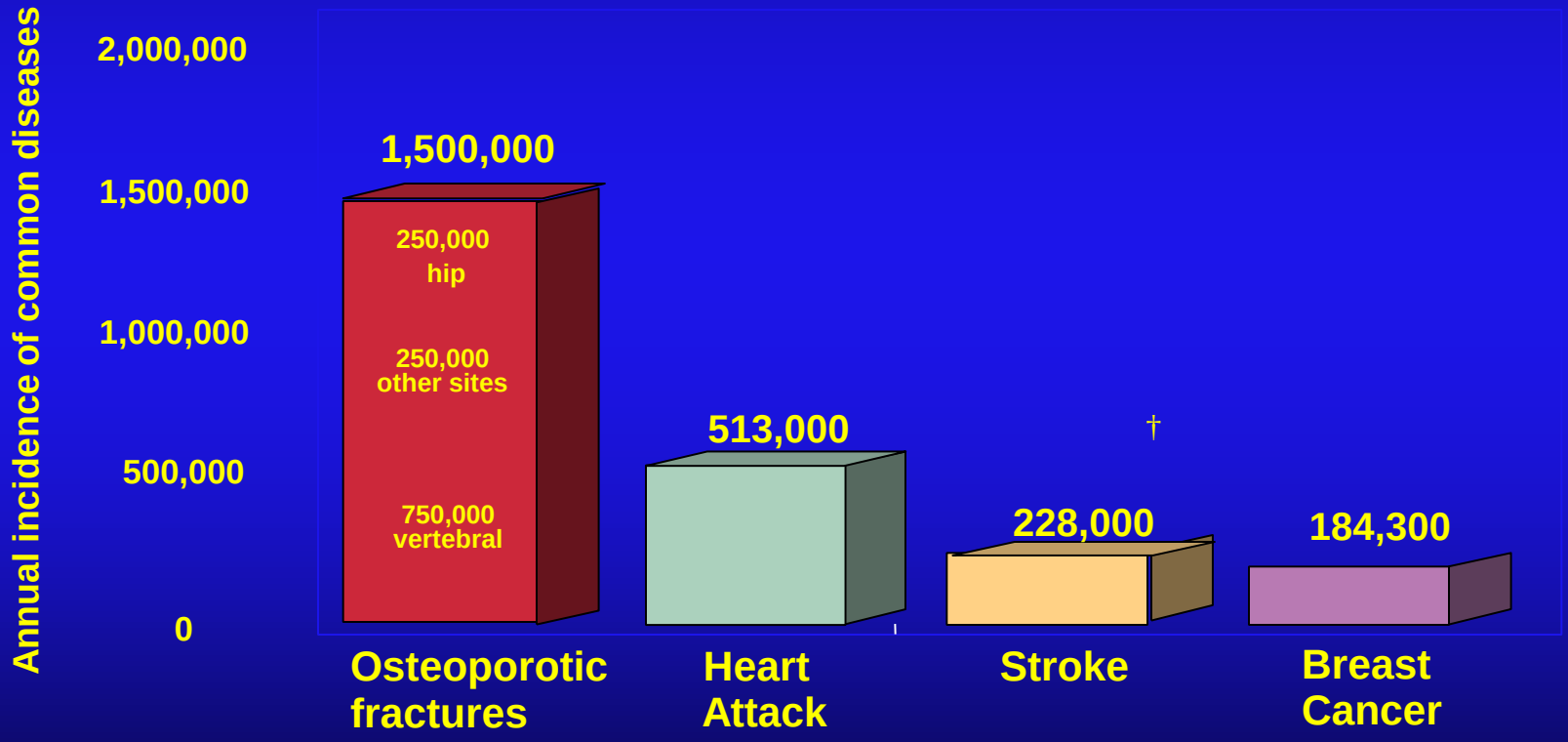




Background

- Big problem
- Increasing problem
- Costly problem

Osteoporosis vs Other Disease in U.S.



Source: National Osteoporosis Foundation

Importance

- Fragility fractures are a challenge to the orthopedic surgeon
- Elderly patient

↓

Institutionalized care

General Concepts of Fixation

- Fracture stability
  - –Fracture impaction (load sharing)
  - –Not on husky implant (load bearing)
- Rigid implants – more likely to fail
- Strong implants not a substitute
  - –Stable reduction
  - –Gentle soft tissue handling

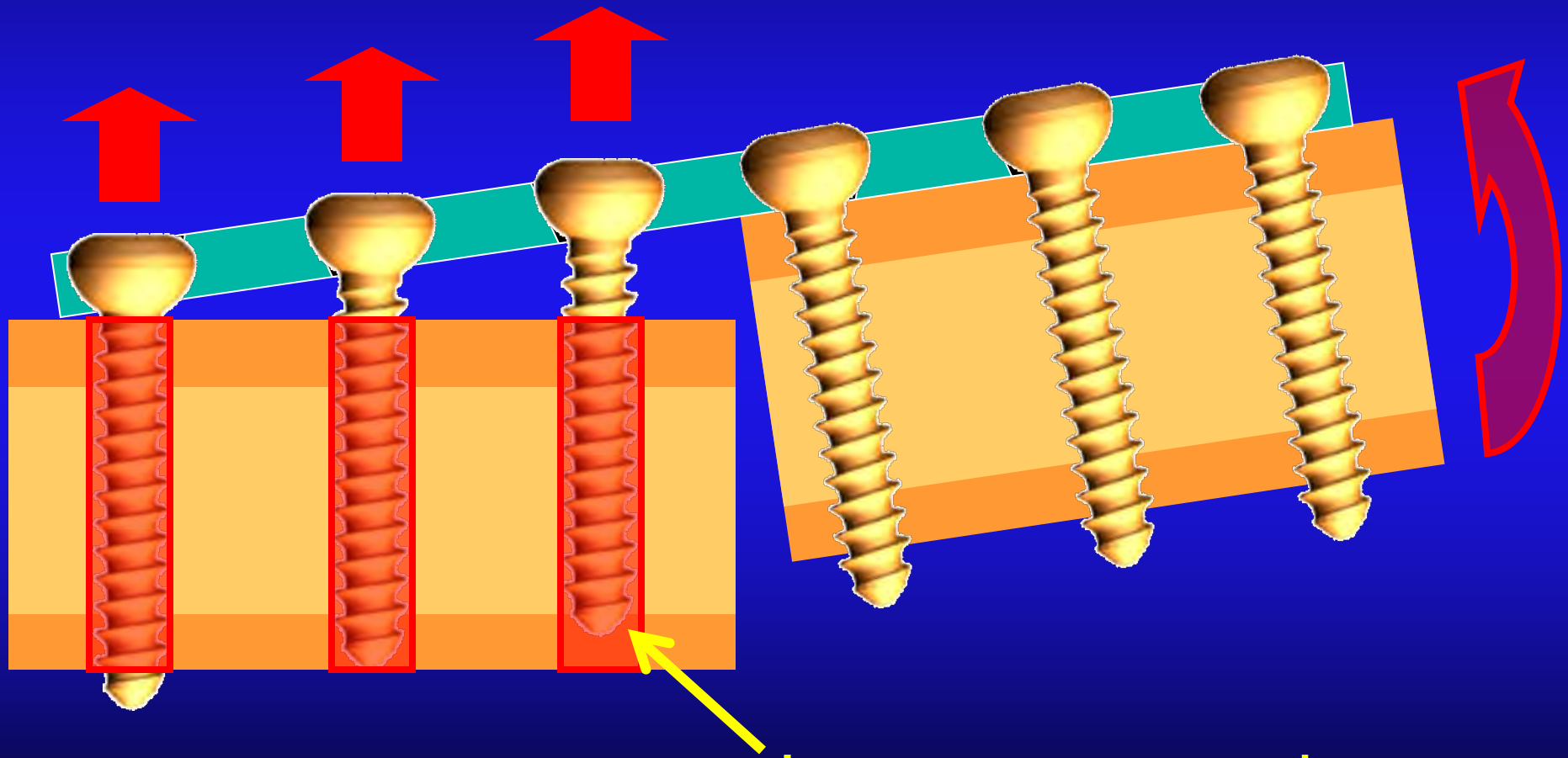
Implant Choices

- Standard plates
- Fixed angle devices
- IM fixation
- Locked plates

1. Standard Plates

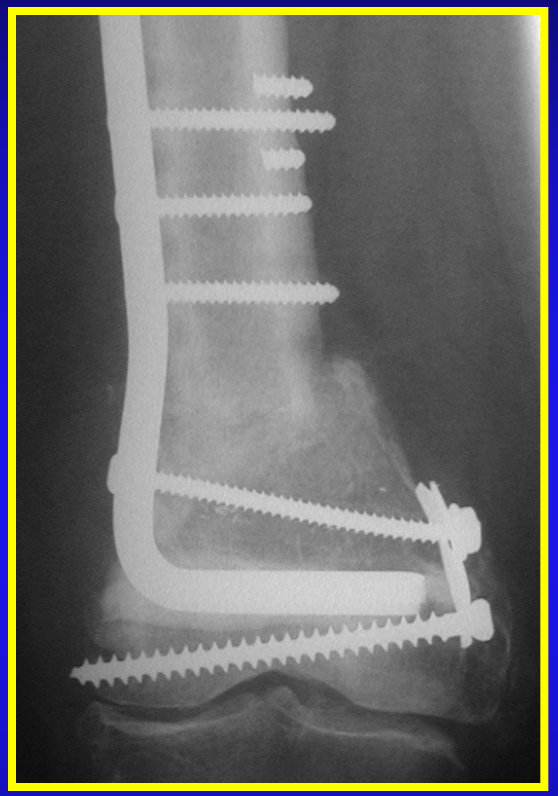
- Function
  - –Buttress, compress, neutralize, bridge
- Poor coupling of screws to bone in osteoporosis
  - –Cannot generate friction between bone/ plate
- Screw augmentation
  - –Enhance coupling of implant and bone
- Buttress mode can be stronger
  - –Anti-glide of distal fibula

Pullout of Regular Screws

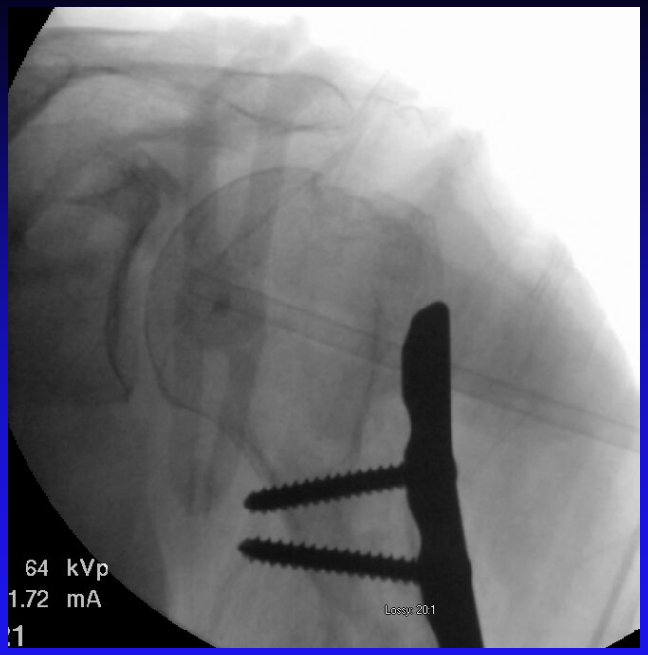


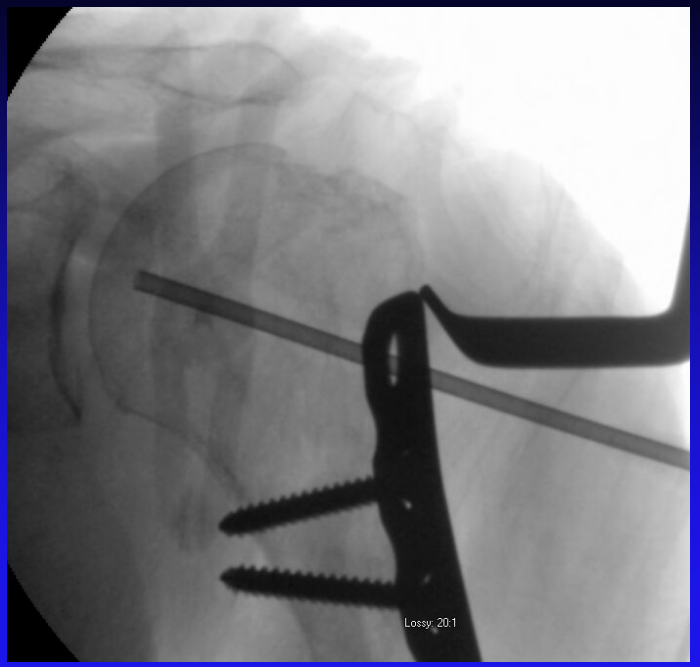
Screw Augmentation

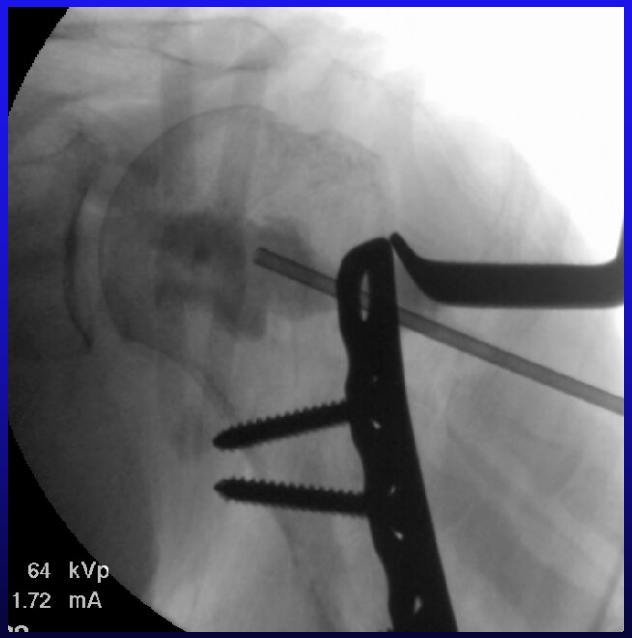
- PMMA
  - –Inexpensive
  - –Does not resorb
  - –Binds well to bone and screw
- $CaPO_4$, $CaSO_4$
  - –Relatively new, ?resorb?, $$
  - –Does not bind well to screws
  - –Some improvement in osteopenic bone

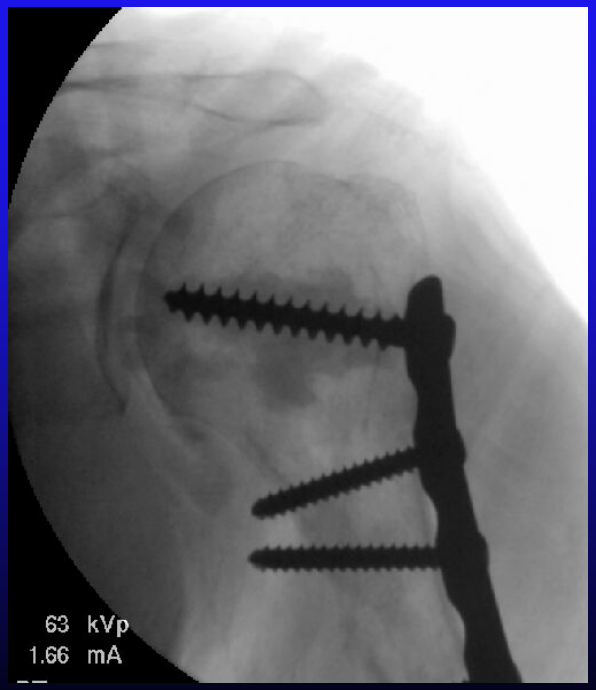


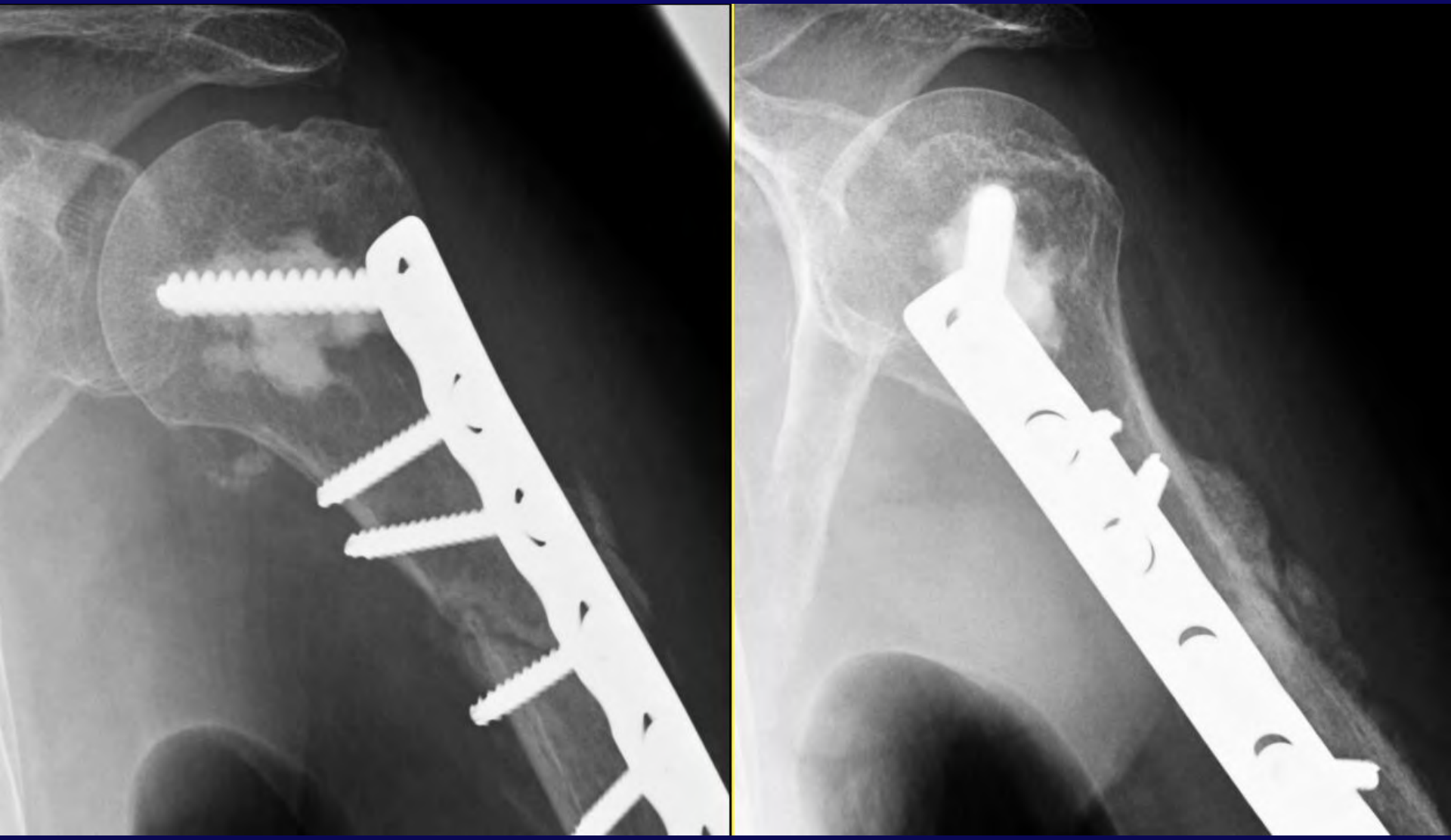
Linder et al, JBJS Br 91 (2009) 294-303


64 kVp
1.72 mA
Lossy: 20:1

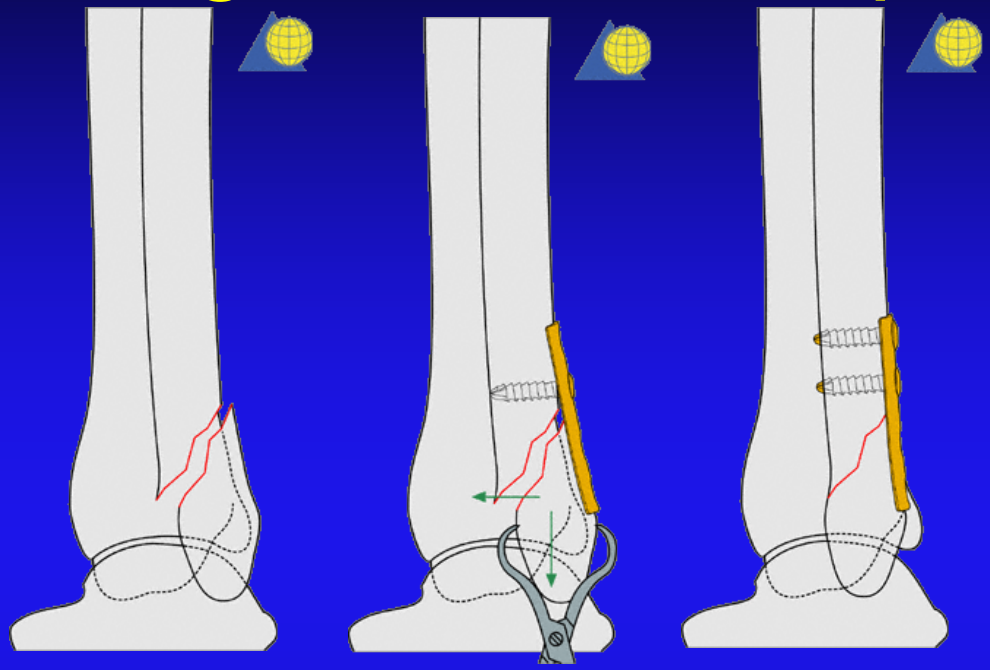

Lossy: 20:1


64 kVp
1.72 mA


63 kVp
1.66 mA



Antiglide/Buttress plating



Ostrum, JOT, 10 (1996) 199-203

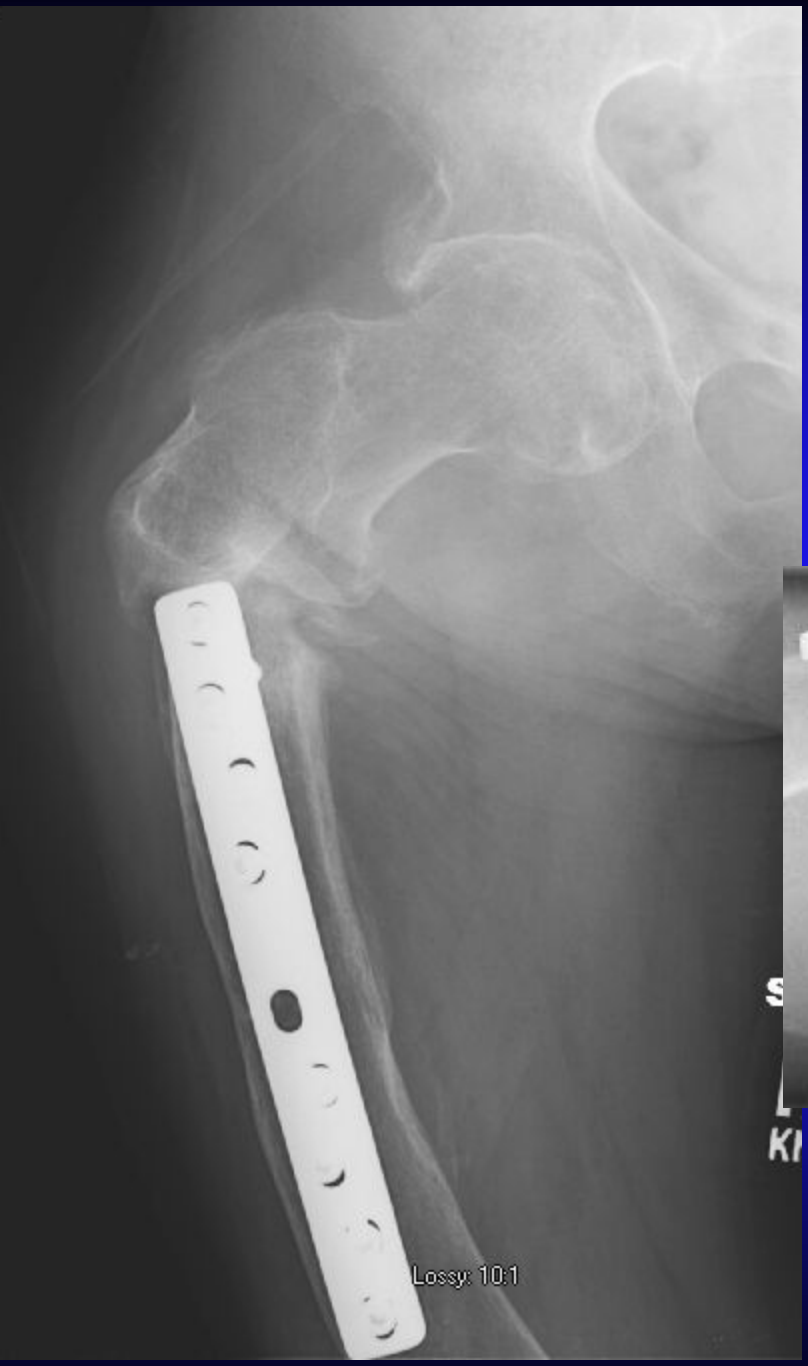
Prospective series with no failures

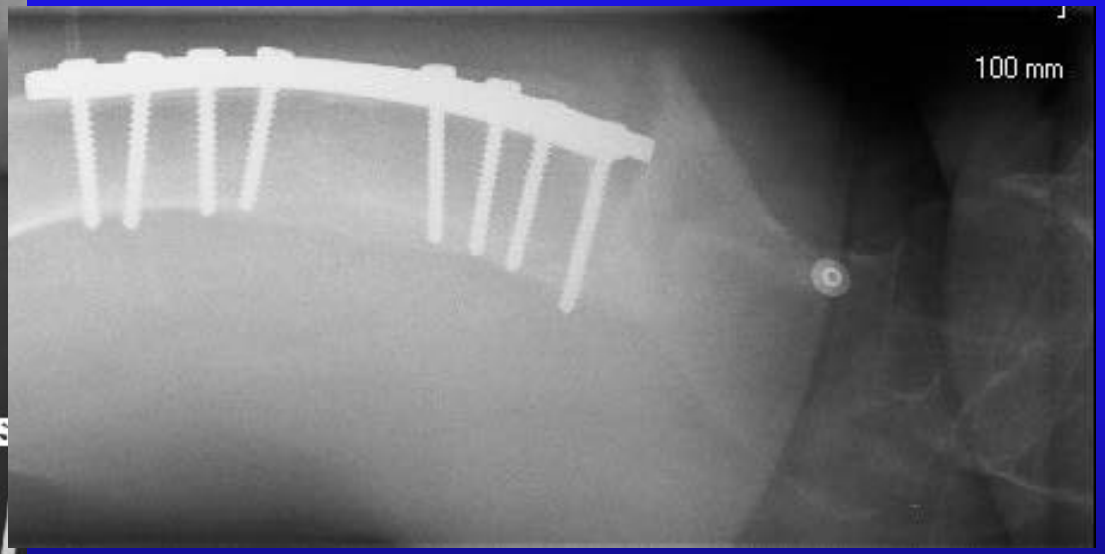
Minihane et al, JOT, 20 (2006), 562-566

Stronger than lateral locked plating in osteoporotic bone

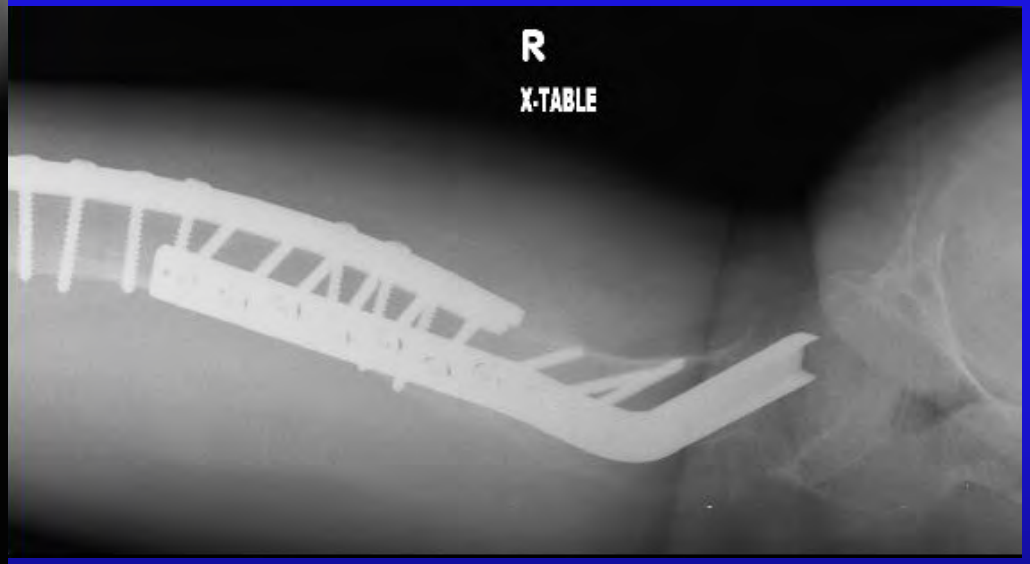
2. Fixed Angle Plates

- Blade plate
  - –Metaphyseal location
- Sliding hip screw
  - –Allows for fracture impaction
  - –Load sharing


Lossy: 10:1

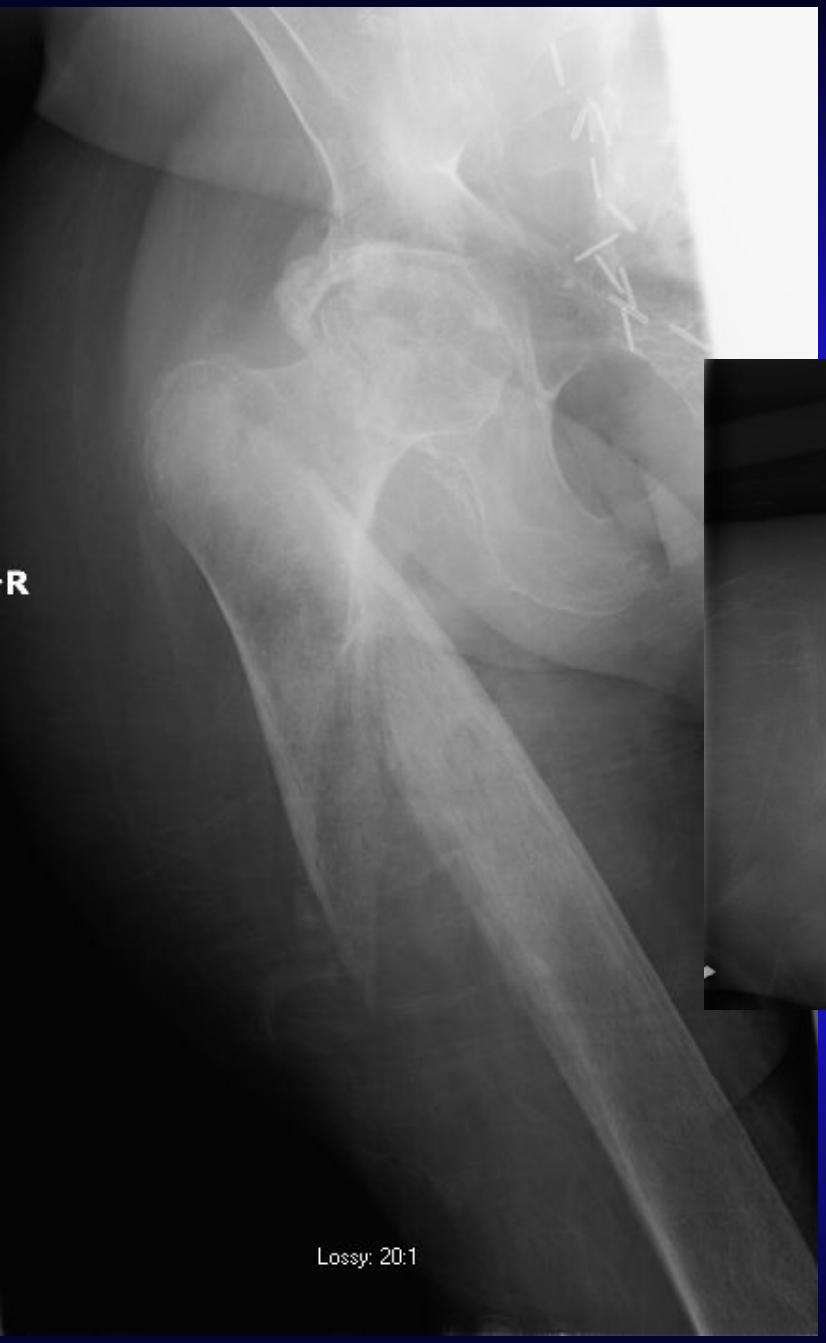

100 mm

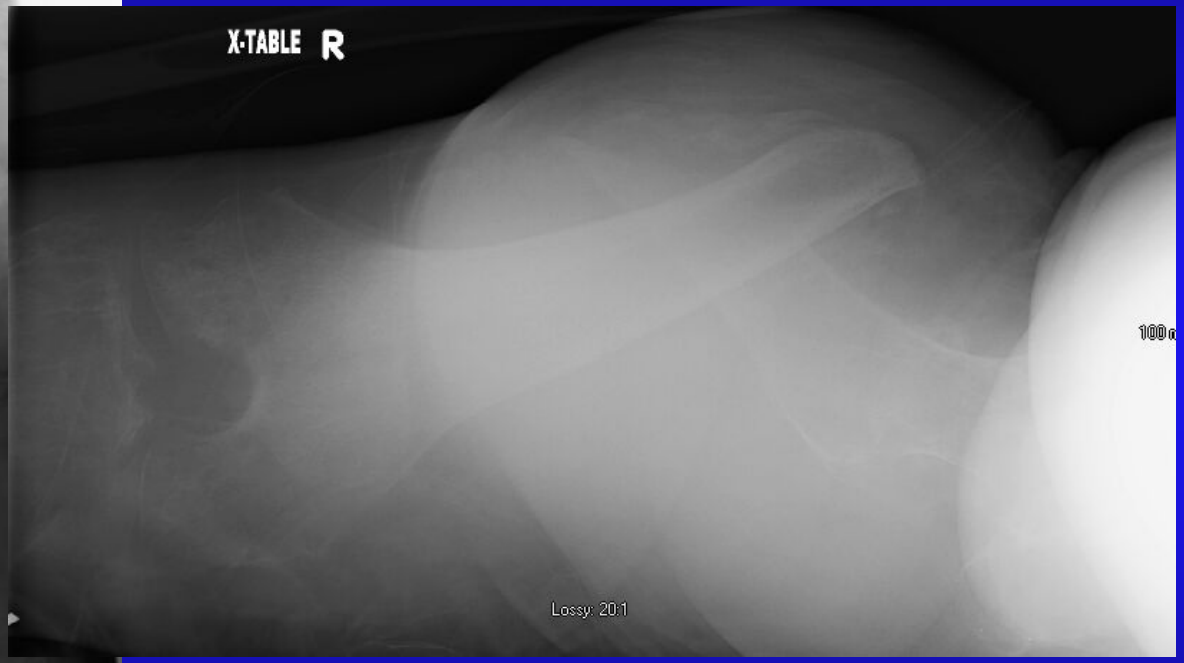
1 year f/u



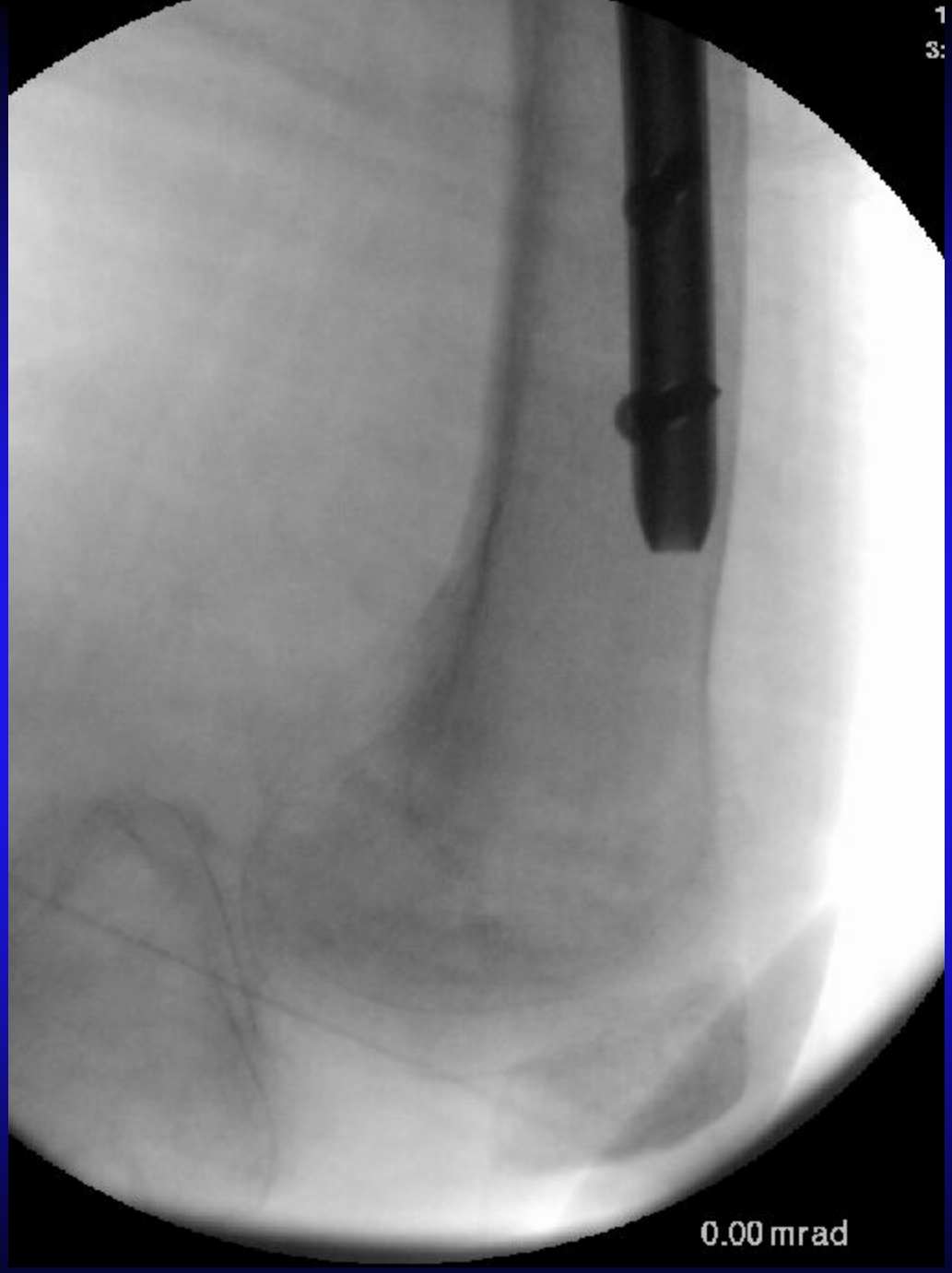
3. IM Devices

- Excellent for diaphyseal and selected metaphyseal fractures
- Closer to central mechanical axis
- Less rigid—usually a good thing
- Watch out for sagittal plane mismatch in femur
  - –Supracondular fracture risk

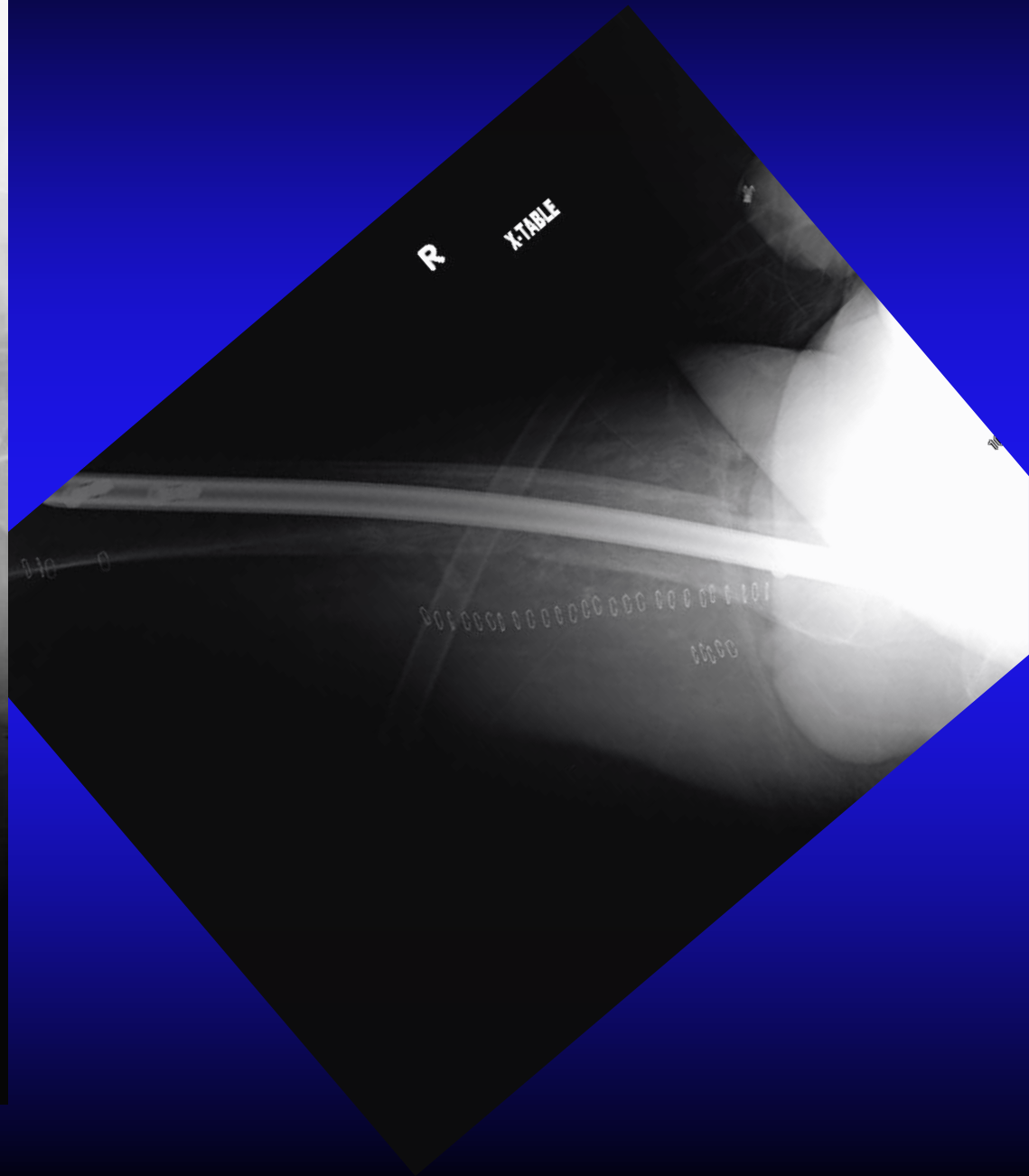

R
Lossy: 20:1


X-TABLE R
Lossy: 20:1


CAUTION!


0.00 mrad

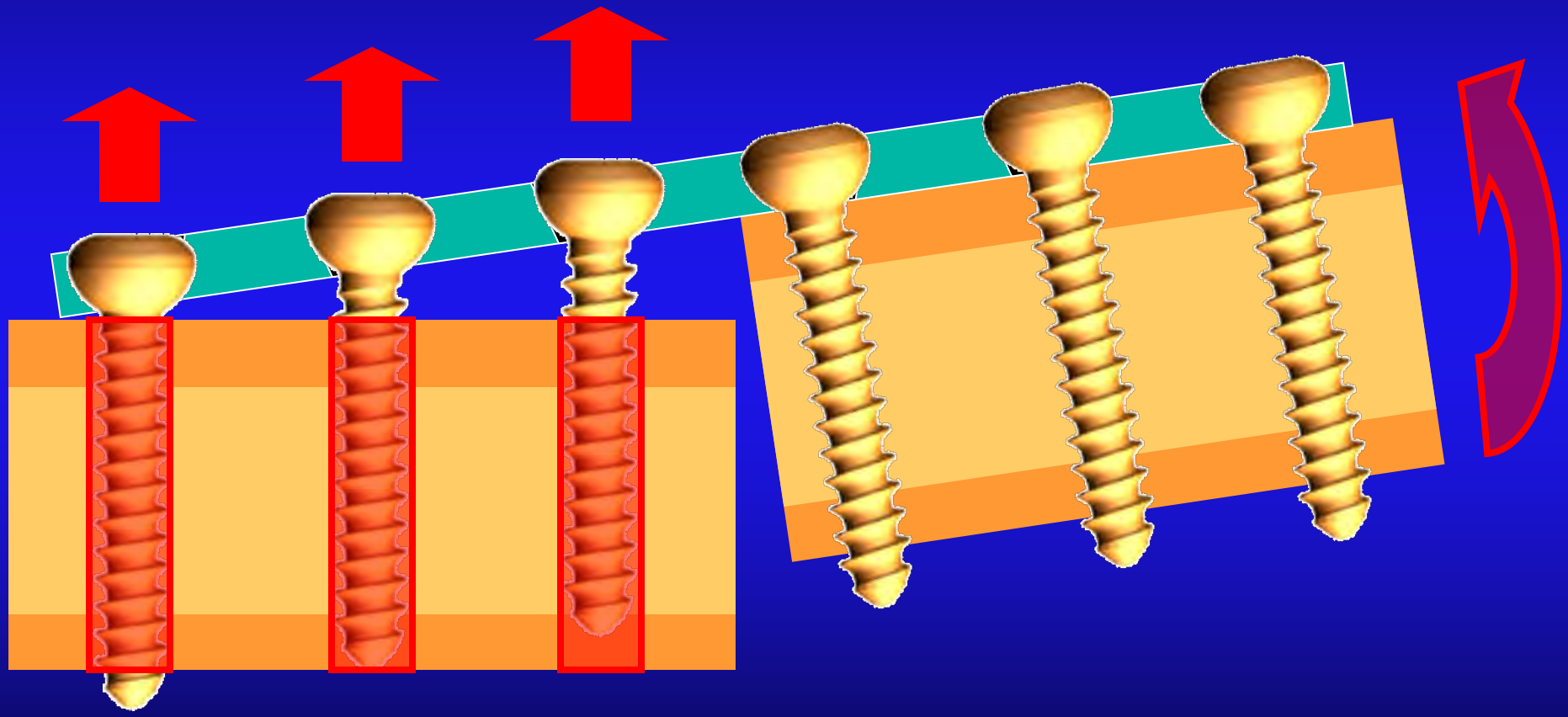

R
Lossy: 20:1


R
X-TABLE

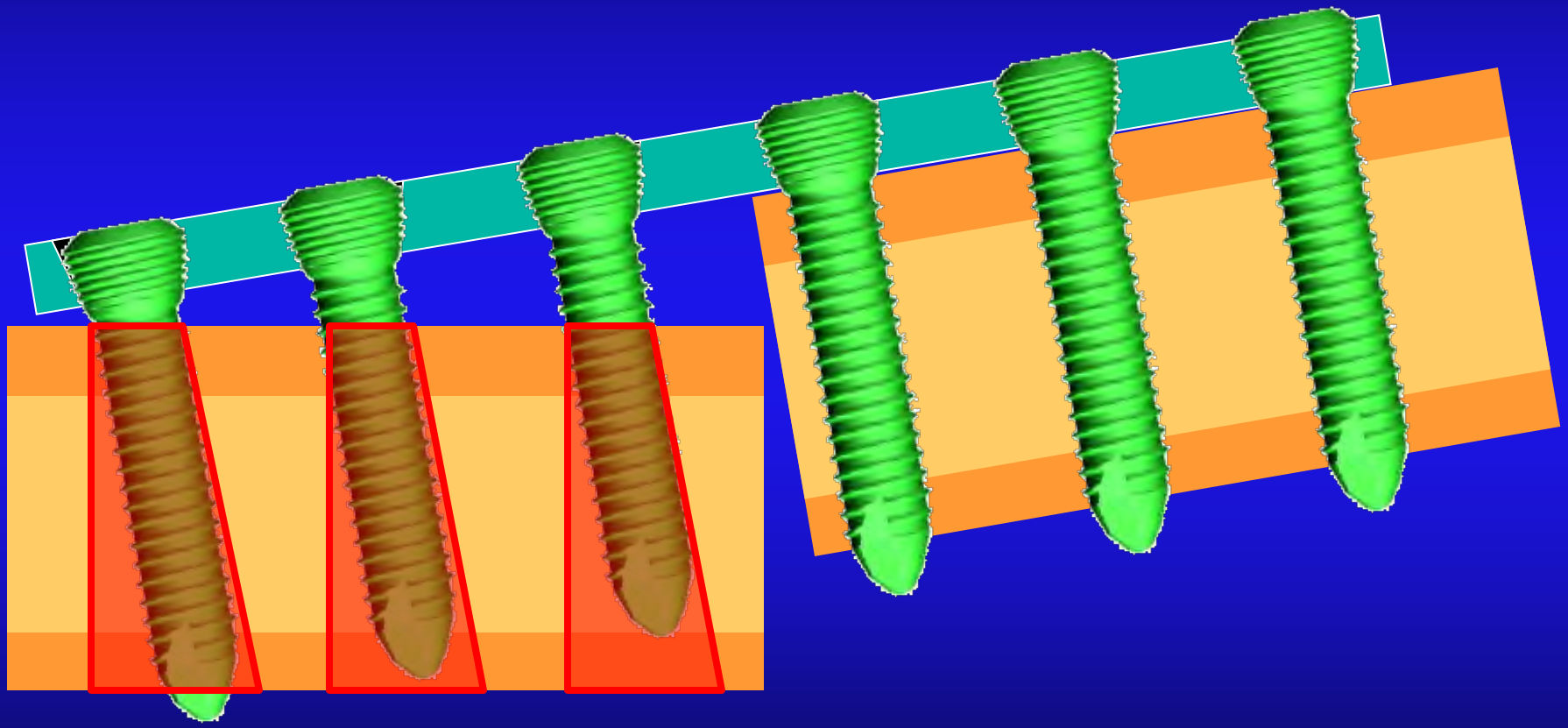
4. Locked plates

- Each locked screw is an angle stable unit
- Does not rely on friction for stability
- Don’t forget to compress small gaps
- Hybrid concept of using both locking and non-locking screws

Pullout of regular screws

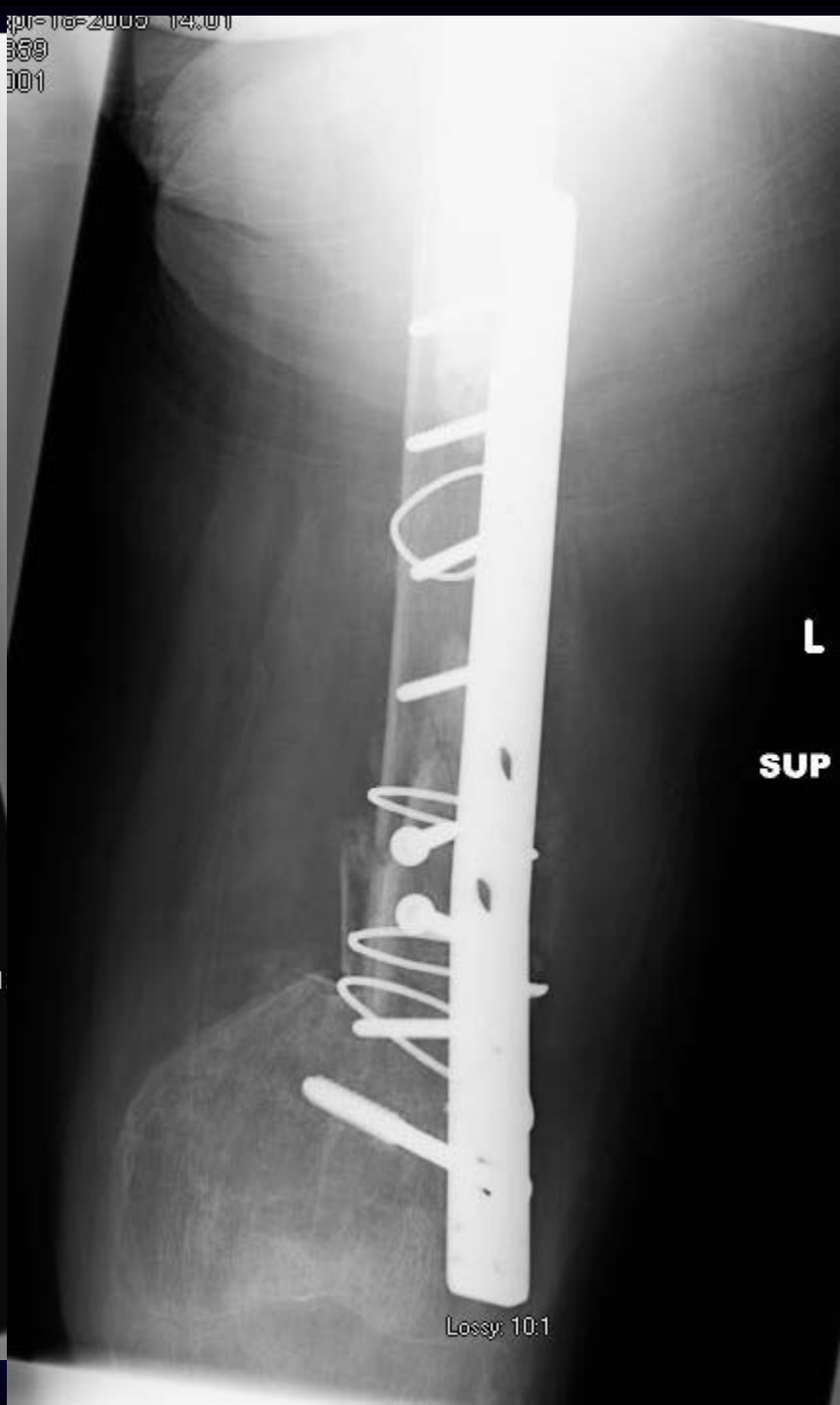


Cut out of locked screws

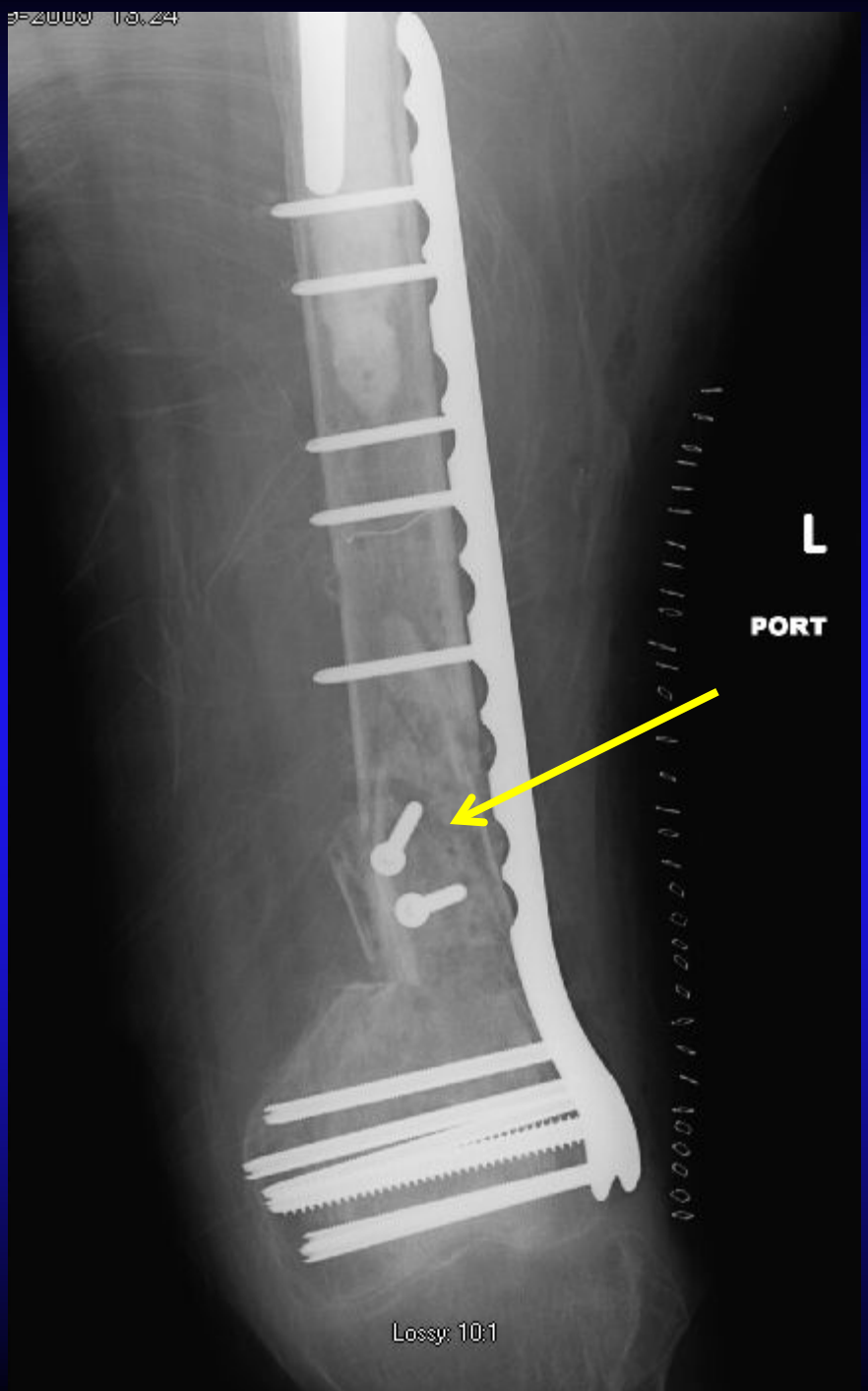


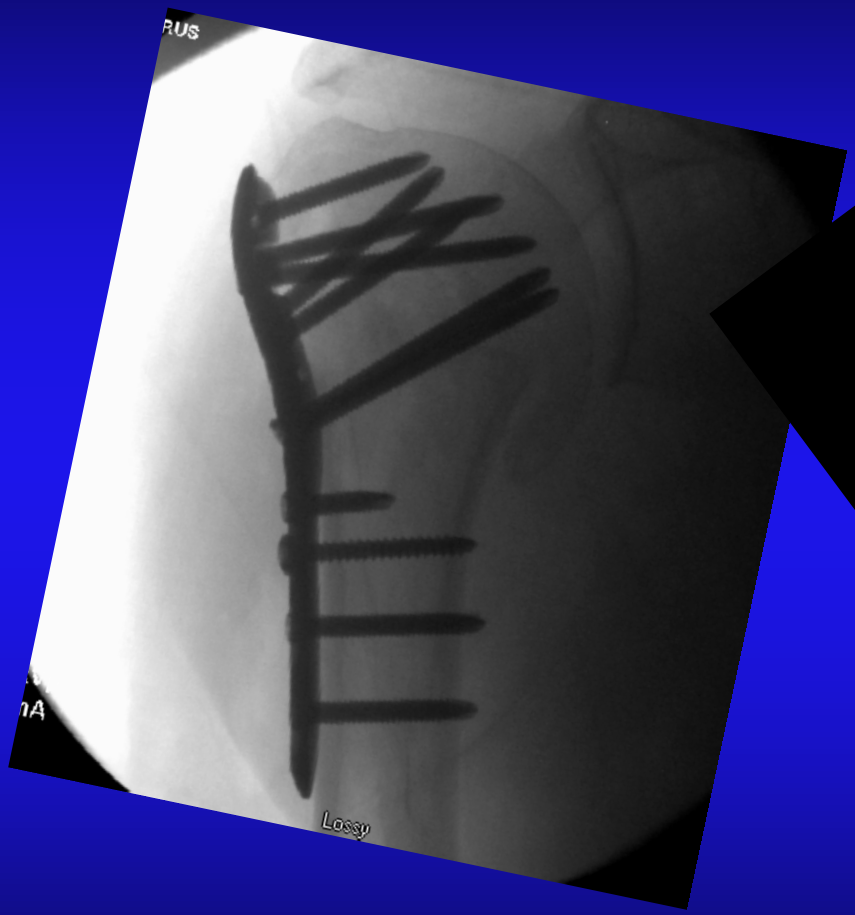
Larger Resistance Area

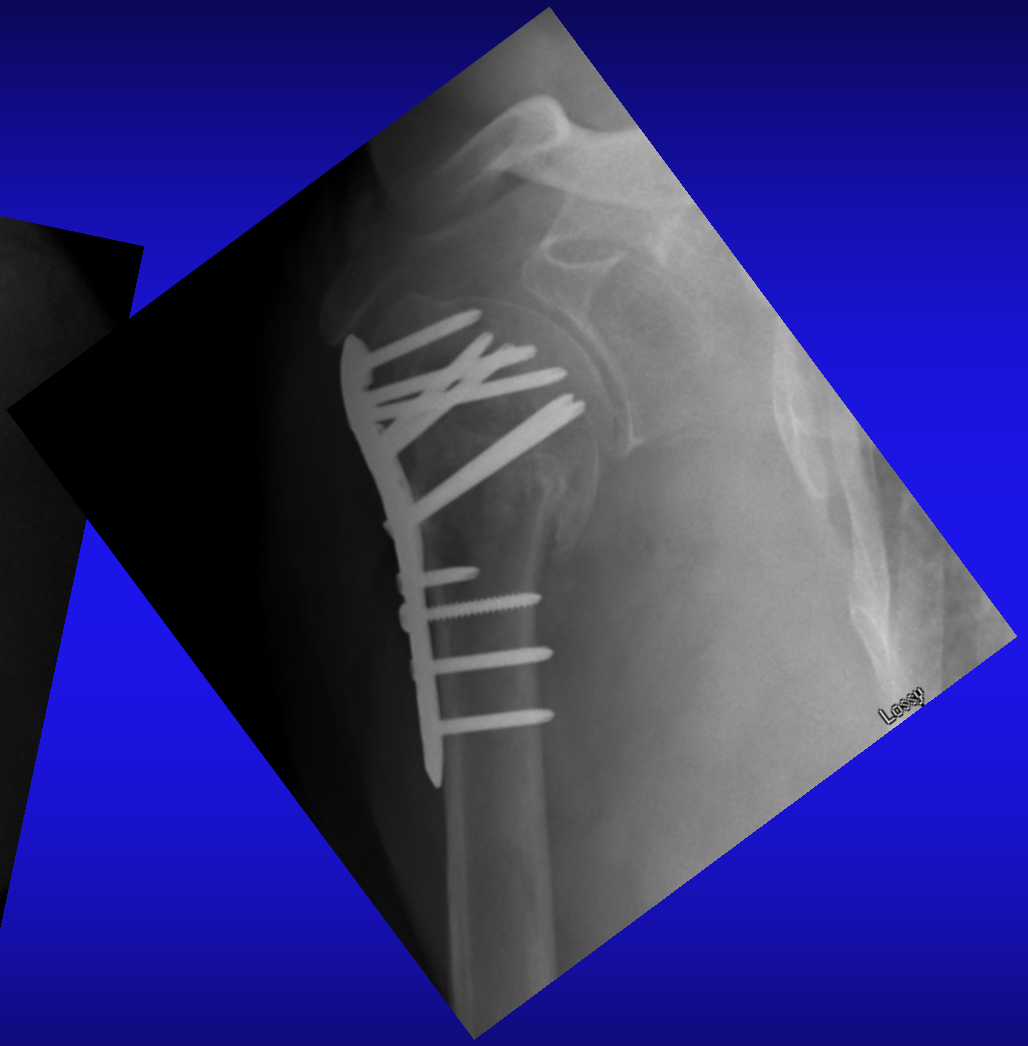

2 Apr-18-2005 14:06
311369
s: 1002
L
SUP


L
SUP
Lossy: 10:1


7244
1002
L
X-TAE
PORT
Lossy: 10:1

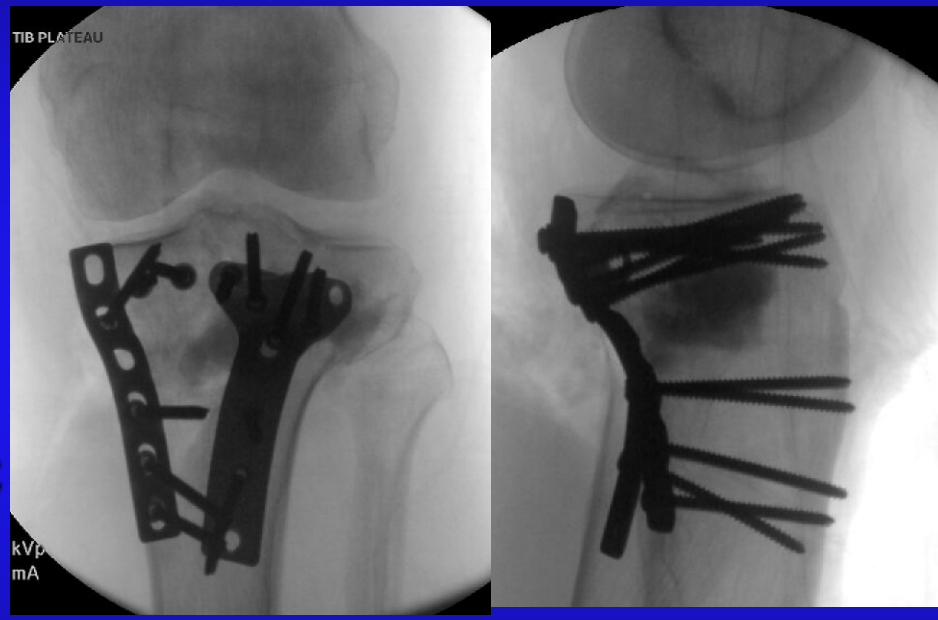

L
PORT
Lossy: 10:1


RUS
Lossy


Lossy

Augmentation at Fracture Site

- Void fillers
  - –Allograft/ autograft
  - –Synthetic fillers
    - »CaPO4, CaSO4
    - »Allograft/synthetic combo puddy



Void fillers: Autogenous bone graft vs. calcium phosphate cement

CaP cement better at resisting subsidence in tib plateau fractures— Level 1

Russell and Leighton JBJS 90 (2008), 2057-2061

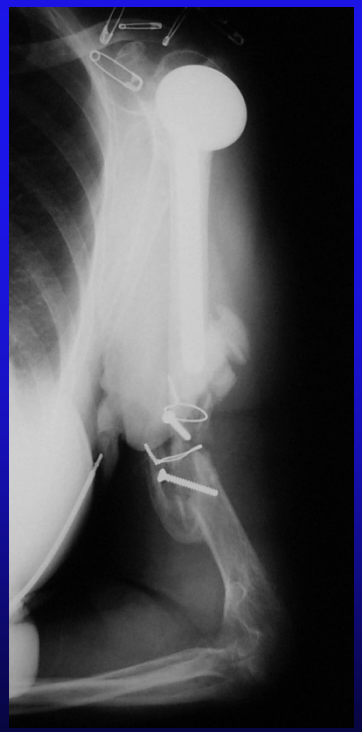
CaP outperformed autograft in meta-analysis of fracture care— Level 1

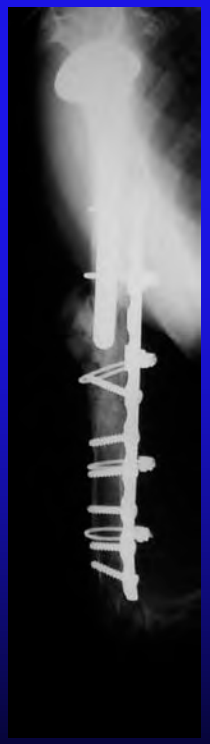
Bajammal et al, JBJS 90 (2008), 1186-1196

Summary: CaP better

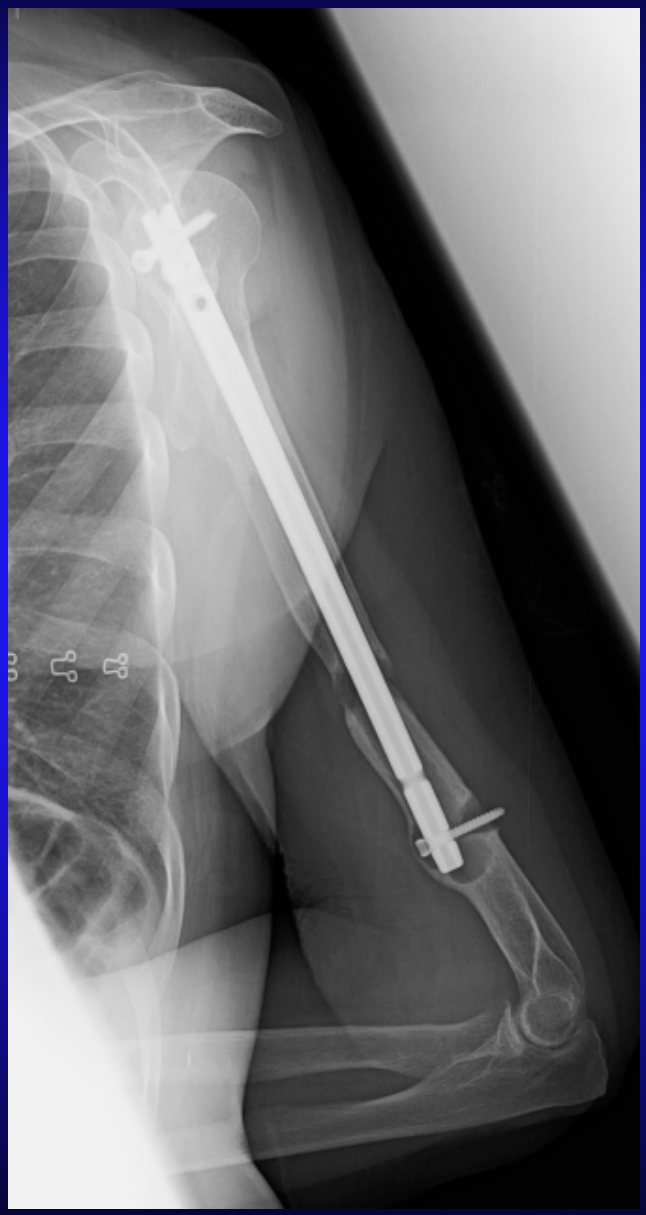
Other Augmentaion

- Cortical struts
  - –Peri-prosthetic fractures
  - –Cerclage cable
  - –?vascularity?
- IM allograft
  - –Humerus
  - –Prox humerus



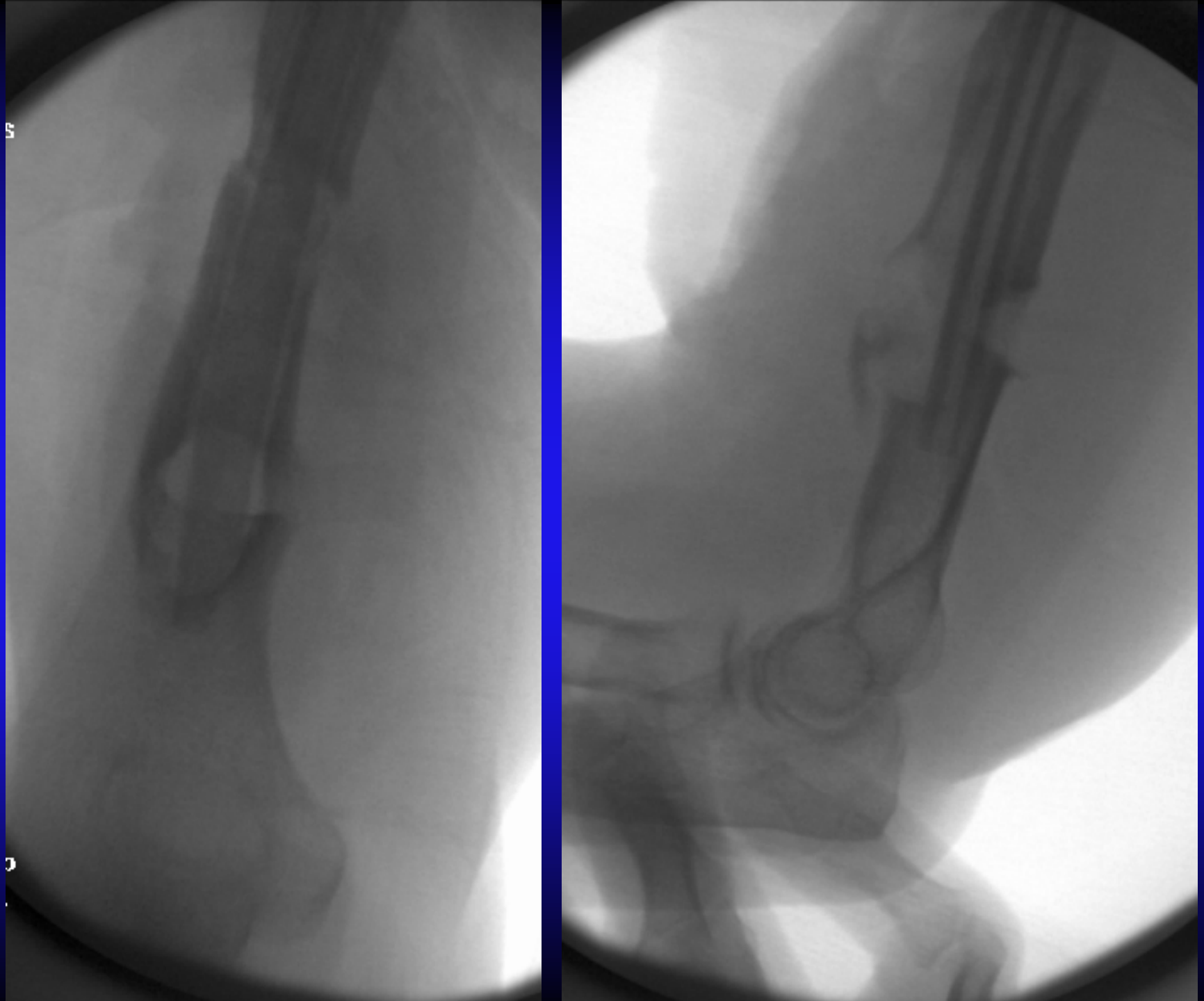


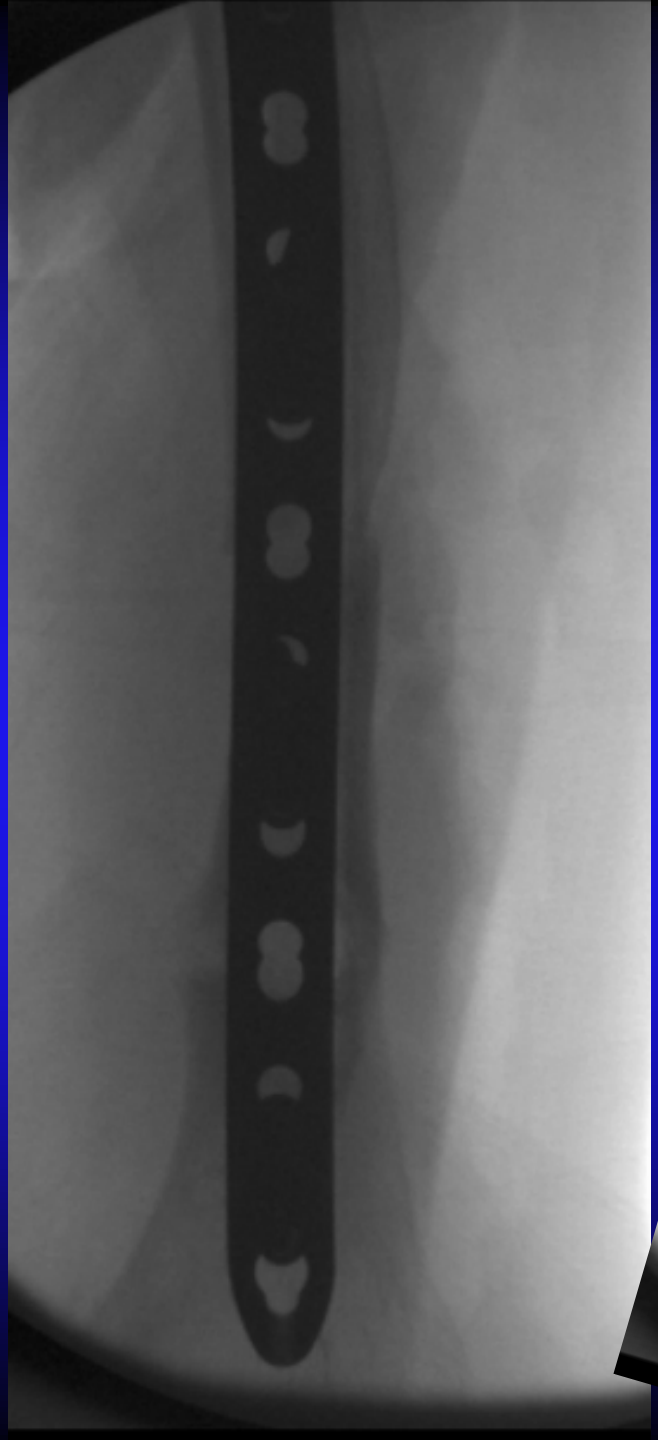
Case: 2 years out from IM nail

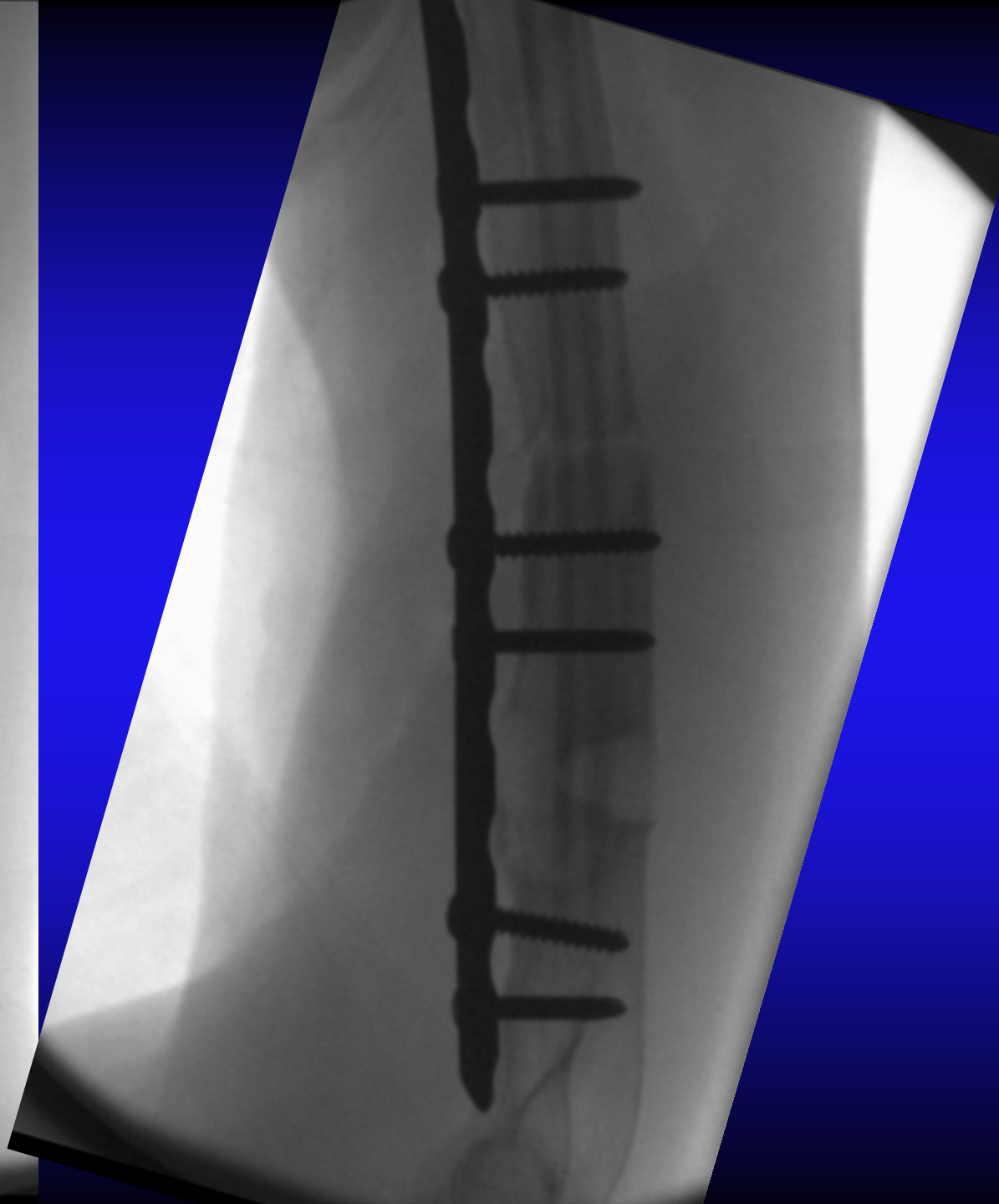




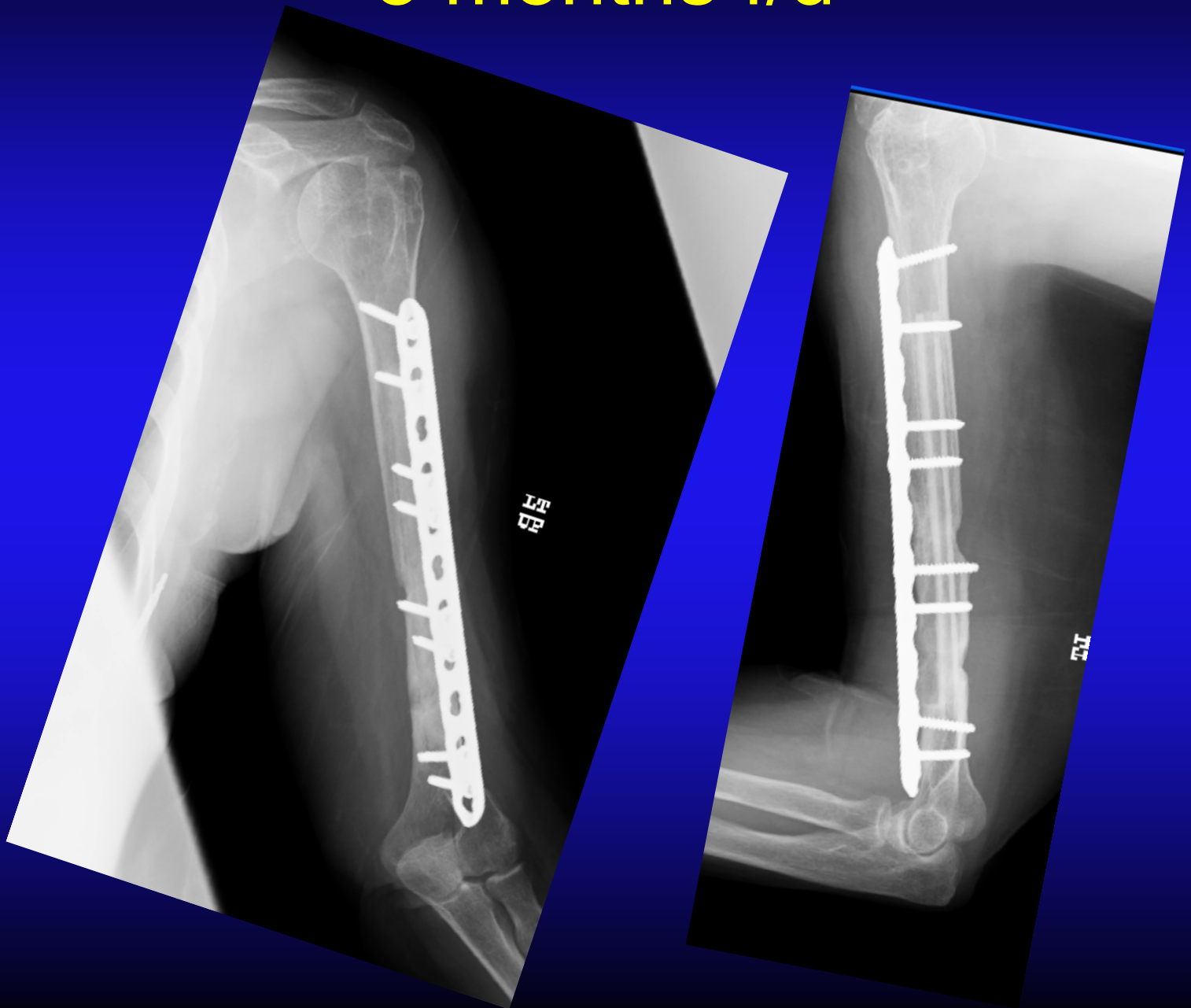
AUS
Vp
nA





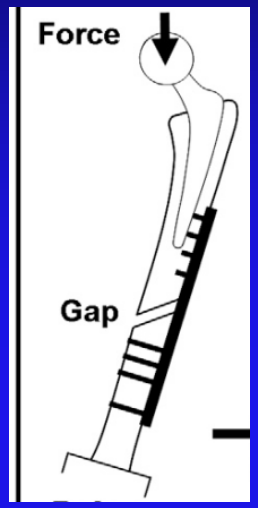
8 months f/u



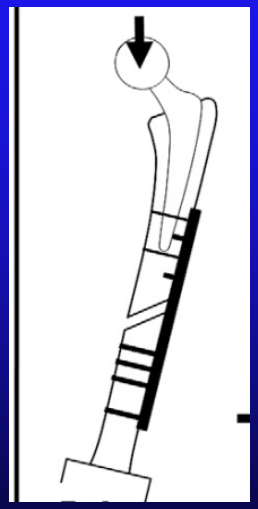
Fixation of periprosthetic femur fractures

- Expanding problem
- Almost always bad bone
- Usually implant remains stable

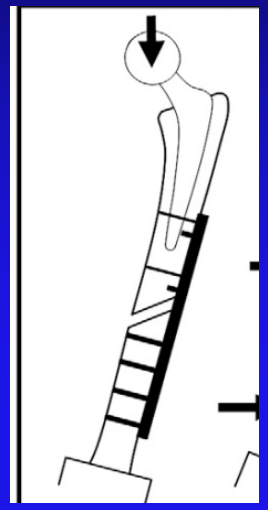
Fixation of periprosthetic femur fractures



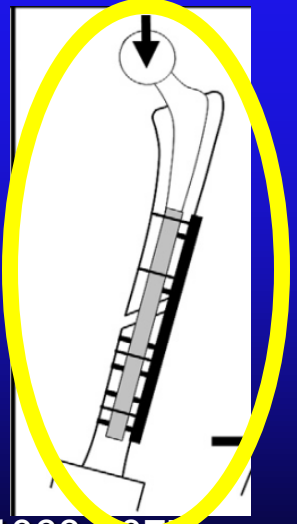
Locking plate with unicort screws



Locking plate with unicort screws and cables



Non-locking plate with unicort screws and cables



Non-locking plate with unicort screws/cables **and allograft strut**

- Zdero et al JBJS 90 (2008) 1068-1077
- Buttaro et al JBJS 89 (2007) 1964-1969

Fixation of periprosthetic femur fractures

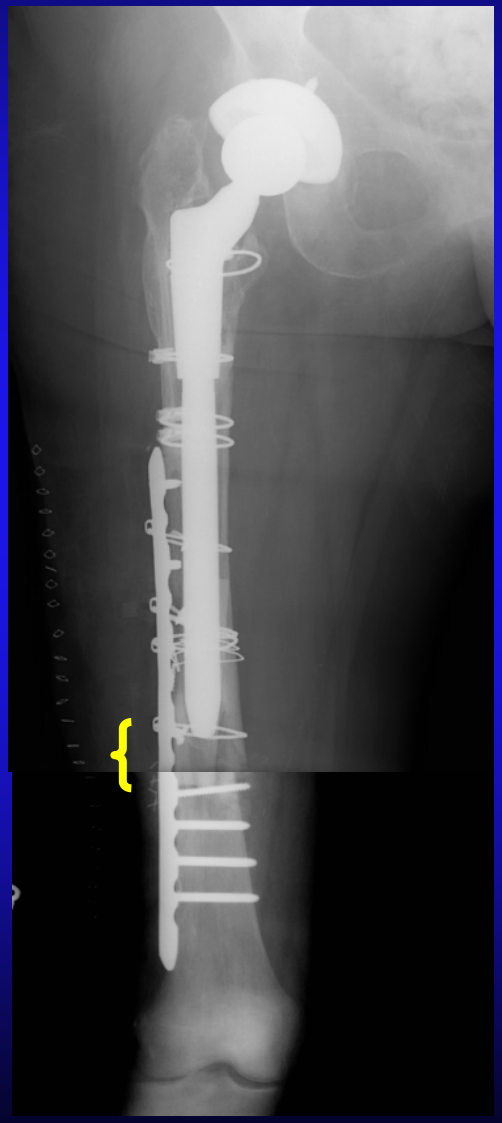
- Allograft struts can help stability
- Unicort locking screws alone –use with caution
- In any case, **LONGER IS BETTER**

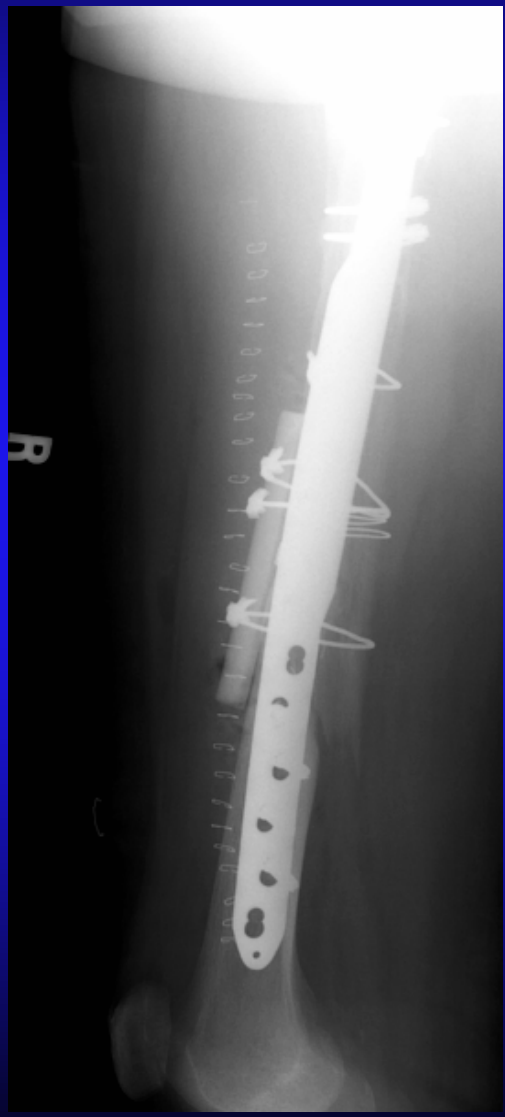
83 y/o female revision hip

Slip and fall
Vancouver B1 fracture

Post op

- Proximal
  - Allograft/cerclage to protect unicort screws
  - Too short, too clustered
- Distal
  - Allograft does not even span fracture
  - Distal screws too clustered
  - No protection of supracondylar
  - Short working length





1 month
post op

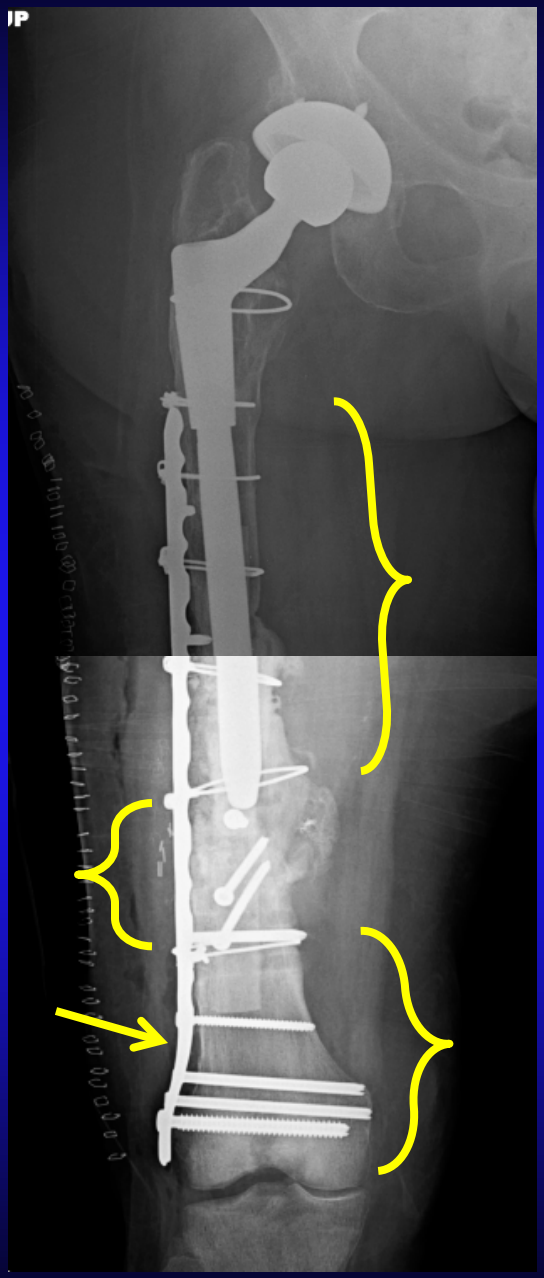
2 months
post op

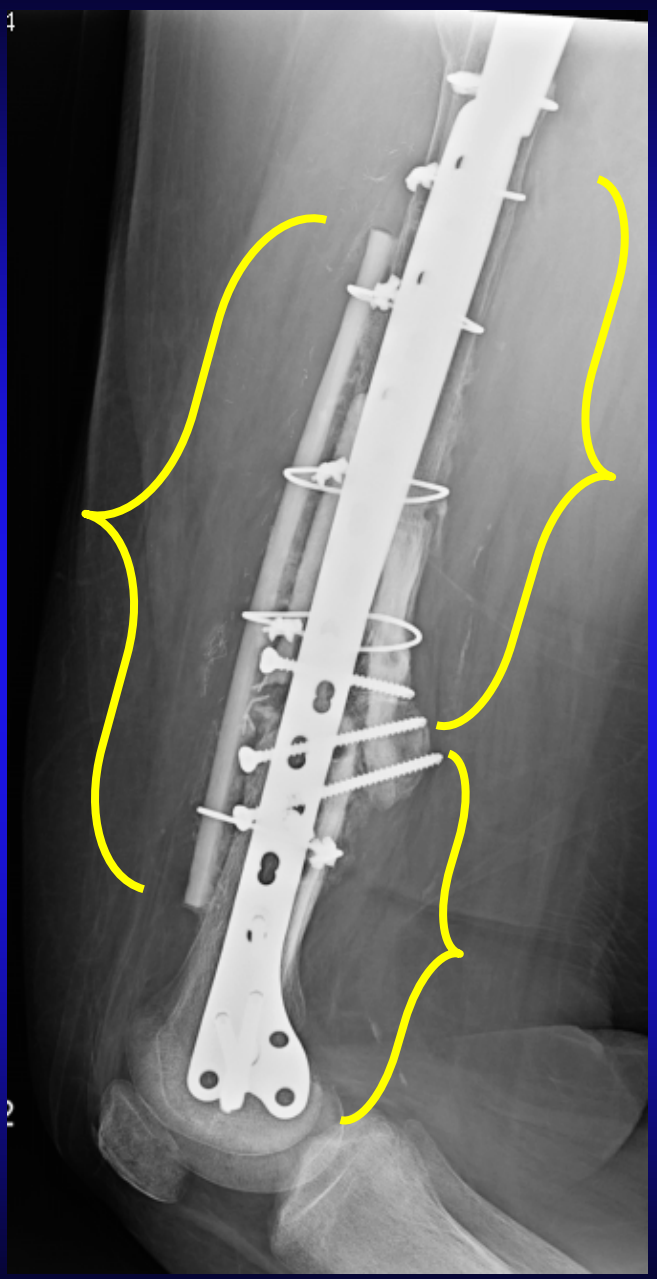
10 months post op

14 months post op

Revision surgery

- Compression when possible
- Bone graft
- BMP-2
  - controversial





Key Points

- **GO LONG!!**
- Spread out fixation points
- Avoid short working length at fx
- Some locking screws OK
- Allograft can be useful
- Protect supracondylar region

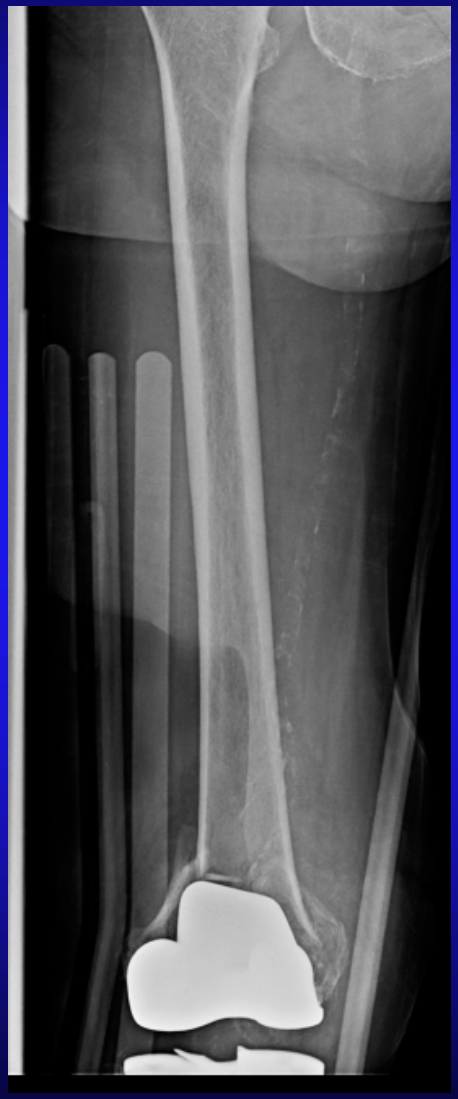
- 72 y/o female
  - –Obese, DM
  - –Multiple prior surgeries
- Slip and fall

Key Points

- **GO LONG!!**
- Spread out fixation points
- Avoid short working length at fx
- Some locking screws OK
- Allograft can be useful
- Protect supracondylar region
- Allow metaphyseal impaction/shortening

91 y/o female

- Shortened
- Metaphyseal comminution

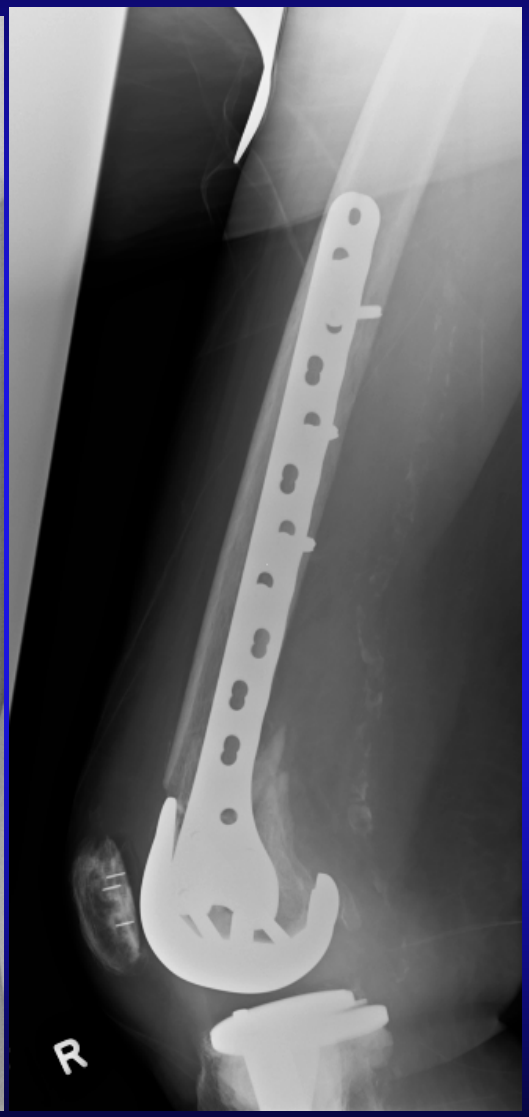


91 y/o female

- Shortened
- Metaphyseal comminution
- Gap when out to length

91 y/o female

- Accept shortening (impaction) in elderly
- Rather than fixing out to length with gap



Fixation Summary

- Fracture impaction when possible
  - –Make reduction as stable as possible
- Enhance fixation
  - –Screw augmentation
  - –CaP (or similar) under tibial plateau
  - –Locked plating—not a panacea
  - –IM devices, fixed angle
  - –Allograft supplementation
- GO LONG

Prevention

- Well established link between decreasing bone mass and risk of fracture

Updated NOF Clinician's Guide

Initiate Treatment in PM women and men age ≥50 with:

- Hip or vertebral fragility fracture
- T-score below -2.5 (2º causes excluded)
- Low bone mass (T score -1.0 to -2.5) AND 10-yr hip fracture probability ≥3% or 10-yr major OP-related fracture probability of ≥20% based on FRAX

National Osteoporosis Foundation (2010)

Google FRAX Search Share More »

FRAX® WHO Fracture Risk Assessment Tool

Home | Calculation Tool | Paper Charts | FAQ | References | English

Calculation Tool

Please answer the questions below to calculate the ten year probability of fracture with BMD.

Country: US (Caucasian) Name/ID: About the risk factors

Questionnaire:

1. Age (between 40-90 years) or Date of birth
   Age: Date of birth: Y: M: D:
2. Sex ○ Male ○ Female
3. Weight (kg)
4. Height (cm)
5. Previous fracture ● No ○ Yes
6. Parent fractured hip ● No ○ Yes
7. Current smoking ● No ○ Yes
8. Glucocorticoids ● No ○ Yes
9. Rheumatoid arthritis ● No ○ Yes
10. Secondary osteoporosis ● No ○ Yes
11. Alcohol 3 or more units per day ● No ○ Yes
12. Femoral neck BMD (g/cm²)
    Select DXA
    Clear Calculate

Weight Conversion

Pounds → kg
Convert

Height Conversion

Inches → cm
Convert

01318943
Individuals with fracture risk assessed since 1st June 2011

Prevention: Treatment options

- Calcium/Vit D **1000/1000**
- Bisphosphonates
- Hormone Replacement
- SERMs (Evista)
- Calcitonin
- **Bone stimulators**
  - –rh PTH (Forteo)

Prevention

- Bisphosphonates
  - Inhibits bone resorption by reducing osteoclast activity
- Strong evidence for rapid fracture risk reduction
  - "FIT" trial (Lancet 1996)
- Recent evidence of increased risk of subtrochanteric insufficiency fractures with long term use (Lenart et al. NEJM 2008)

65 y/o female

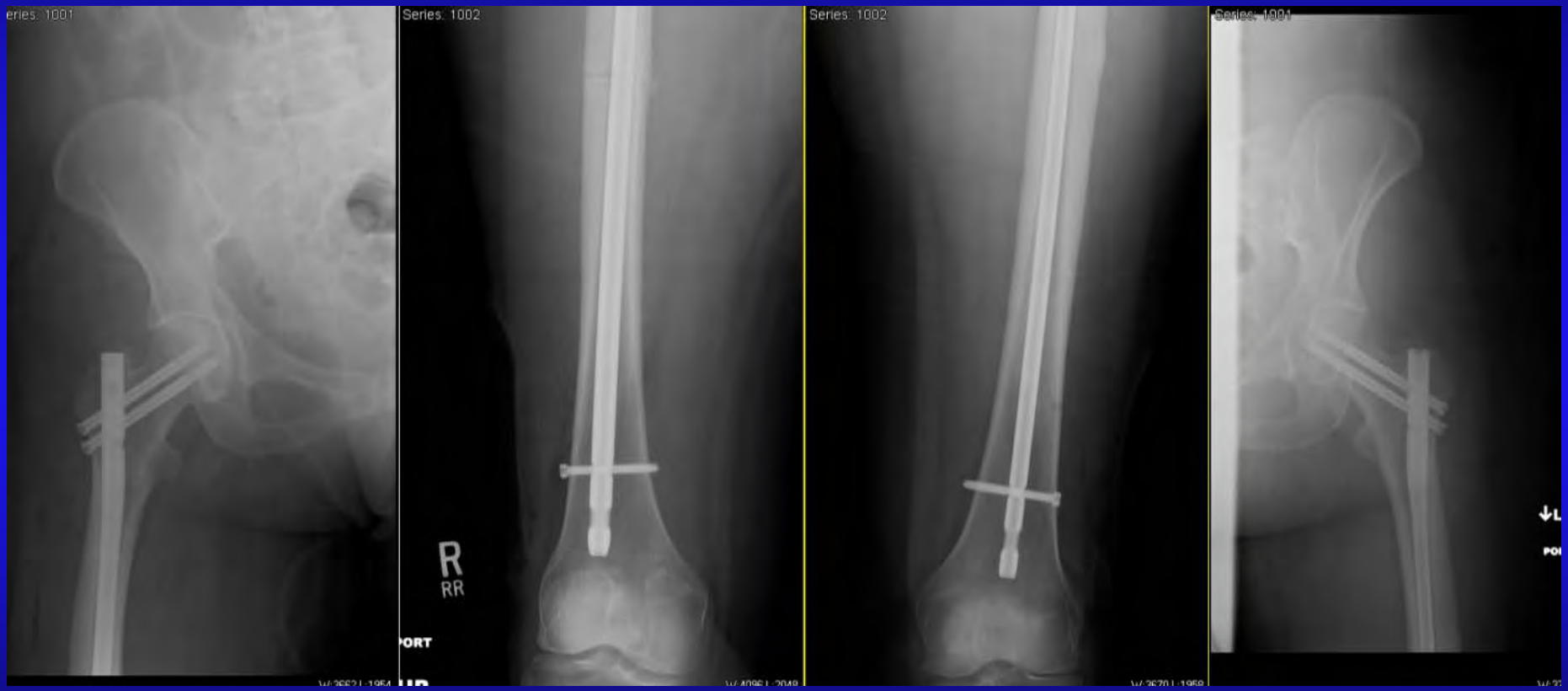
- H/O breast cancer
- Alendronate x 8 yrs
- 1 year of thigh pain
  - Neurology w/u
- Felt snap and <u>then</u> fell

Always xray other side

- H/O breast cancer
- Alendronate x 8 yrs
- 1 year of thigh pain
  - Neurology w/u
- Felt snap and <u>then</u> fell

Prophylactic nailing

JBJS 2009, 91:2556



Prevention: Anabolic

- Teriparatide (Forteo)
  - Recombinant subset of parathyroid hormone
  - Stimulates osteoblasts
  - Once daily injection
  - $$$

PTH

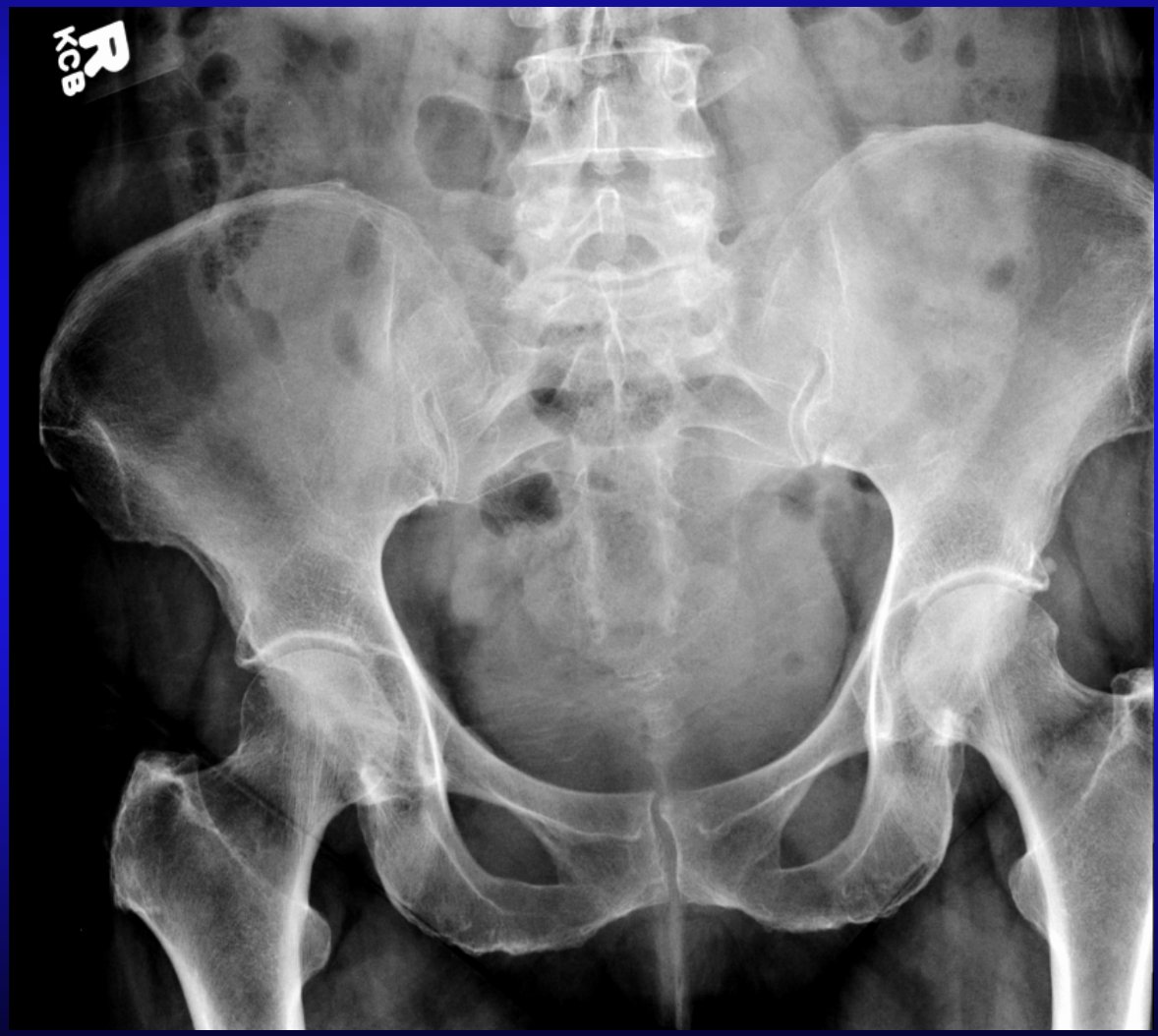
- Has shown positive effect in nonunion and fracture therapy in long bones and pelvis

- Peichl et al JBJS 93 (2011) 1583-7
- Cipriano et al HSS Journal 5 (2009) 149-153
- Della Rocca J. Ortho Trauma 2010 24: S31

Off label unless patient with refractory osteoporosis

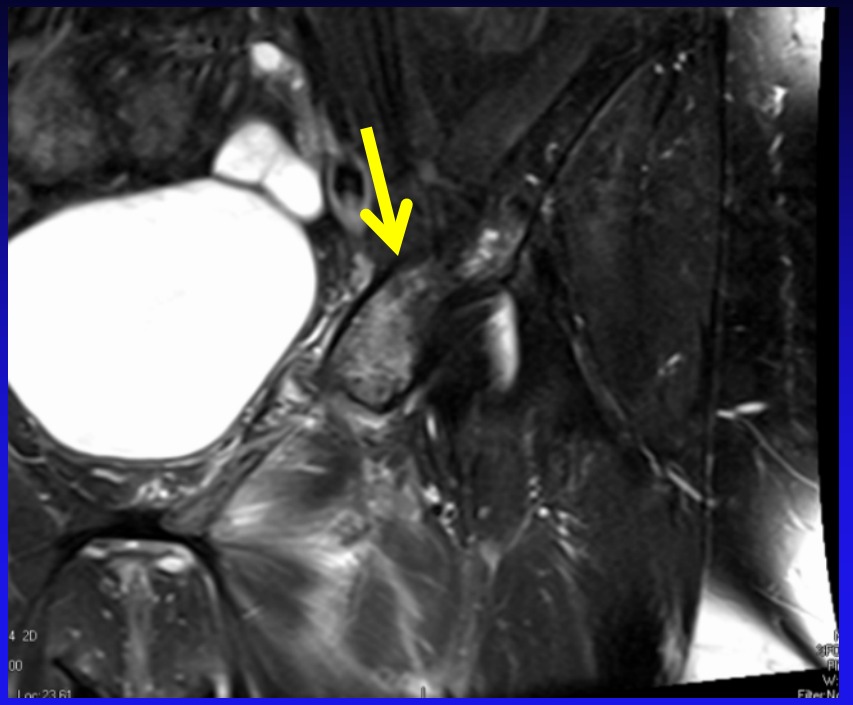
64 y/o female slip and fall

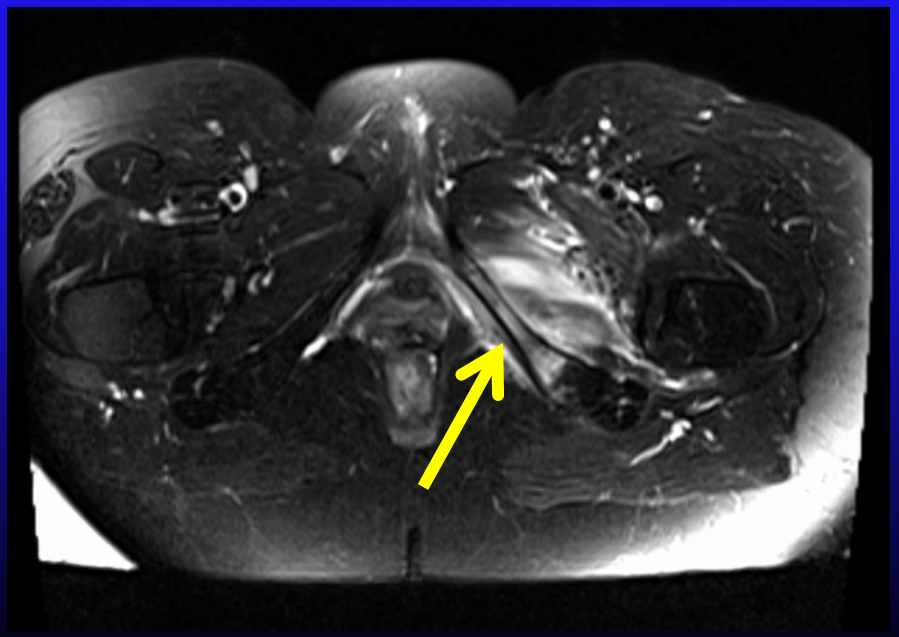
- Pituitary tumor
  - Endocrinopathy
  - On synthetic somatostatin
- Osteoporosis
  - Previously on zolendronate
- Xrays and CT (-)



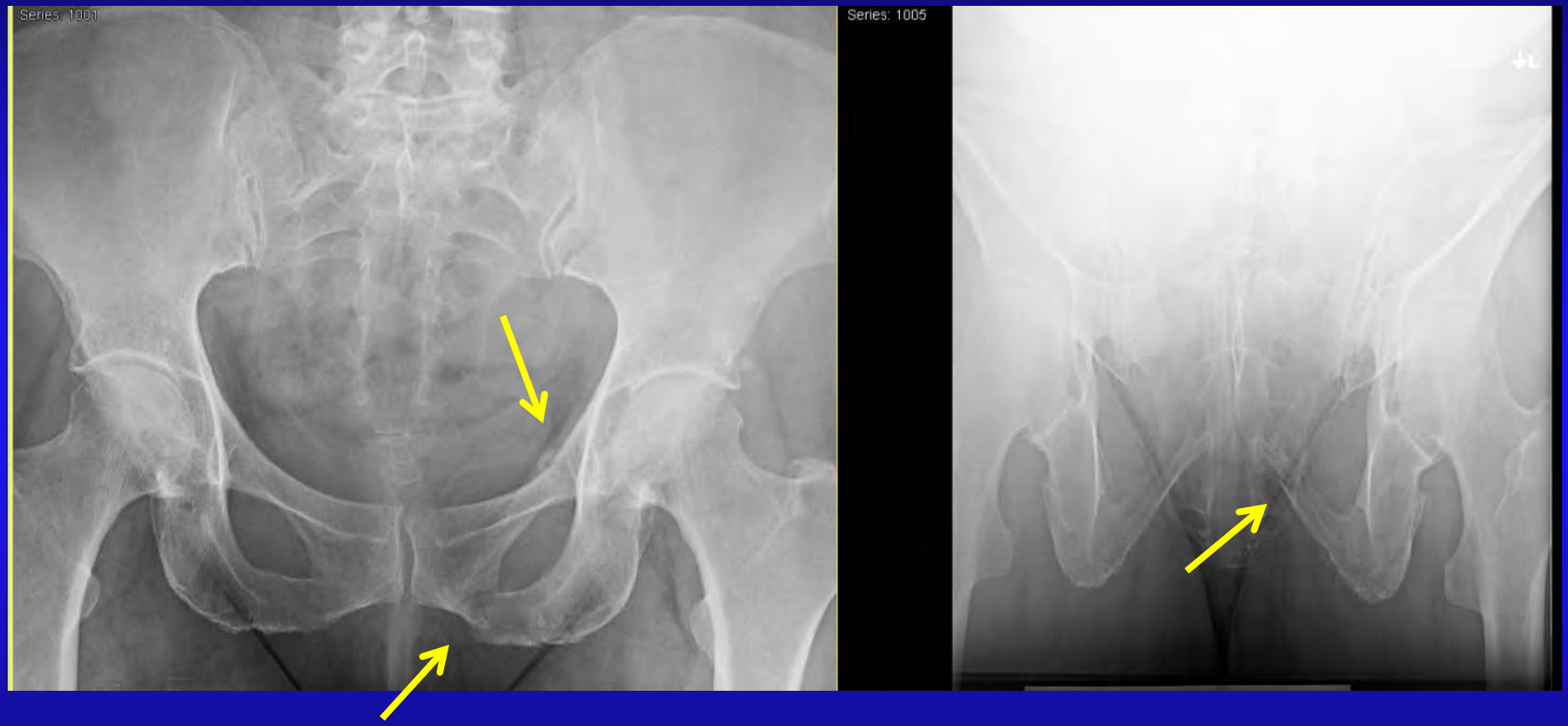
- MRI 3 weeks later for continued pain
- L rami fractures

- WBAT with walker



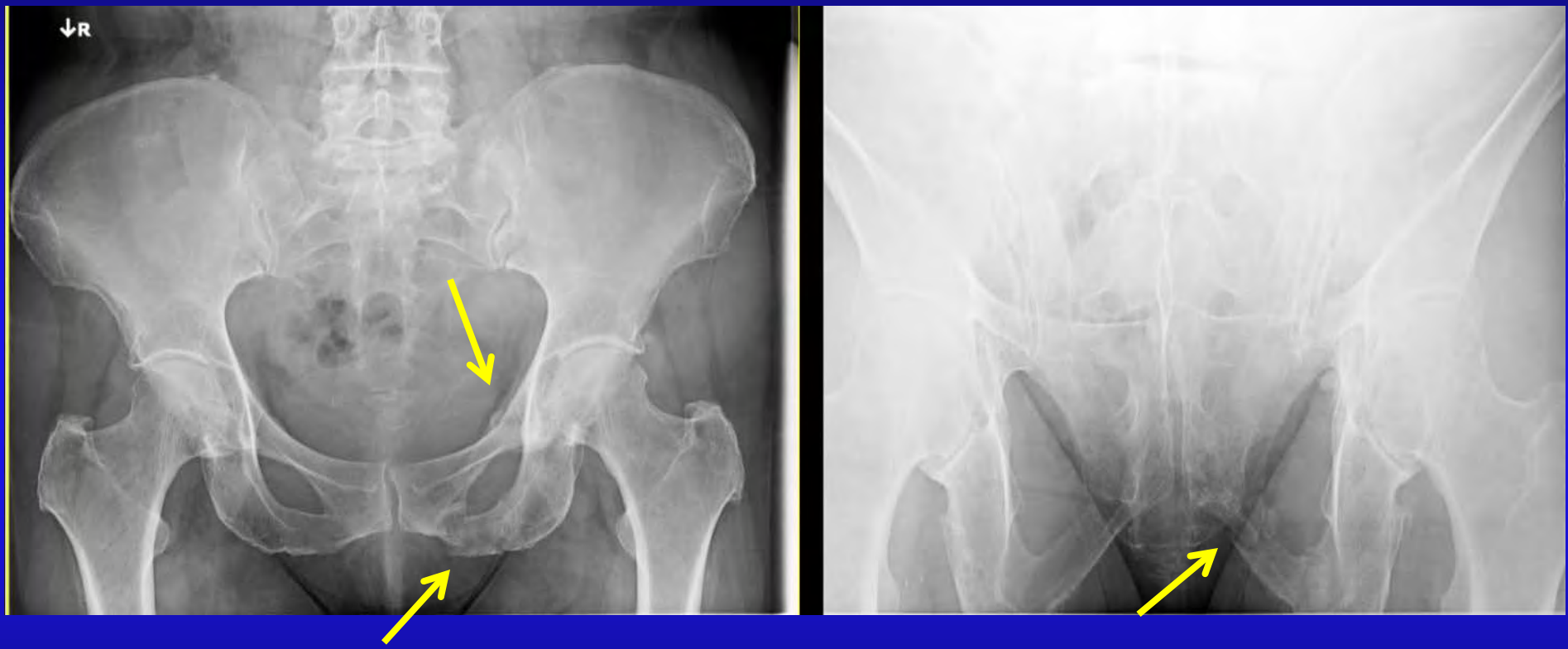


2 months post injury



- Continued pain
- Confirm Vit D, calcium supplementation

4 months post injury



- Continued pain with sitting
- Tender right over inferior ramus fracture
- **Treatment → ??Forteo** (on label)

Conclusions
"We are part of the team"

- **GO LONG**
- **1000/1000**

Bogoch et al JBJS 2006 88A:25-34

Extra slides

Prevention and Treatment of Bone Fragility

- Estrogen/progestin
  - FDA approved for prevention, not treatment of osteoporosis
  - 3-5% bone loss/year with menopause
  - Unopposed or combined therapy has been shown to reduce hip fracture incidence in women aged 65-74 by 40-60% (Henderson et al. 1988)
  - However, the Women's Health Initiative (2009) concluded reduction in hip fracture not offset by increased risk of breast & endometrial cancers, thromboembolism, dementia, and coronary heart disease

Prevention and Treatment of Bone Fragility

- Calcitonin
  - Inhibits bone resorption by inhibiting osteoclast activity
  - Approved for treatment of osteoporosis in women who have been post-menopausal for > 5 years

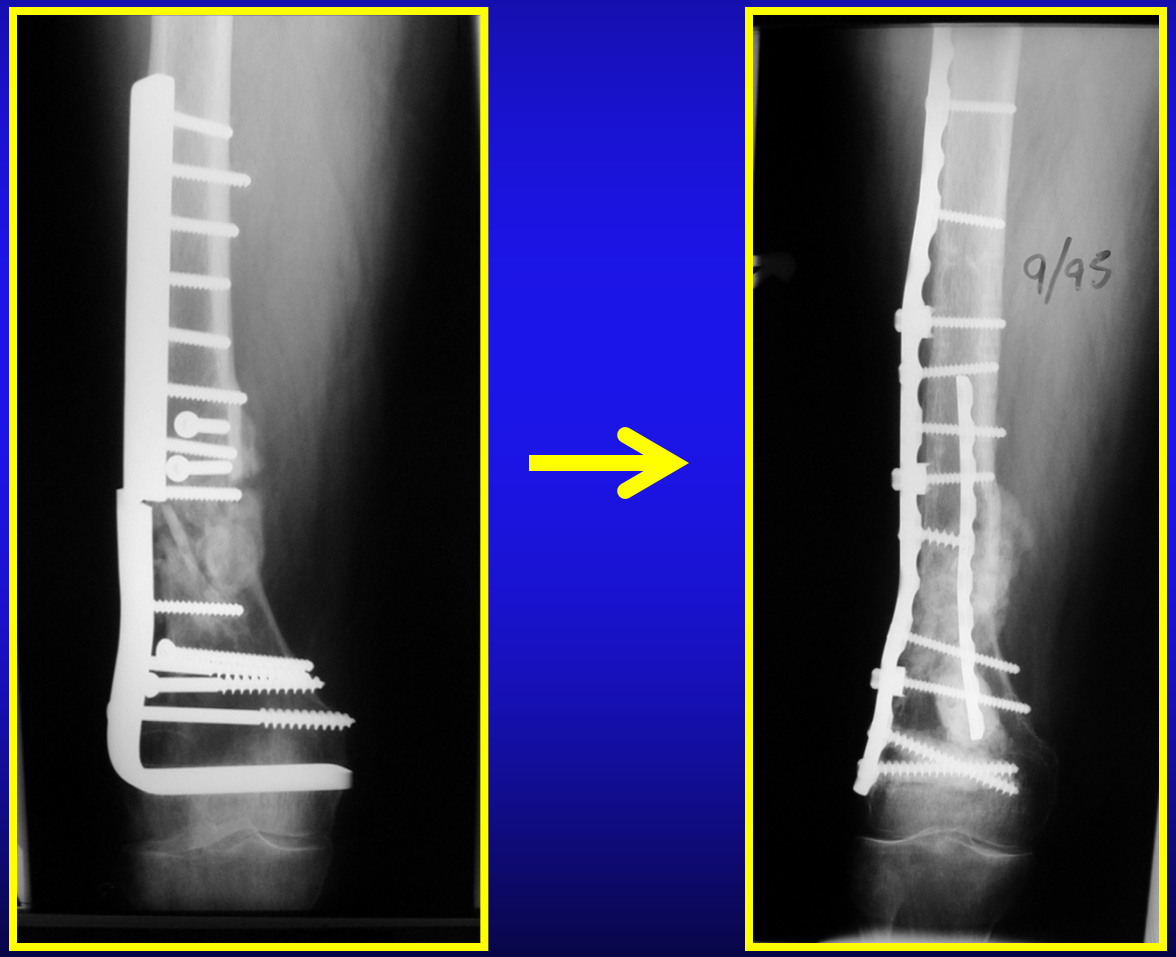
»Daily intranasal spray of 200 IU

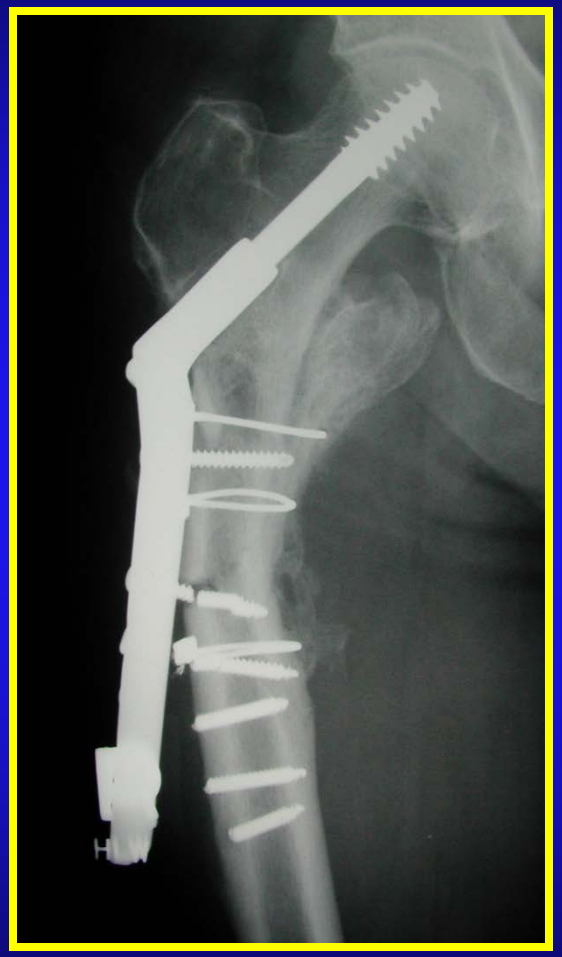
  - Trial demonstrated 33% reduction of vertebral compression fractures with daily therapy (Ches… *Med* 2000)
  - Calcitonin is indicated for no longer than 24 months in the United States to prevent "resistan…

Recommended Reading

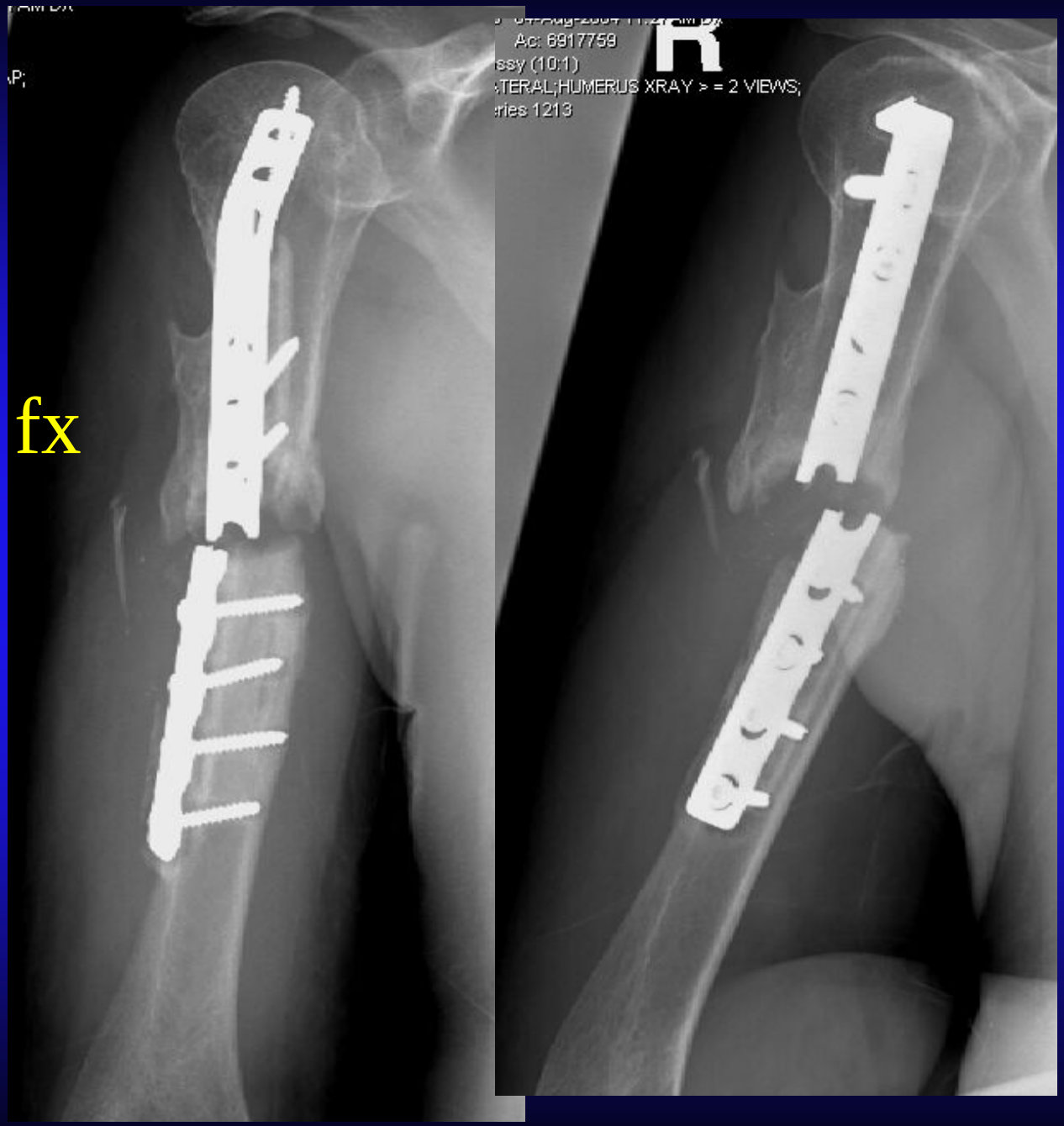
- Turner CH. Biomechanics of bone: determinants of skeletal fragility and bone quality. Osteoporos Int 13:97–104, 2002.
- Kleerekoper M. Osteoporosis prevention and therapy: preserving and building strength through bone quality. Osteoporos Int 17:1707–1715, 2006.
- www.nof.org/professionals/WHO_Osteoporosis_Summary.pdf

Creating Artificial Stability with Implants





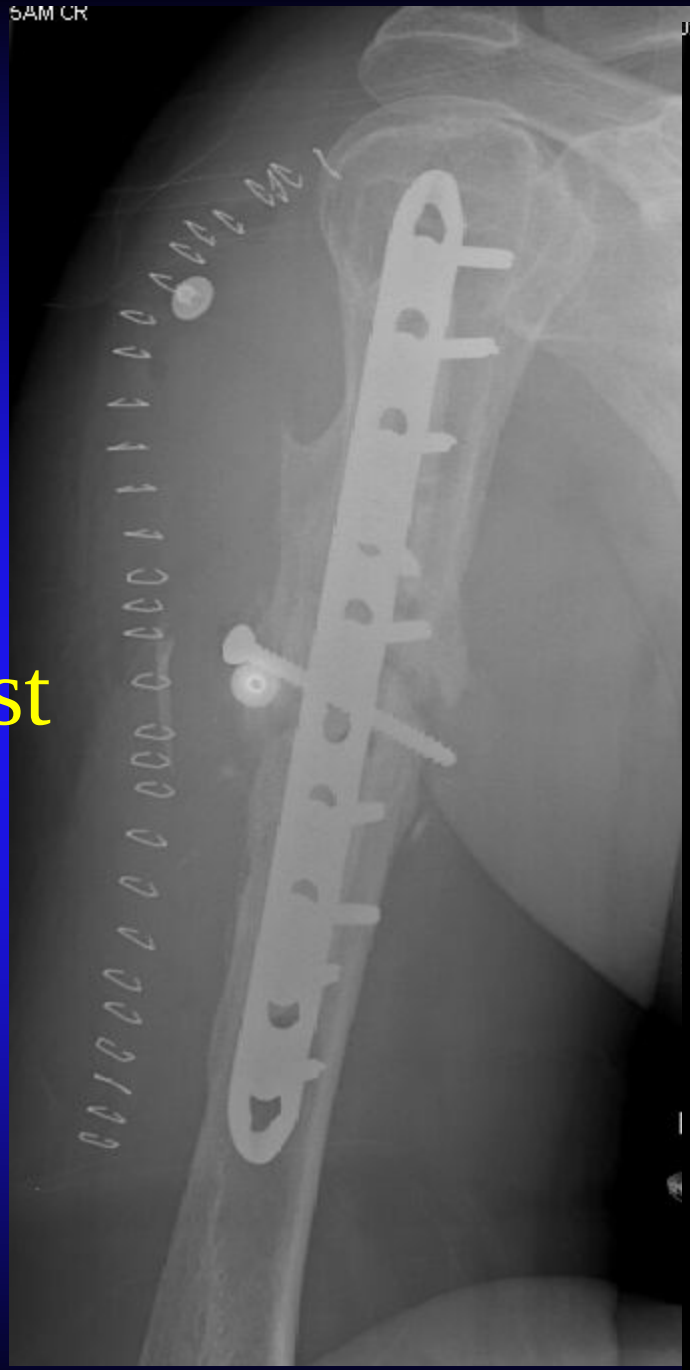
- Recent fall
- Pain and instability at fx site

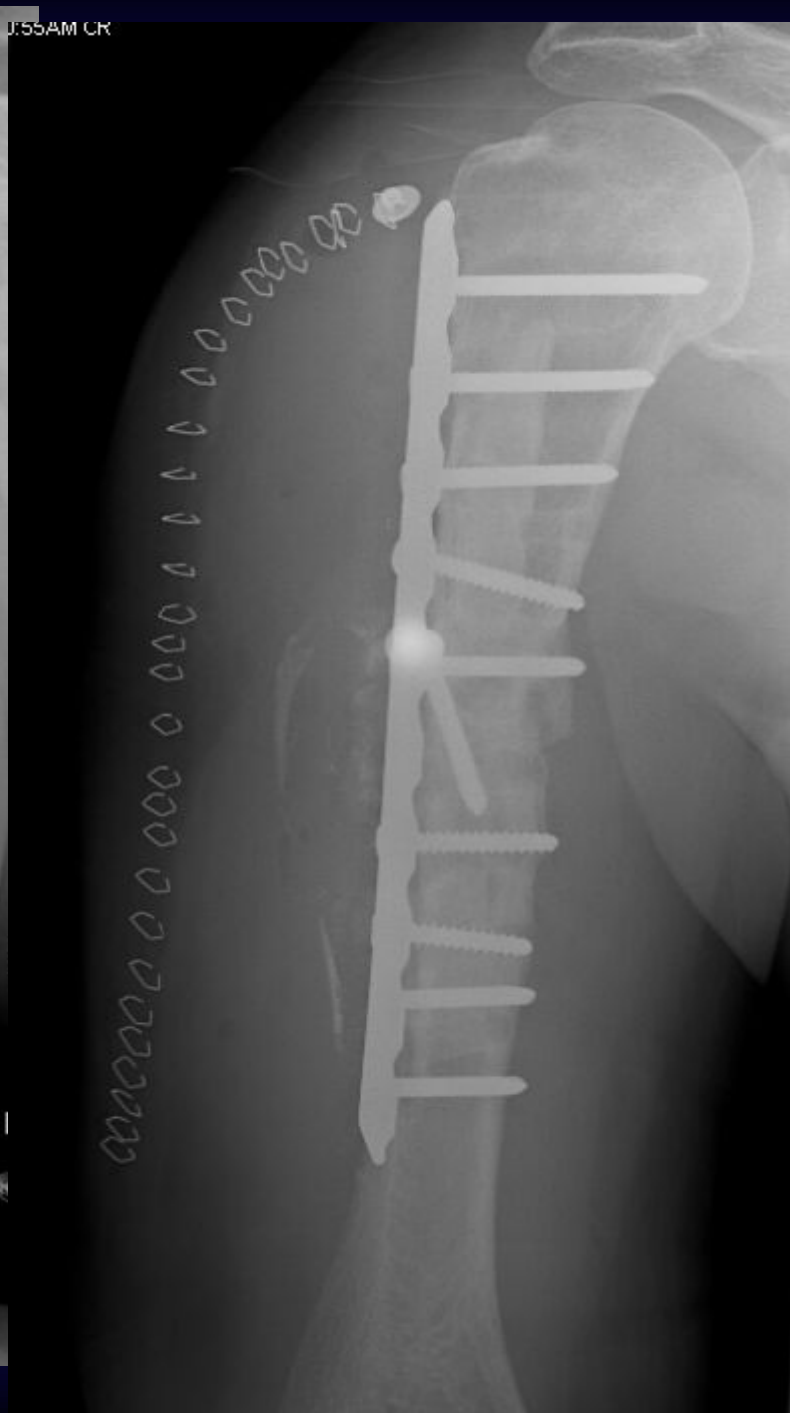


»Plated

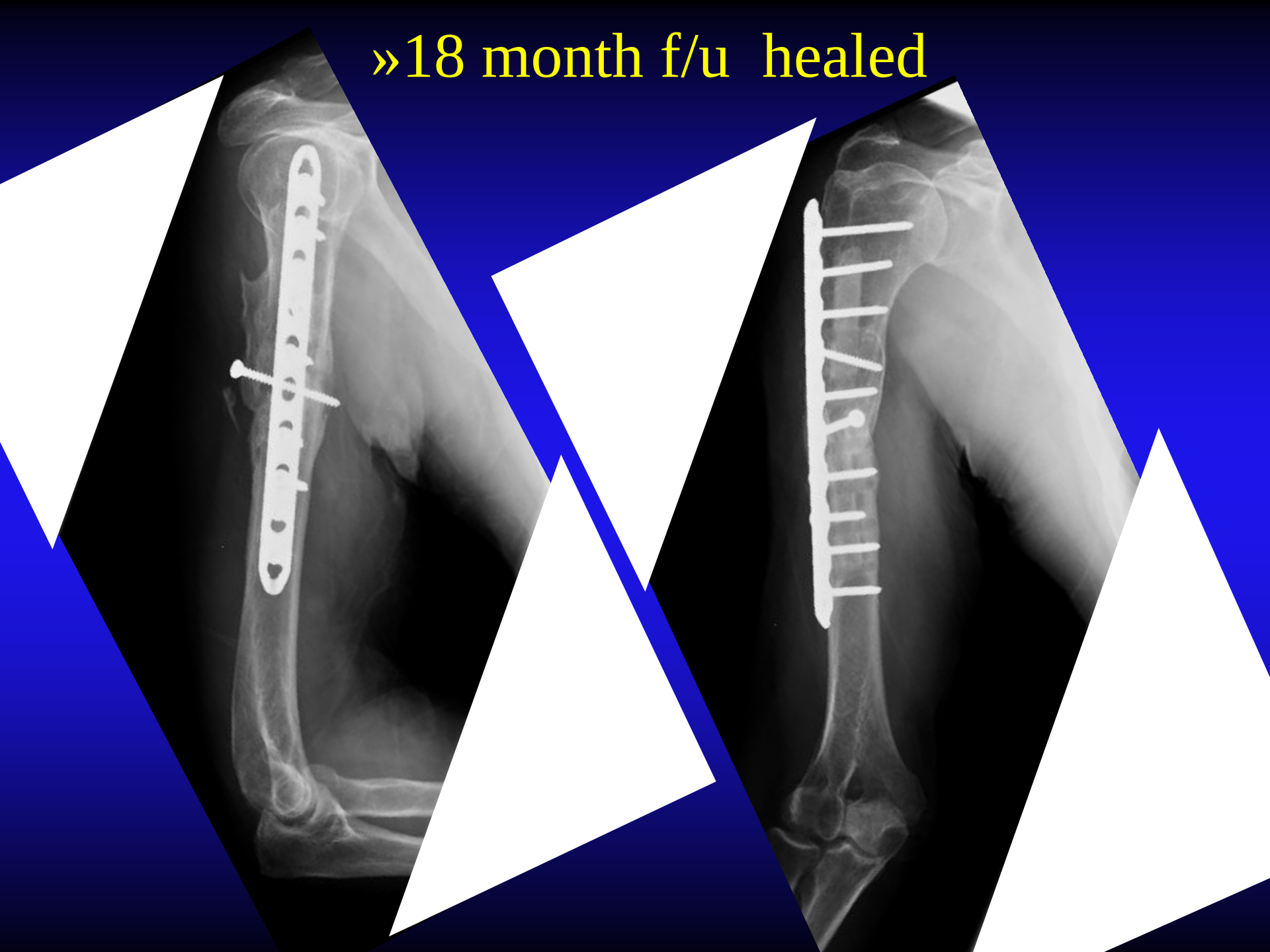
»(locked)

»Iliac crest





»18 month f/u healed



Prevention

- Strategies focus on controlling factors that predispose to recurrent fracture
  - –Consider bone mineral density test
  - –Rule out secondary causes of osteoporosis
  - –Initiate and monitor

Prevention

- Alendronate
  - Shown to increase the bone density in femoral neck in post menopausal women with osteoporosis (Lieberman et al. NEJM 1995)
  - Fracture Intervention Trial (FIT) demonstrated daily Fosamax for 3 years significantly reduced the risk of vertebral fracture by 47% and of hip fracture by 51% in women with low BMD and previous vertebral fracture (Black et al. Lancet 1996)
  - Recently associated with lateral cortical stress fractures following long term use.