



# HUMERAL SHAFT FRACTURES: ORIF, IMN, NONOP...What to do?

---

**TRAUMA 101 2018 – FRACTURE CARE  
FOR THE COMMUNITY ORTHOPEDIST**

---

William W. Cross III, MD  
Assistant Professor  
Division of Orthopaedic Trauma  
Chair, Division of Community Orthopedic Surgery  
Vice Chair, Department of Orthopedic Surgery  
Mayo Clinic  
Rochester, MN



# DISCLOSURES

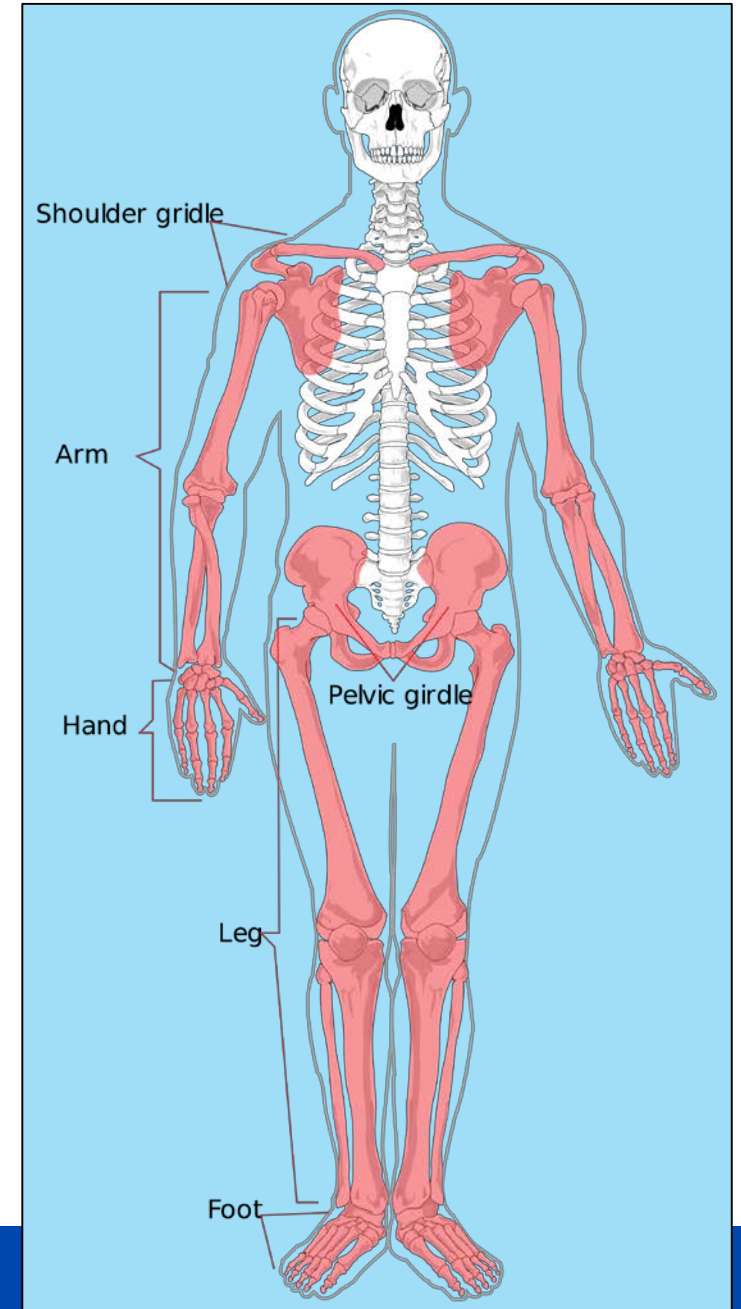
- Independent Device Design contract related to SI joint fusion with Mayo Clinic Ventures and CoorsTek Medical
  
- None related to this talk

# GOALS AND OBJECTIVES

- Why the humerus is unique
- Principles of [nonoperative treatment](#)
- Surgical indications
- Pros and cons of [plating](#) and [nailing](#)
- How to manage radial nerve injury

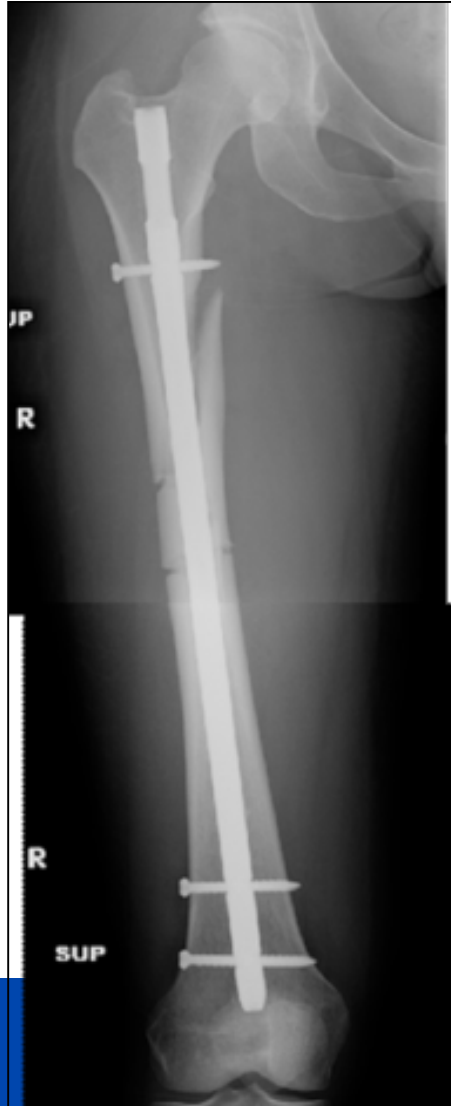
# HUMERAL SHAFT FRACTURES

- Different from other diaphyseal fractures
- Acceptable deformity much greater
  - Shoulder ROM
- Leg length inequality  $\neq$  arm length inequality



# HUMERAL SHAFT FRACTURES

***NON-OP WORKS!***



# NONOPERATIVE TREATMENT

- Hanging Arm Cast
- Coaptation Splint
- Velpeau
- Abduction Brace
- **Functional Brace**



# TREATMENT PROTOCOL

- Minimal reduction
- Over lateral deltoid
- Upright position
- Until comfortable



# FUNCTIONAL BRACE

- Prefabricated vs. custom
- Snug as tolerated
- Add collar and cuff
- Encourage early motion



# FUNCTIONAL BRACE



# FUNCTIONAL BRACING

Balfour et al, JBJS 1982

Zagorski, et al, JBJS 1988

Sarmiento et al, JBJS (Br) 1990

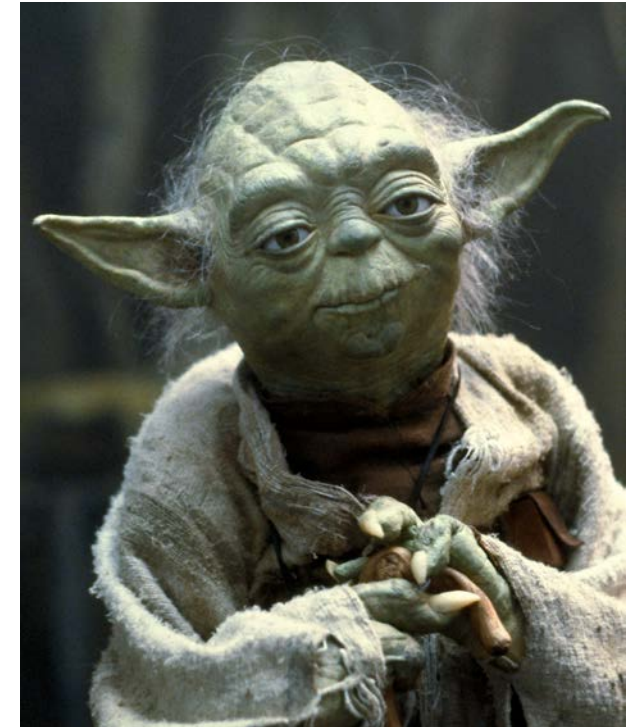
Wallny et al, JOT, 1997

Sarmiento et al, JBJS 2000

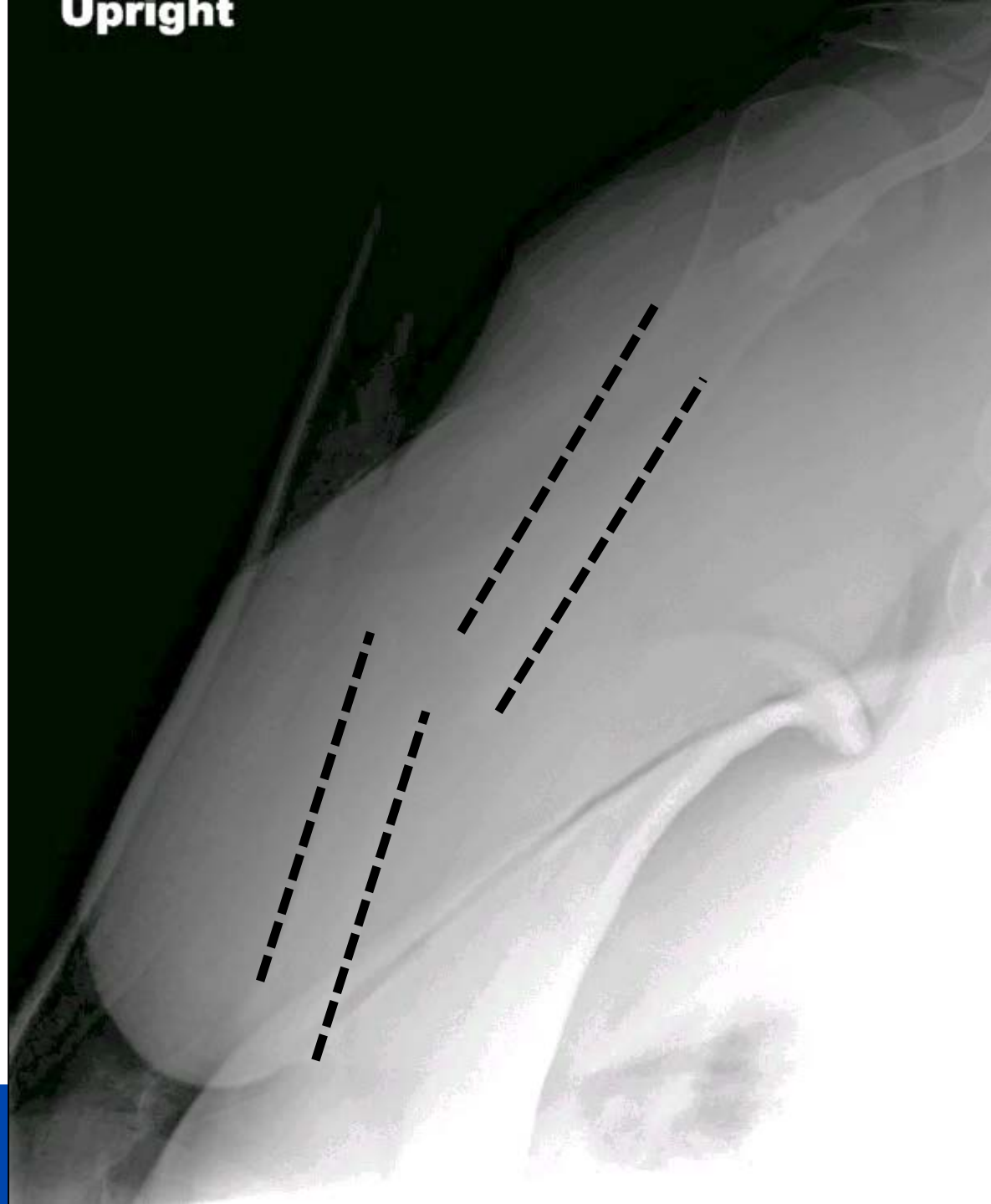
**UNION RATES: 94-100%**

## Words of Wisdom

- Apply coaptation splint in ER
  - May check ONE x-ray
  - Let hang out for a week or so
- Change to functional brace
  - May check ONE x-ray
- See back q2-3 weeks for imaging evaluation
- **Must Must** let gravity do its job
- Watch out for varus-producing anatomy



**Upright**



R  
JDH

UPRIGHT



Date/Time	Description	Dept	Imgs	Sta	Site
<input checked="" type="checkbox"/> 10-Feb-2012 13:21:00	R Humerus Upright	RAD	8	FNL	MCR
<input type="checkbox"/> 10-Feb-2012 13:21:00	R Humerus Upri...	RAD	8	FNL	MCR
<input type="checkbox"/> 10-Feb-2012 12:20:00	R Humerus Upri...	RAD	2	FNL	MCR
<input type="checkbox"/> 10-Feb-2012 11:00:00	R Humerus Upri...	RAD	2	FNL	MCR
<input type="checkbox"/> 30-Jan-2012 10:22:00	R Humerus Upri...	RAD	2	FNL	MCR
24-Jan-2012 18:46:00	Fluoro Assistan...	RAD	ARC	FNL	MCR
<input type="checkbox"/> 24-Jan-2012 18:25:00	R Humerus Upri...	RAD	3	FNL	MCR
24-Jan-2012 14:42:00	R Humerus 2vw...	RAD	ARC	FNL	MCR
24-Jan-2012 14:42:00	R Humerus 2vw...	RAD	ARC	FNL	MCR

**ALL IMAGES**

10-Feb-2012 13:21:00

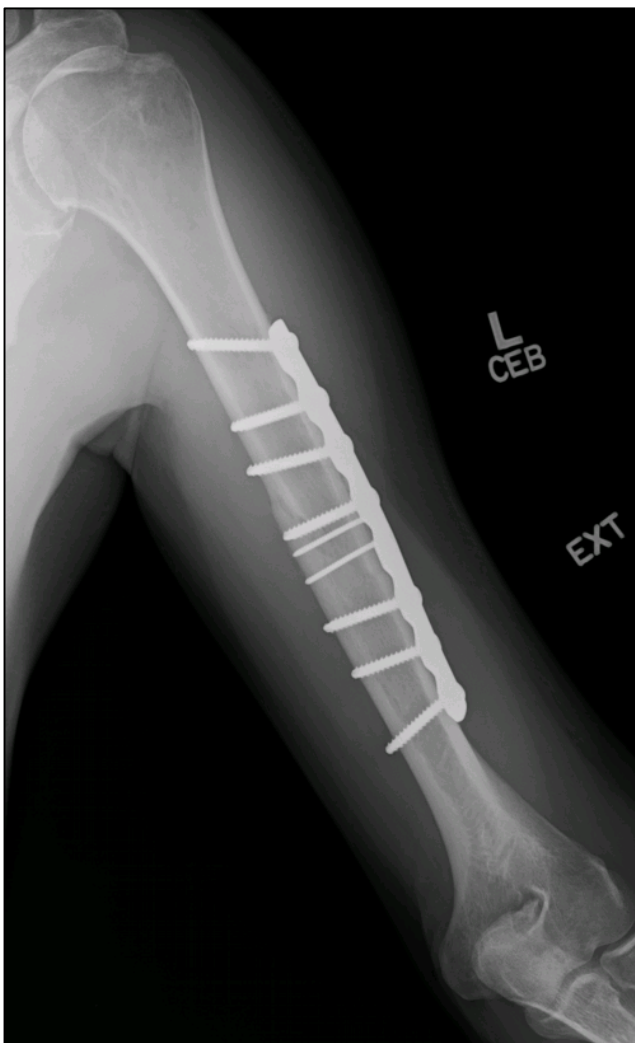
Se: 6001 Se: 6002 Se: 6001 Se: 6002 Se: 6001 Se: 6002 Se: 6001 Se: 6002



# HUMERAL SHAFT FRACTURES

- Almost all patients have some minor deformity and shortening
- **Acceptable Healing**
  - **20° anterior angulation**
  - **20° varus angulation**
  - **2.5 cm shortening**
- 40% have some loss of shoulder ROM
- 25% have some loss of elbow ROM

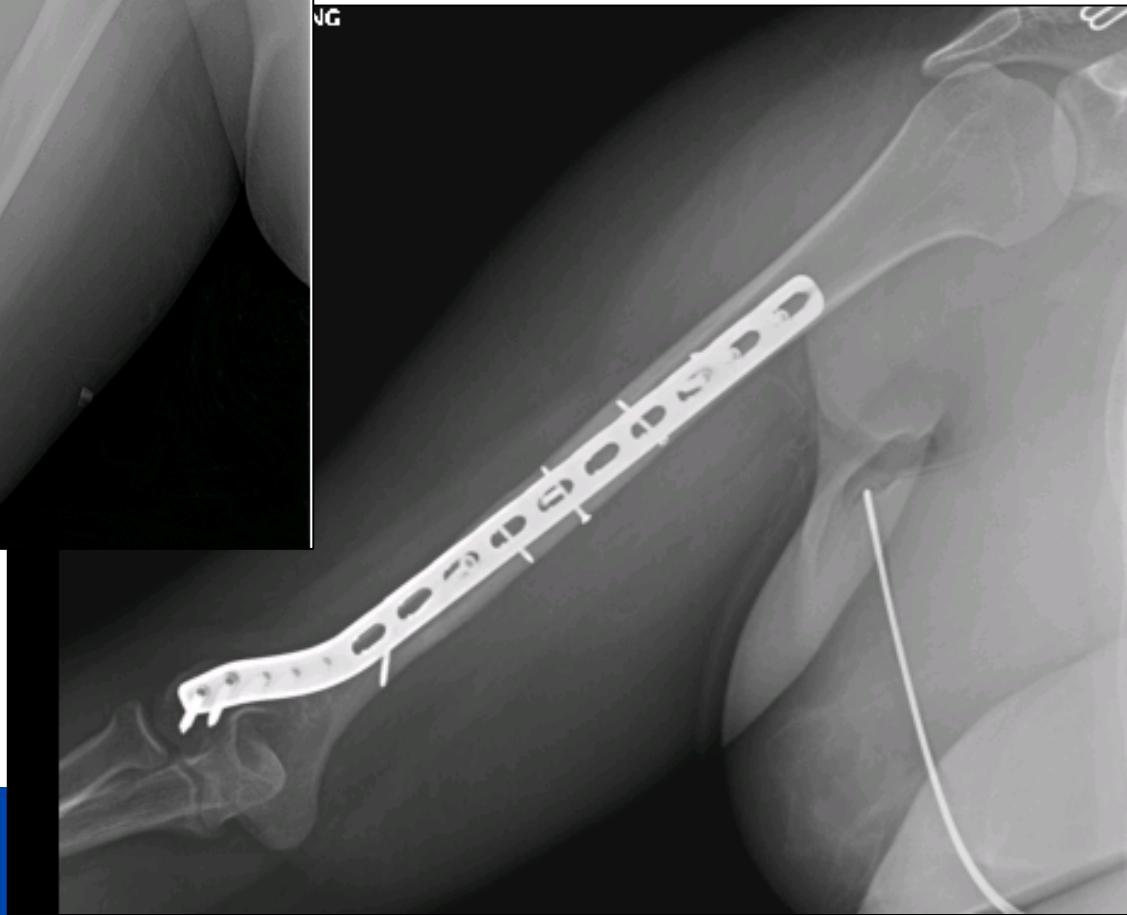




# OPERATIVE INDICATIONS

- **OPEN FRACTURES**
  - Significant soft tissue injury that precludes bracing
- **FLOATING ELBOW**
- **VASCULAR INJURY**
- **POLYTRAUMA**
- **PATHOLOGIC FRACTURES**
- **BRACHIAL PLEXOPATHY**
- **INTRA-ARTICULAR EXTENSION**
- **FAILURE OF NON-OPERATIVE MANAGEMENT**

# Bilateral Fractures



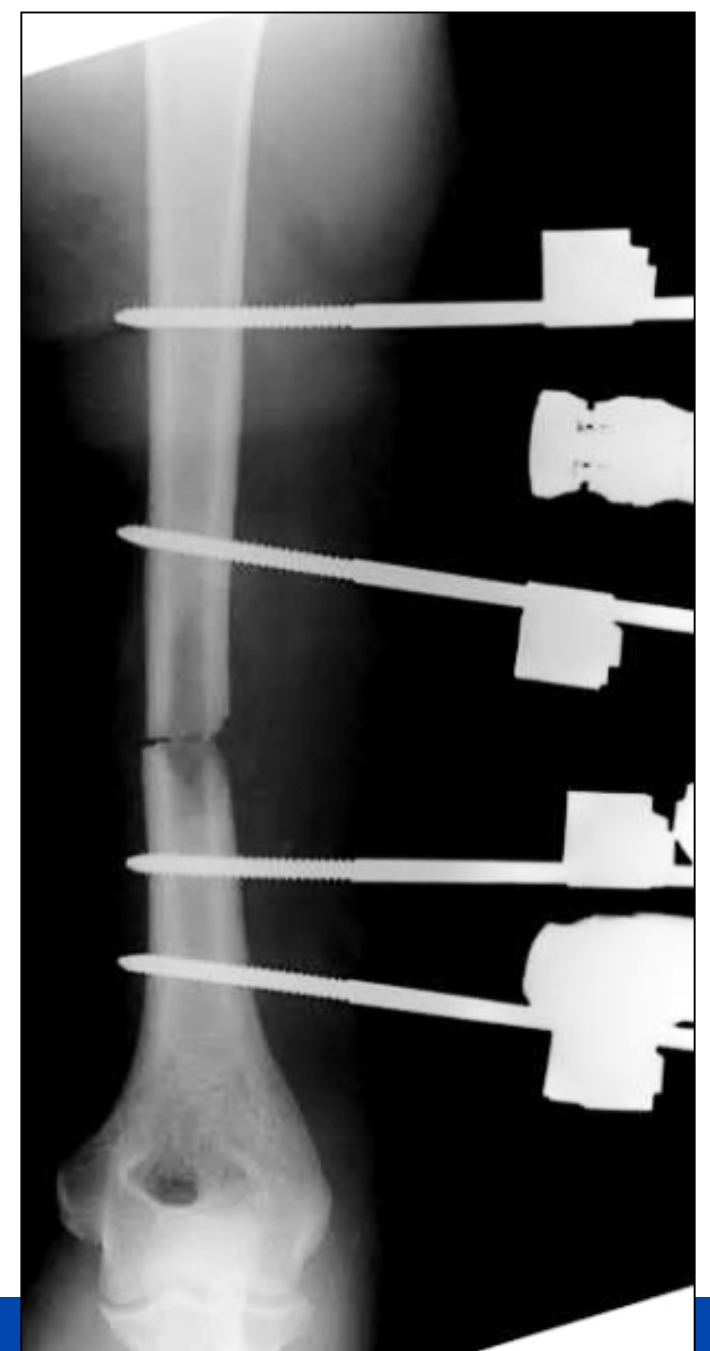
# OPERATIVE TREATMENT

- **ORIF with plates**
- **Antegrade nails**
- **Retrograde nails**
- **Flexible nails**
- **Flexible locked nails**
- **External fixation**



# EXTERNAL FIXATION

- Neurologic risk
  - Radial nerve
- Elbow and shoulder stiffness
- Pin tract infections
- Malunion
- Rarely used definitively



# EXTERNAL FIXATION

- **Massive soft tissue injury/contamination**
- **Vascular injury**
- **Severe polytrauma**



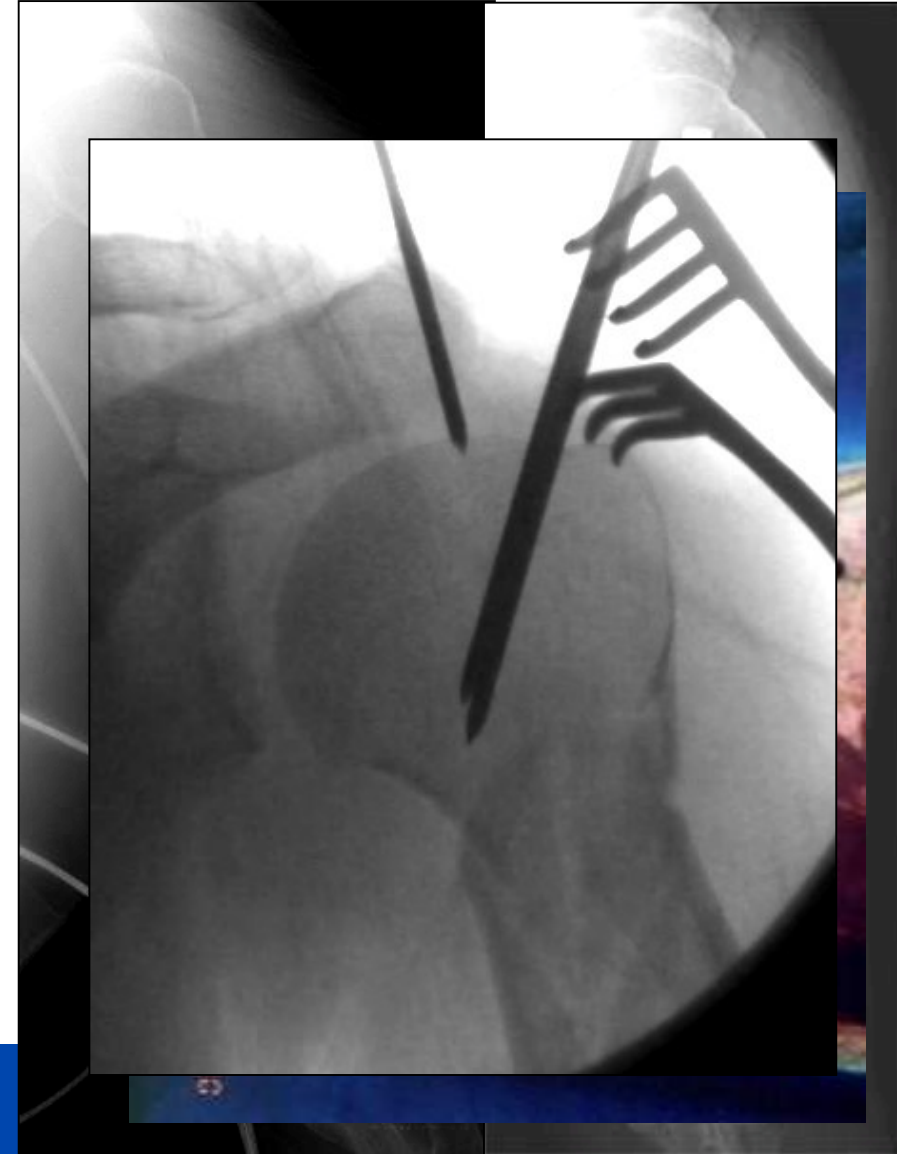
# ANTEGRADE NAILING

- Closed technique
- Load sharing
- Mechanical advantages
- Consider in:
  - Pathologic fx
  - Segmental fx
  - Polytrauma
  - Osteoporosis



# ANTEGRADE NAILING

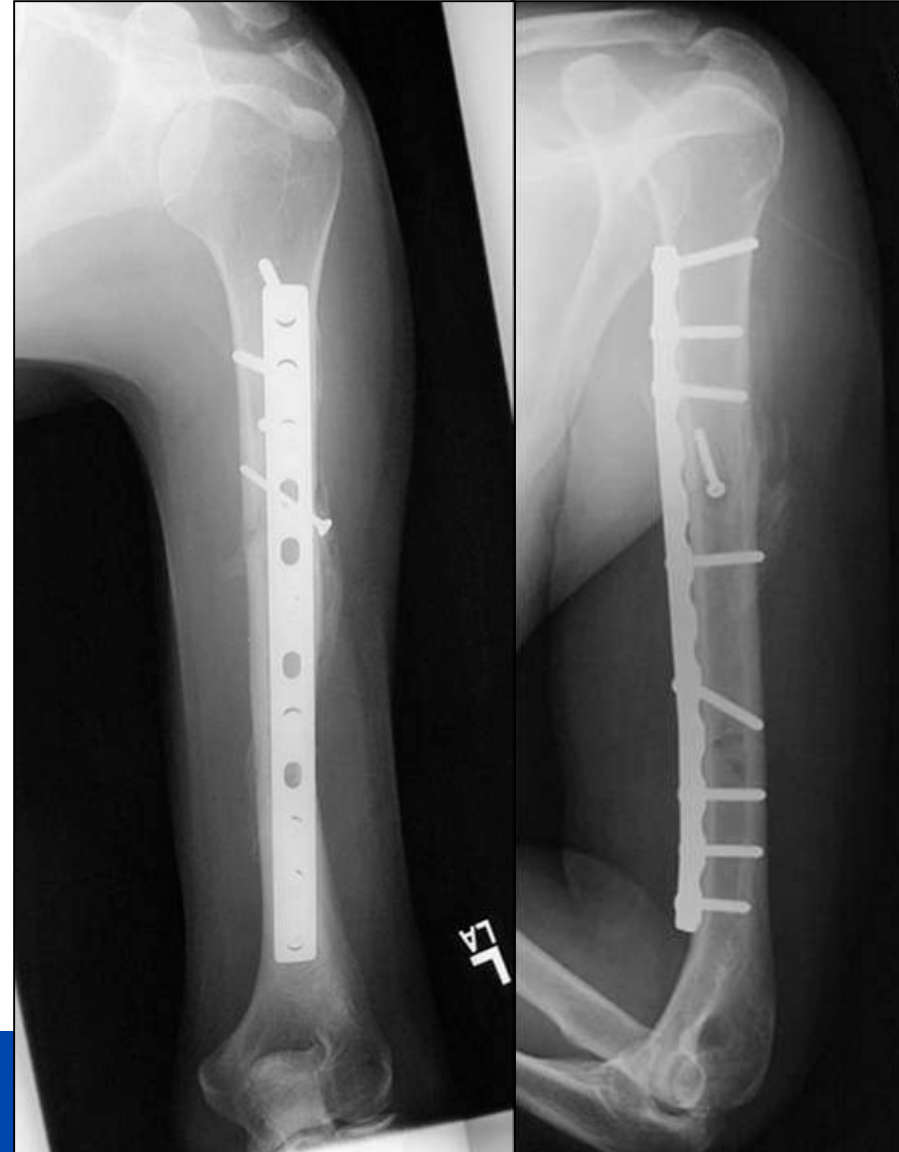
- Technical factors important:
  - Countersink nail
  - No fx distraction
  - Minimize cuff injury
    - Rotator interval
    - **Medial start point**
  - Avoid radial n. injury
    - Anatomic reduction or expose



# OPEN REDUCTION INTERNAL FIXATION

## ***GOLD STANDARD***

- Anatomic reduction/ compression or bridging
- High union rates (96%)
- Exposures extensile
- Allows radial nerve protection
- Early weight bearing



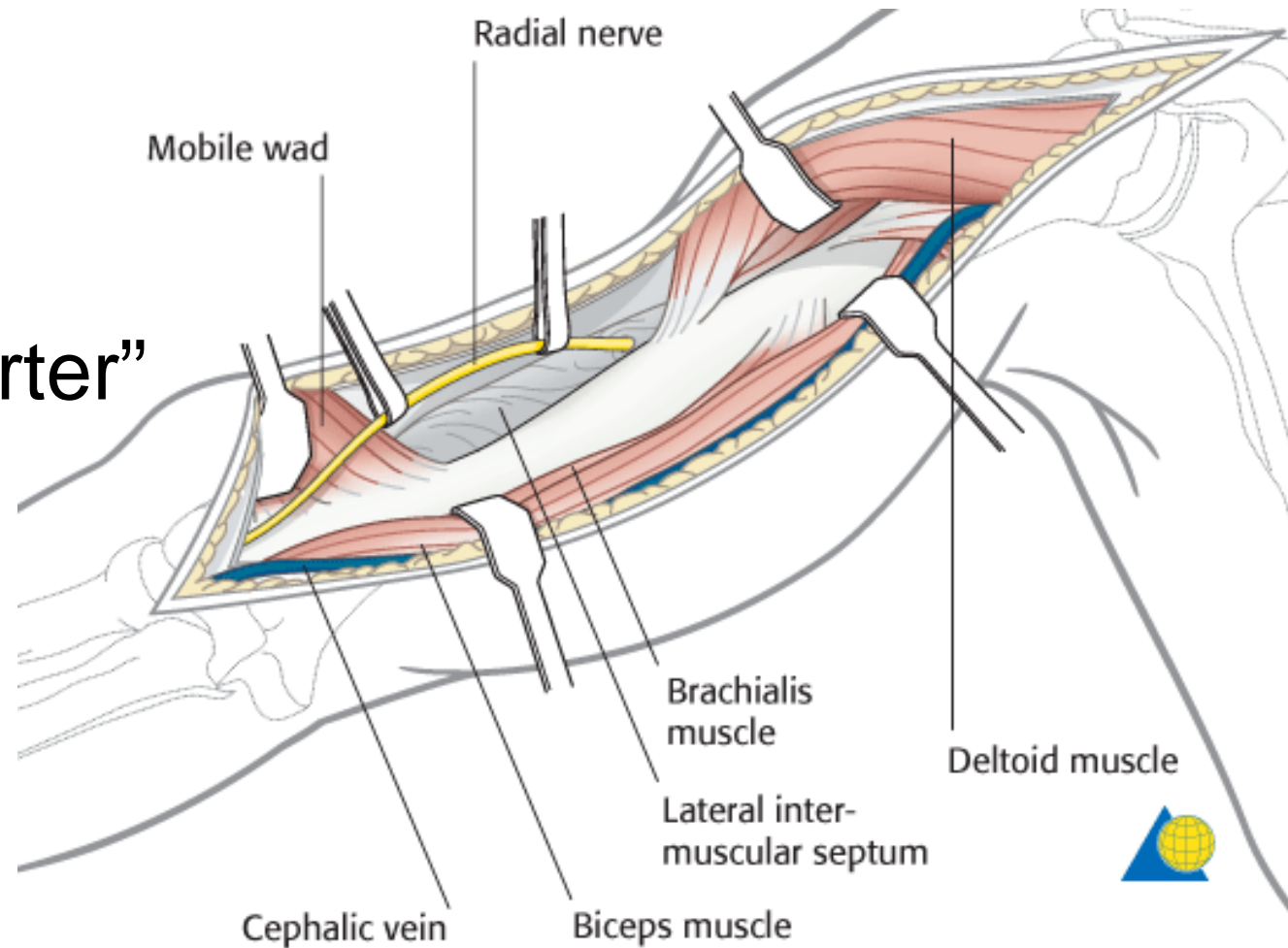
# OPEN REDUCTION INTERNAL FIXATION

- Plate size:
  - 4.5 broad LC-DCP
    - Historical
  - **4.5 narrow LC-DCP**
    - **Current**
  - 3.5 LC-DCP
    - Future?
- Over-contour posterior plate
- **No shorties!!**
- Locking screws typically not necessary



# ANTEROLATERAL APPROACH

- Extensile
  - DP proximally
- “Cannot access distal quarter”
- Retract biceps medially
- Elevate brachialis

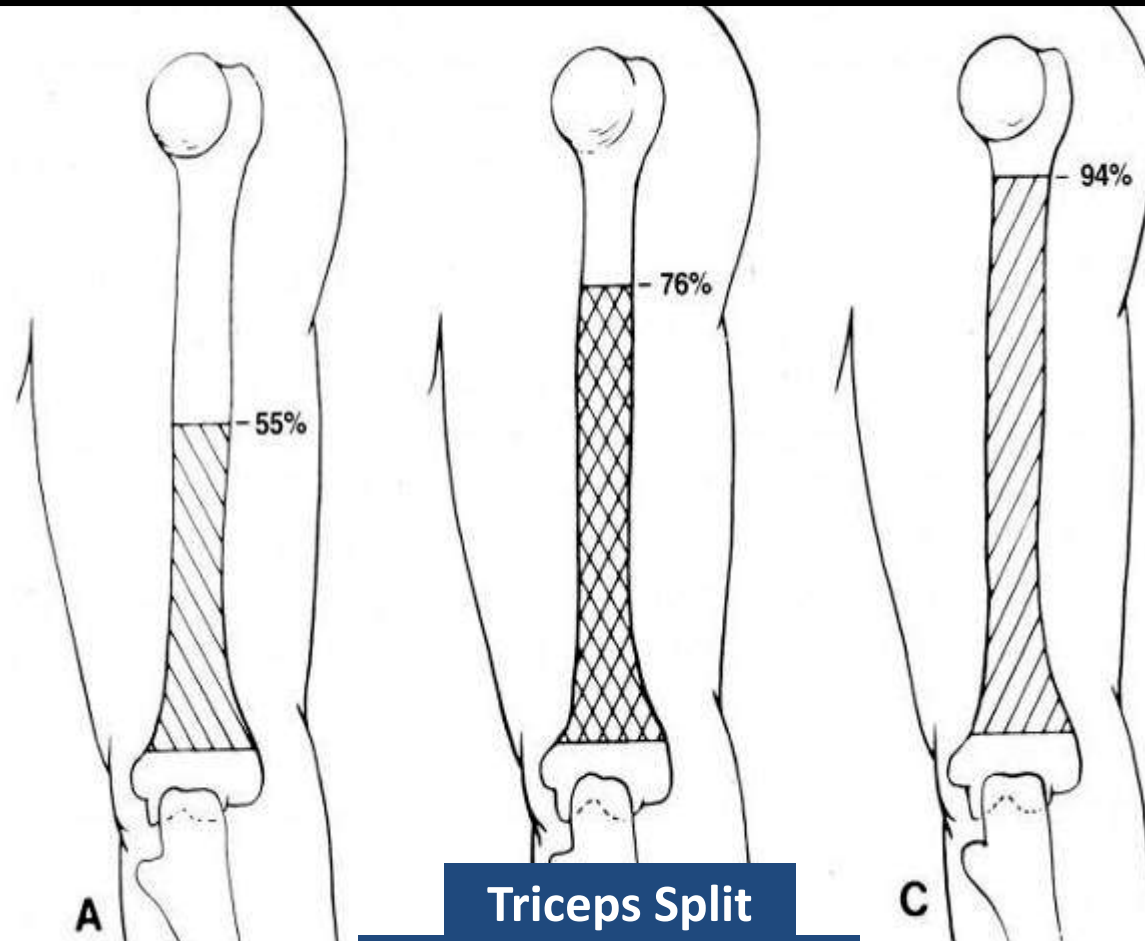


# Alternative Operative Exposures of the Posterior Aspect of the Humeral Diaphysis

WITH REFERENCE TO THE RADIAL NERVE\*

BY MICHELLE GERWIN, M.D.†, ROBERT N. HOTCHKISS, M.D.†, AND ANDREW J. WEILAND, M.D.†, NEW YORK, N.Y.

*Investigation performed at The Hospital for Special Surgery, New York City*



**A**  
Triceps Split

**B**  
Triceps Split  
& nerve mobilization

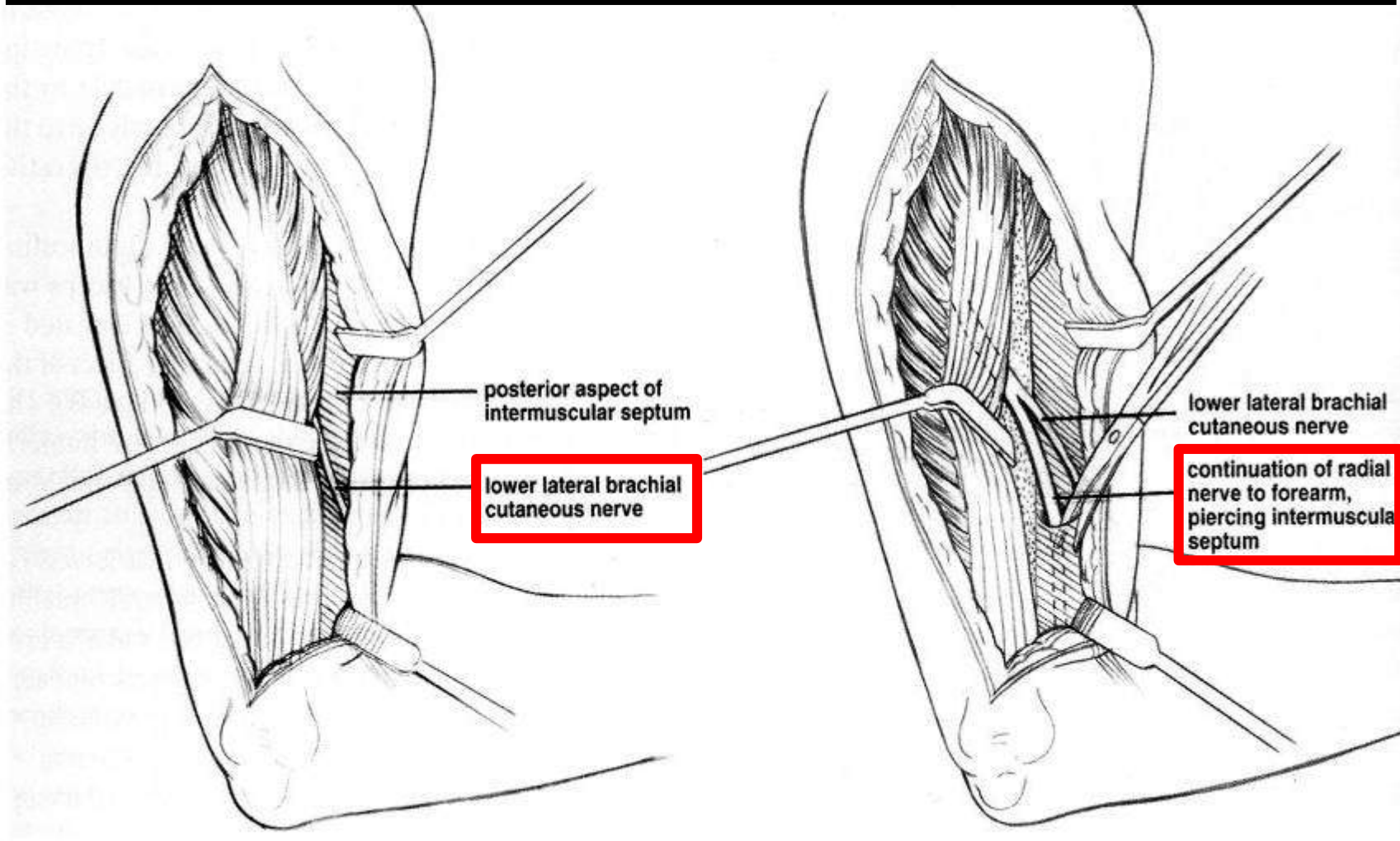
**C**  
Triceps Sparing

# Alternative Operative Exposures of the Posterior Aspect of the Humeral Diaphysis

WITH REFERENCE TO THE RADIAL NERVE\*

BY MICHELLE GERWIN, M.D.†, ROBERT N. HOTCHKISS, M.D.†, AND ANDREW J. WEILAND, M.D.†, NEW YORK, N.Y.

*Investigation performed at The Hospital for Special Surgery, New York City*



# NAIL VS PLATE: PRT's

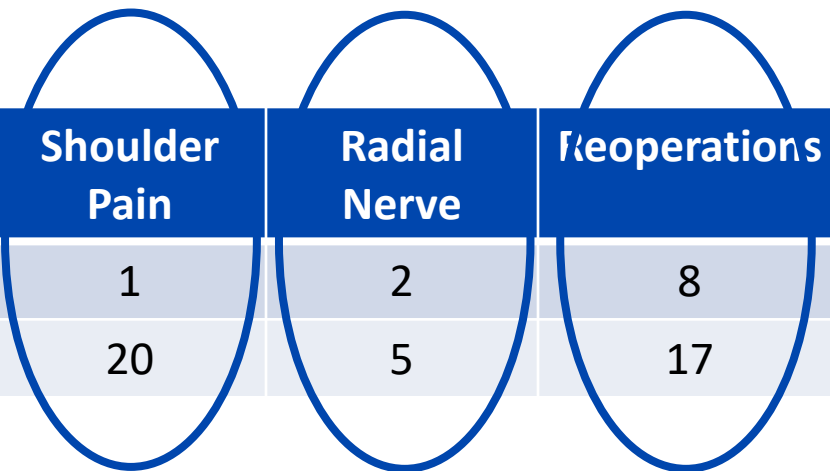
Changulani et al., SICOT 2006

Chapman et al., JOT 2000

McCormack et al., JBJS[Br] 2000

Bolano et al., AAOS 1995

	n	Nonunion	Infection	Shoulder Pain	Radial Nerve	Reoperations
Plate	105	8	6	1	2	8
Nail	87	11	2	20	5	17



# RADIAL NERVE PALSY? **CLOSED** FRACTURE

*Pollack et al, JBJS, 1981*

- 24 Radial Nerve Palsies
- Incidence: 11%
- All Resolved Eventually
- 8% (2) Required Late Exploration

**RECOMMENDATION:**  
Don't need to explore early  
Spontaneous recovery rate 90-95%

# RADIAL NERVE PALSY? **OPEN** FRACTURE

*Foster et al, JHS, 1993*

- 14 Patients with open fractures
- 64% (9) with nerve injury interposed or lacerated

**RECOMMENDATION:**  
Explore and ORIF

# **CLOSED FRACTURE**

## **Radial n palsy **after** reduction**

*Bostman et al., Acta Orthop Scand 1986*

- 59 patients : immediate radial nerve palsy
  - Useful recovery: 46/59 (88%)
- 16 patients: secondary radial nerve palsy
  - Useful recovery: 14/16 (87.5%)

**RECOMMENDATION:**  
Exploration not required  
(More controversial)

# Radial Nerve Palsy After Humeral Shaft Fractures



## The Case for Early Exploration and a New Classification to Guide Treatment and Prognosis

Gerard Chang, MD\*, Asif M. Ilyas, MD [Hand Clin 34 \(2018\) 105–112](#)

- 30% don't recover – explore early to explore
  1. Early nerve injury characterization, subsequent early treatment – Time dependent repair and outcomes correlate
  2. Early exploration is significantly easier
  3. Allows concomitant ORIF = quicker functional recovery and rehab
  4. “Facilitates” primary bone healing and decreases chances of 2<sup>o</sup> bone healing with nerve entrapment

# RADIAL NERVE RECOVERY

- Average time to first sign of recovery: 7 weeks
  - But may take as long as 6 months!
- Average time to complete recovery: 6 months
  - But may take as long as 21 months!

# Case example

- 75 y/o active male
- Non smoker
- Right side weak from head injury 1968
  - **Mildly** hemiparetic

R  
MMK  
©

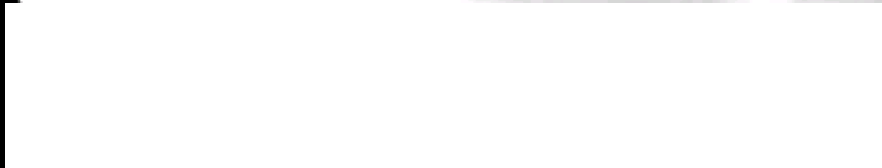
Neutral



- 10 weeks after nonop mgmt trial

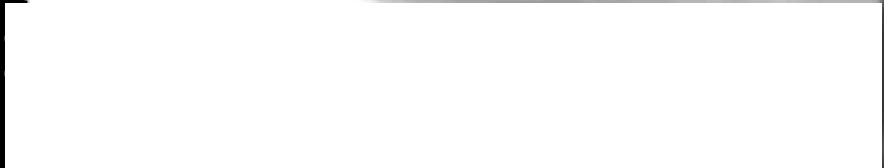


Gen  
LIH 3 1



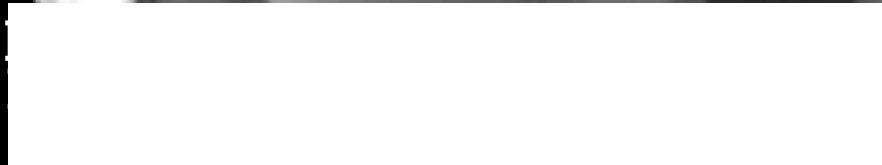
Siemens

Gen  
LIH 5 1

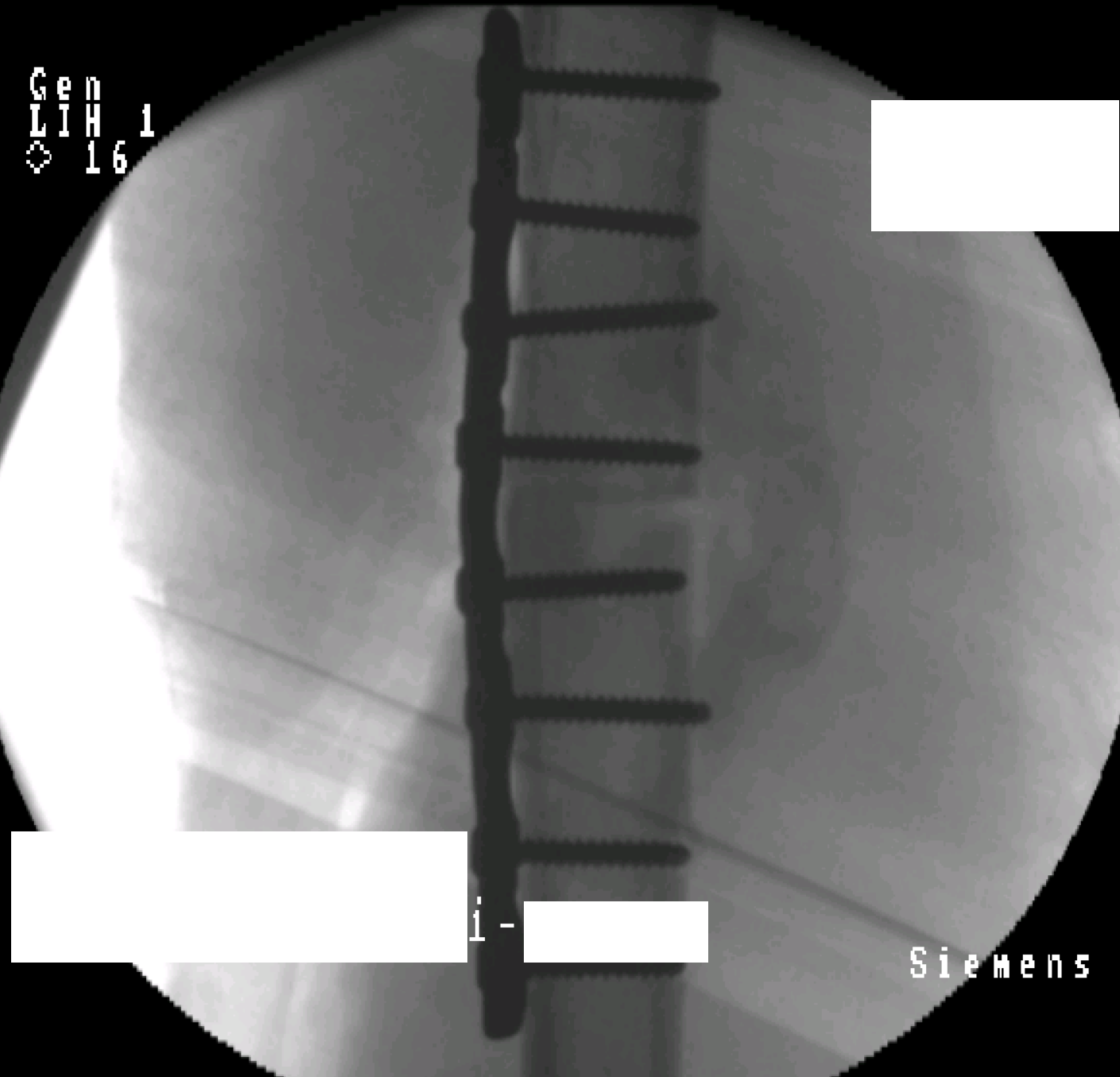


Siemens

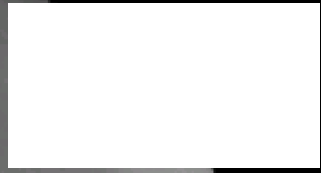
Gen  
LIH 8 1



Siemens

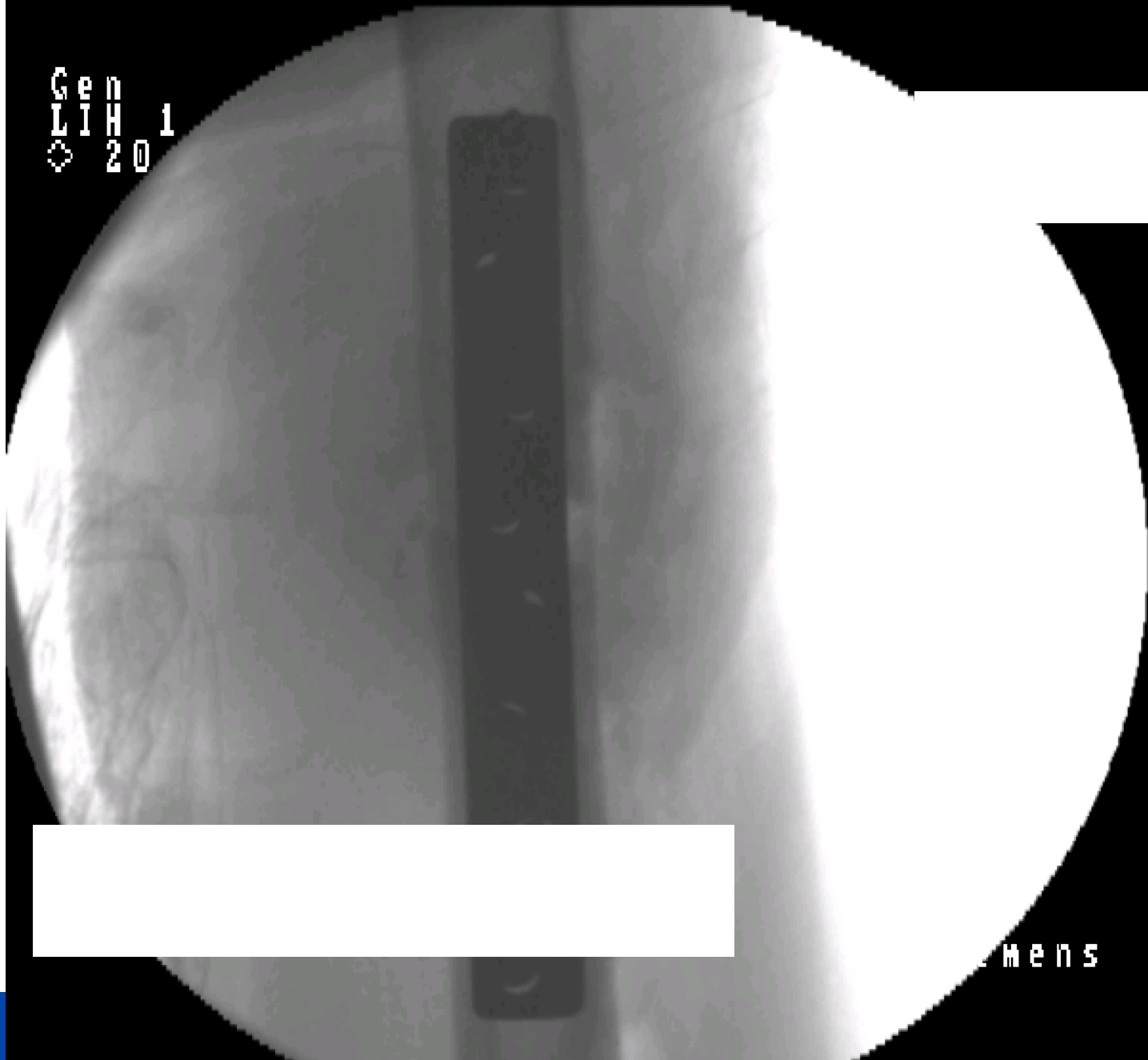


GPD  
LIH 1  
16



Siemens

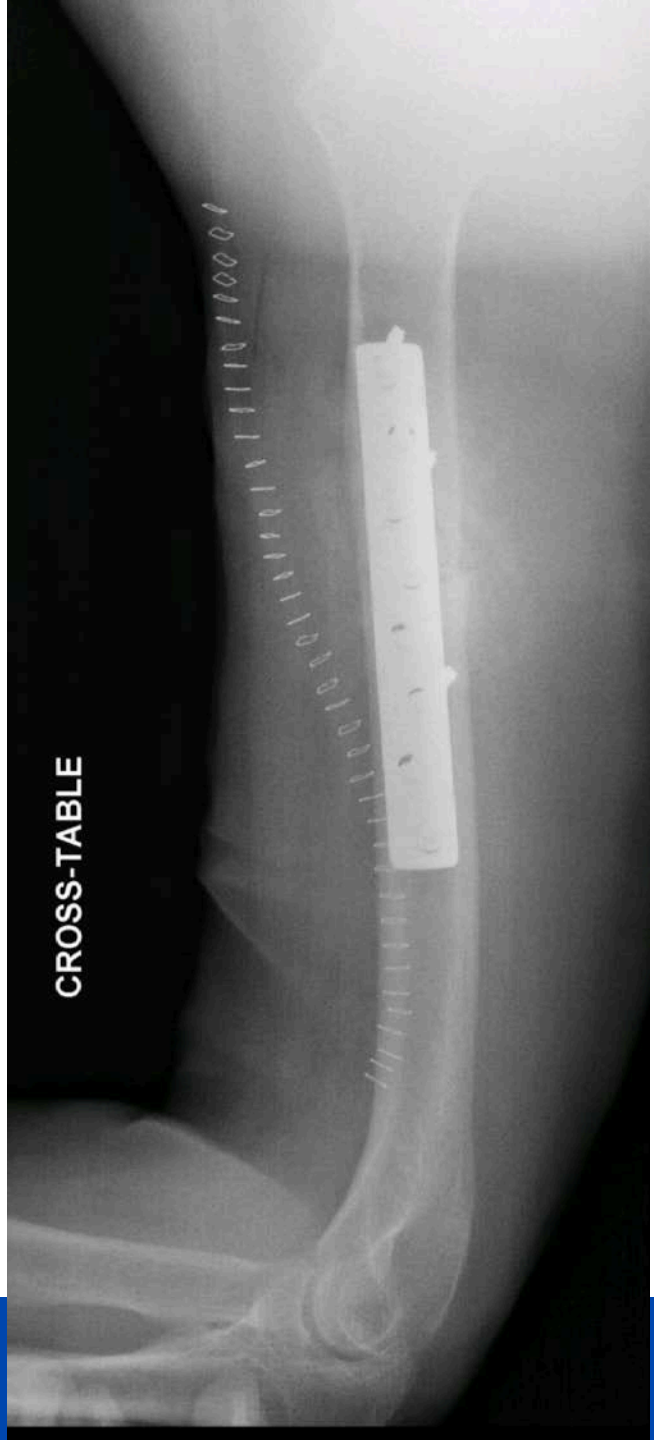
Gen  
L1H 20 1



mens

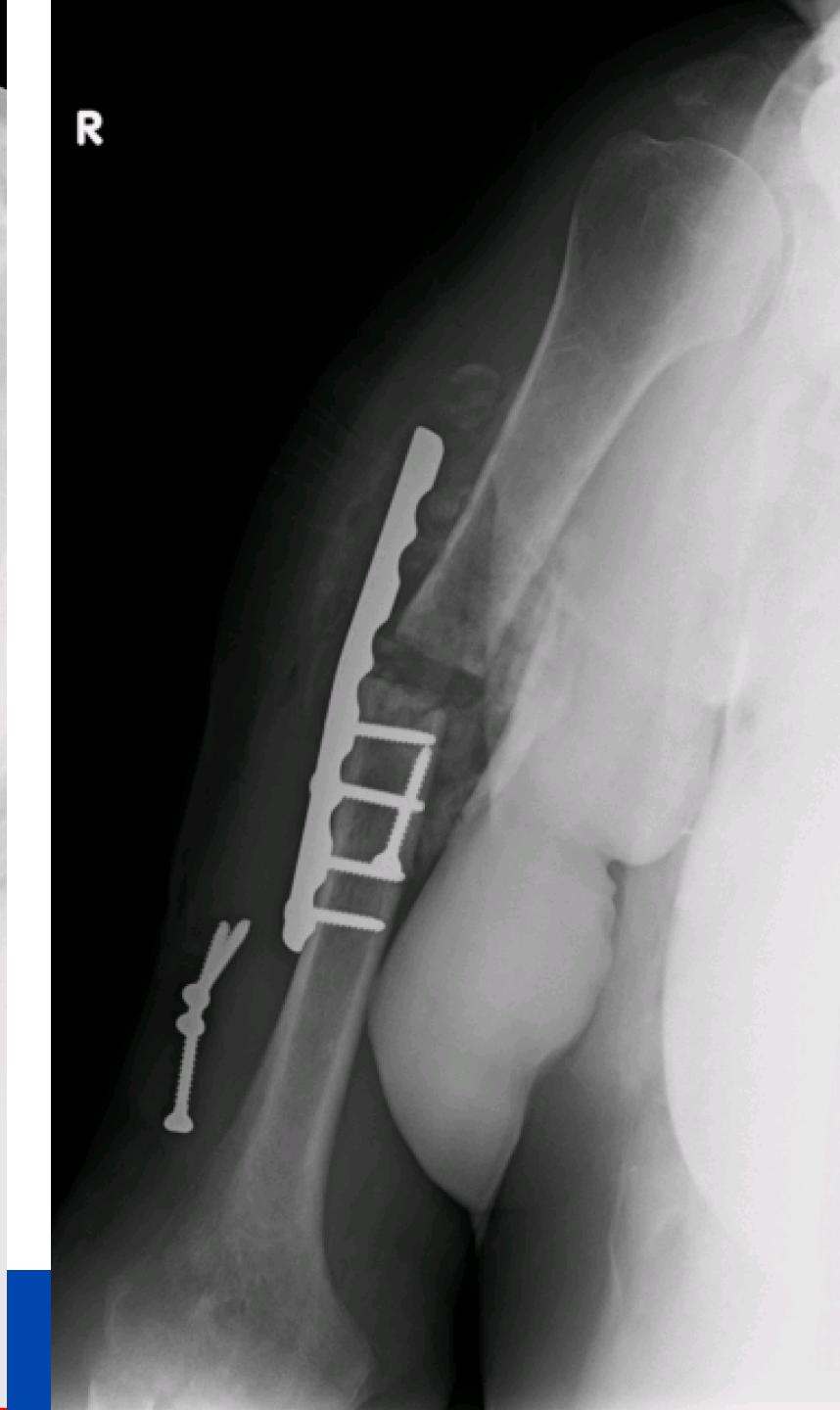


R  
SAN



CROSS-TABLE

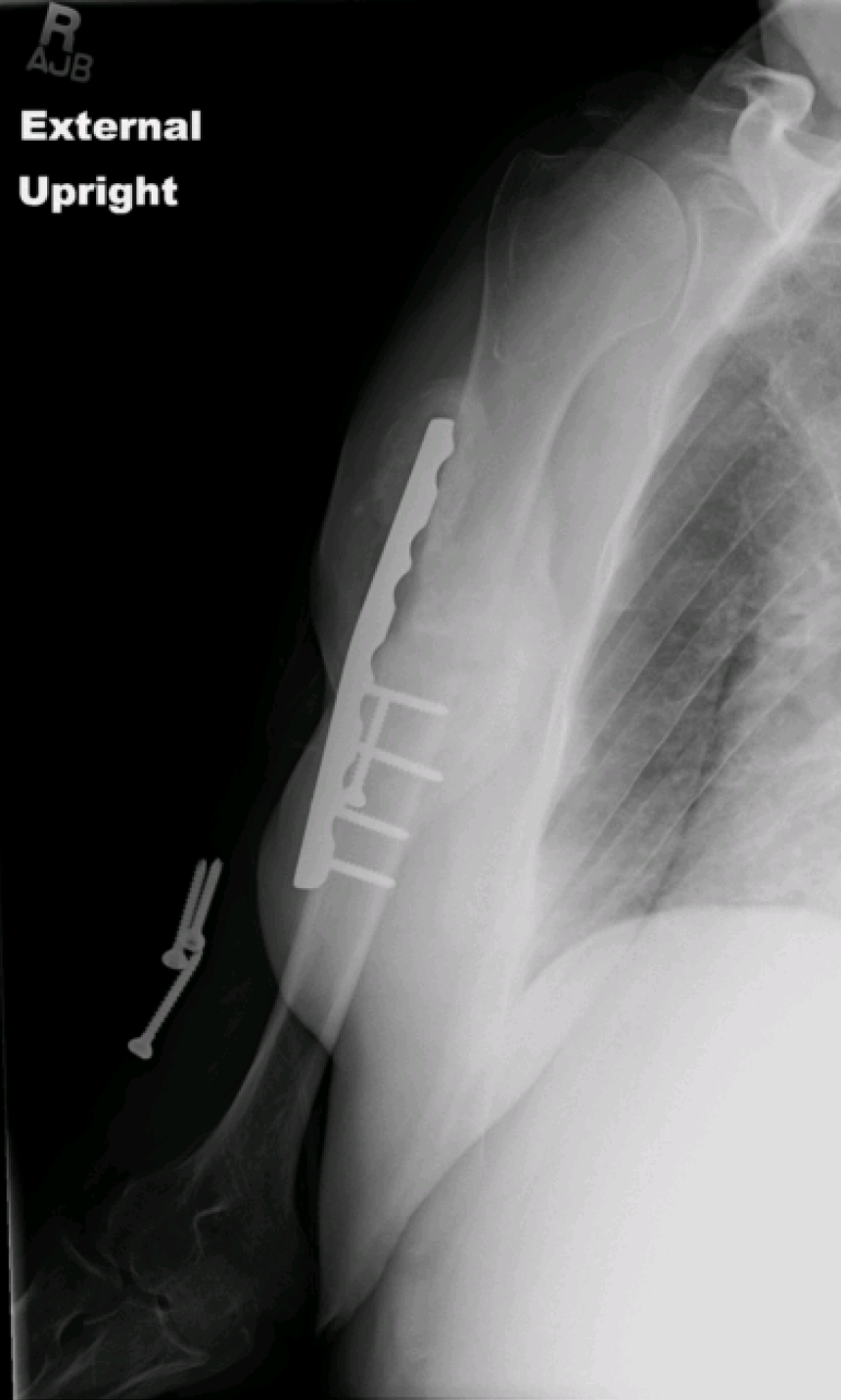
3 weeks postop



3.5 months later

R  
AJB

**External  
Upright**

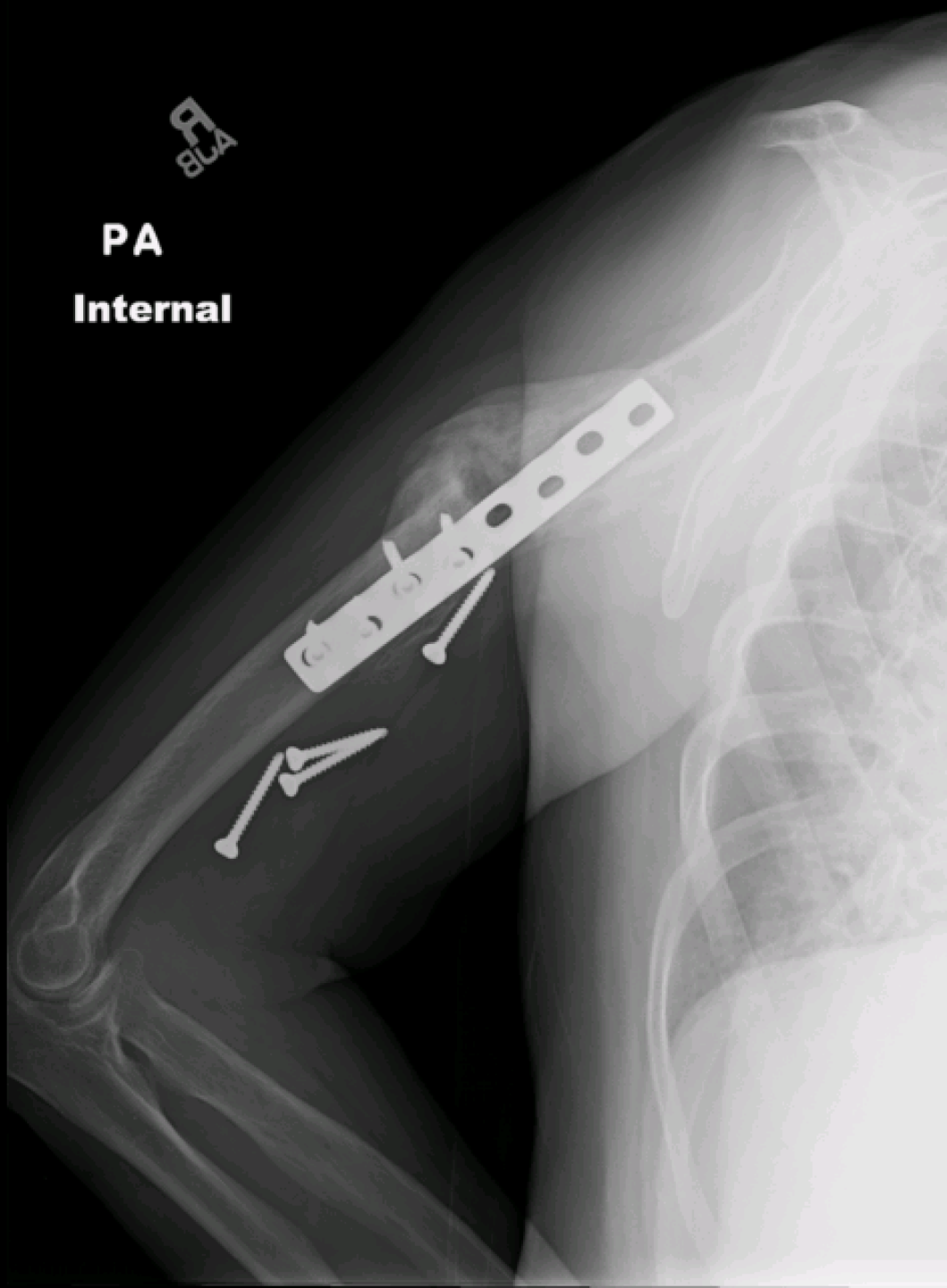


**Right  
Internal**



R  
BLA

PA  
Internal





Used with  
patient  
permission

# My Practice: Humeral Shaft Fractures

- Patient history and desires
- Trial of nonop management
- Not 3 months!
  - Pull trigger at 6 weeks
- Plate is my implant preference (4.5 narrow, non-locked)
  - Posterolateral approach (Gerwin-Hotchkiss)
- Nailing-pendulum may swing back in favor
  - Straight nails

# SUMMARY

- Closed treatment in most injuries
  - Early functional brace
- Know multiple treatment options
  - Customize care based on pt/injury factors
- Know exposures
- Plates work well – go long or go home!
- Radial nerve injury  $\neq$  surgery?? Discussion...
- Technique, technique, technique!