



Current Concepts in Shoulder Arthroplasty

Spencer E. Romine, MD

Objectives

- **Goal:** treat our patients BETTER

Understand:

- Shoulder Pathology
- Arthroplasty Surgical options
- Therapy pearls

R



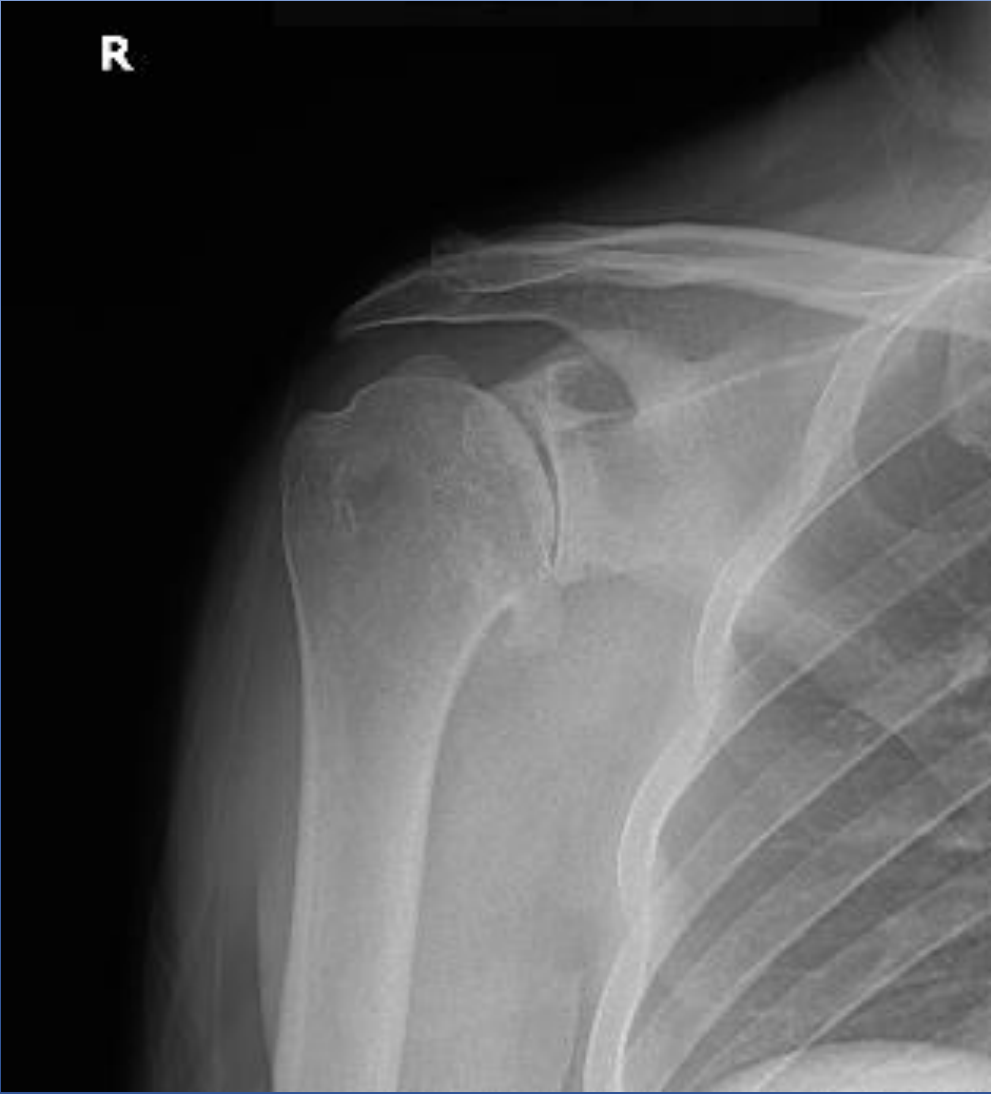
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What do you want to know?



What I want to know?

- Age
- Activity/Job
- Etiology
- Cuff integrity
- Treatment thus far:
 - medications, injections
 - therapy
 - Surgery



What I know?

- Age – 35 YO Male
- Activity/Job – laborer
- Jet ski accident when 19 YO
- Options:
 - injections - multiple
 - therapy – made it worse
 - Surgery – he’s ready
- MRI – cuff intact



Surgical Options

- Arthroscopy
- Arthroplasty
 - Hemiarthroplasty/Resurfacing
 - Total Shoulder Arthroplasty (TSA)
 - Reverse Total Shoulder Arthroplasty (RTSA)

SHOULDER ARTHROPLASTY



- Rapid increase in United States
- Estimate 55-80,000 per year
- **50% are reverse replacements** (200% increase in past 10 years)
 - approved by FDA in 2004
 - no longer requires a “specialist”
 - rapid expansion of indications, implant designs
 - younger patients (no longer just on >70 YO)

Wagner ER, Farley KX, Higgins I, Wilson JM, Daly CA, Gottschalk MB: The incidence of shoulder arthroplasty: Rise and future projections compared with hip and knee arthroplasty. J Shoulder Elb Surg 2020;29:2601-2609.

Preop Thought Process:

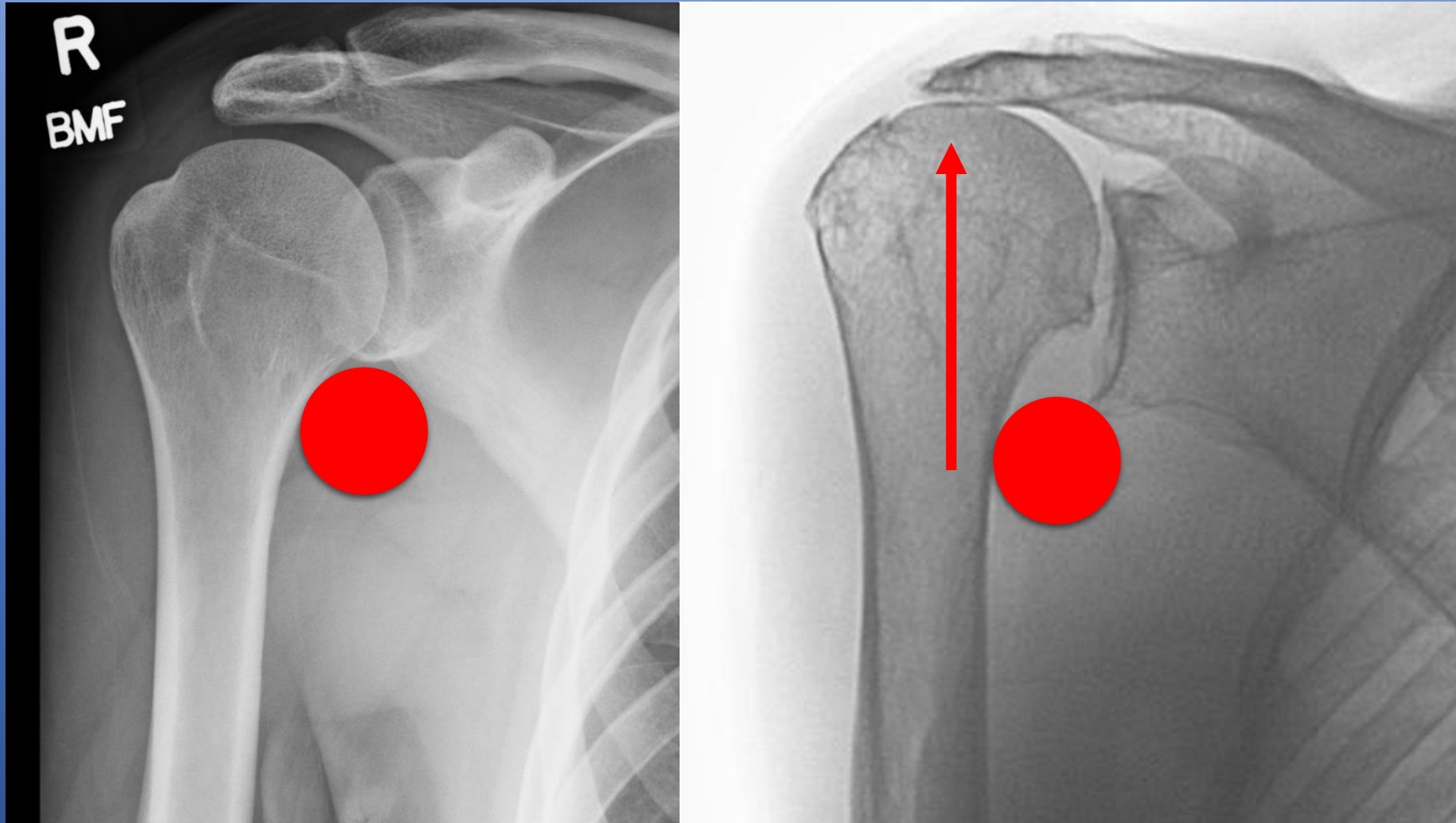
- Patient characteristics
 - age, activity level, bone quality, preop function
- Imaging
- Patient expectations – pain control, function
- History of infection, dentition
- Anticoagulants
- Blood dyscrasias

Pathology for Arthroplasty

- Osteoarthritis
 - Primary
 - Posttraumatic
 - Secondary (Ex. Rheumatoid, Psoriatic)
- Rotator Cuff Arthropathy, Failed RCR  RTSA
- Proximal humerus fractures (acute, malunion, nonunion)  RTSA
- AVN

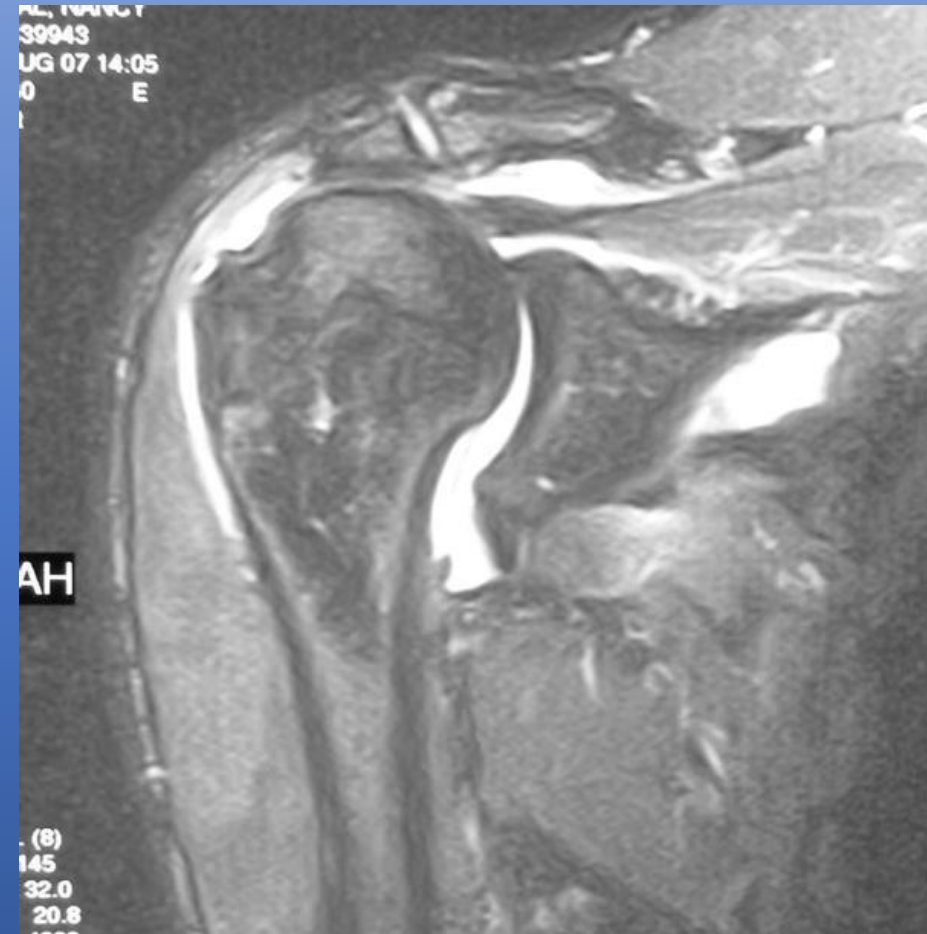
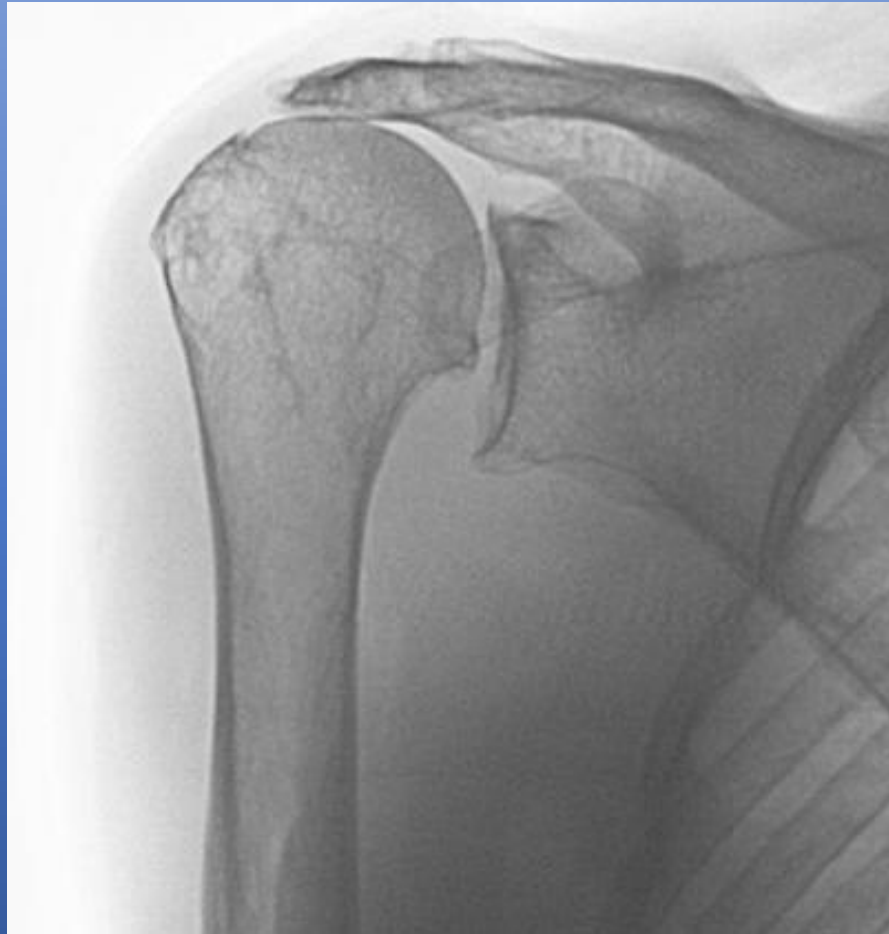
All of these can be treated with RTSA, but not all can be treat with TSA/Hemi

Rotator Cuff Tear Arthropathy



Humeral Head Depressor

Rotator Cuff Tear Arthropathy



Humeral Head Depressor

Arthroplasty Options

- Hemiarthroplasty (Resurfacing)
- Total Shoulder Arthroplasty
- Reverse Total Shoulder Arthroplasty

HOW TO DECIDE?

OSTEOARTHRITIS: HOW to DECIDE?

- Is the Rotator cuff intact?
 - Yes - all apply, need more info (go to step 2)
 - No - RTSA
- Is the intact Rotator cuff healthy?
 - patient's age (chronological and physiological)
 - preoperative function (motion/strength)
 - tobacco use – subscapularis healing with hemi/TSA
 - Rheumatoid disease, etc



The influence of preoperative rotator cuff cross-sectional area and strength on postoperative outcomes in reverse shoulder arthroplasty



Kunal M. Kirloskar, MS^a, Paulina M. Szakiel, MS^a, Maxwell D. Gruber, MS^b, Brian C. Werner, MD^c, Patrick J. Denard, MD^{d,*}

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^cUniversity of Virginia, Charlottesville, VA, USA
^dOregon Shoulder Institute, Medford, OR, USA

Background: Although preoperative function and range of motion (ROM) are determinants of postoperative outcome following reverse shoulder arthroplasty (RSA), there is limited data on the influence of preoperative rotator cuff status. The purpose of this study was to evaluate the relationship between preoperative rotator cuff physiologic cross-sectional area (PCSA) and strength on postoperative RSA outcome.

Methods: A retrospective review was conducted on 53 primary RSAs from a multicenter database performed between 2015 and 2019 using a 135° humeral neck-shaft angle. Preoperative magnetic resonance imaging and computed tomographic scans were used to assess the PCSA of the subscapularis, supraspinatus, infraspinatus, and teres minor. American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form (ASES) scores, ROM, and strength were measured preoperatively and at a minimum of 2 years postoperatively. Correlation coefficients were used to determine the relationship between variables.

Results: There were no significant correlations between preoperative PCSA of any rotator cuff muscles and postoperative ASES scores. Preoperative subscapularis PCSA positively correlated with change in belly press (BP) strength following RSA ($\rho = 0.37, P = .006$). Preoperative abduction strength was significantly correlated with postoperative abduction strength ($\rho = 0.297, P = .006$). Preoperative external rotation (ER) strength was significantly correlated with postoperative ER ($\rho = 0.378, P = .005$) and abduction ($\rho = 0.304; P = .032$) strength. Preoperative BP strength negatively correlated with postoperative ASES ($\rho = -0.283, P = .042$) but positively correlated with postoperative BP ($\rho = 0.411, P = .001$) and abduction ($\rho = 0.367, P = .009$) strength.

Conclusion: With the use of a 135° humeral implant, there is limited correlation between preoperative PCSA and postoperative outcomes 2 years following RSA; the only significant correlation was between preoperative subscapularis PCSA and postoperative BP strength. Preoperative strength is positively correlated with postoperative strength but not ROM or ASES scores.

Level of evidence: Level IV; Case Series; Prognosis Study

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Keywords: Reverse shoulder arthroplasty; cross-sectional area; functionality; outcomes; ROM; strength

Southern Oregon Institutional Review Board approved this study (IRB no. 15-001).

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<https://doi.org/10.1016/j.jse.2022.04.003>

Reverse shoulder arthroplasty (RSA) has become a mainstream treatment for various glenohumeral pathologies including proximal humerus fractures, large irreparable rotator cuff tears, and end-stage glenohumeral arthritis.²⁵ Despite improvement in pain, forward flexion, and

Background:

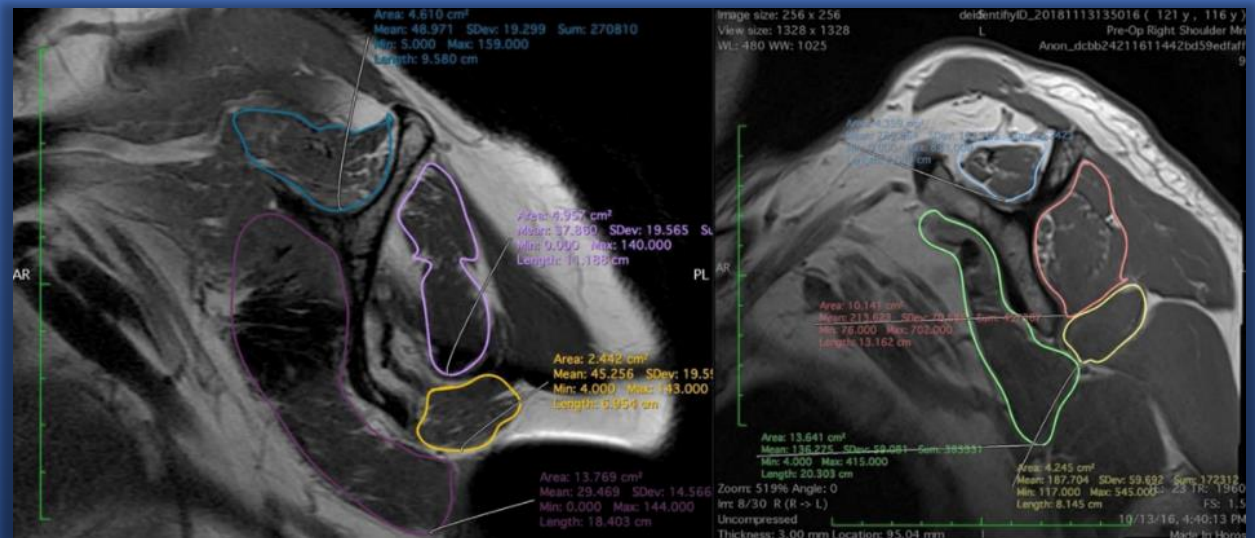
- RSA increasingly being performed for both RTC intact & deficient conditions
- Variable effect of RSA to improve ER & strength

Aim:

- Determine whether cross-sectional area of RTC musculature correlated with outcomes
- Determine if preoperative RTC strength affected outcomes

Methods:

- Primary RSA for CTA or OA
- Outcomes, strength, ROM assessed at min of 2 years





The influence of preoperative rotator cuff cross-sectional area and strength on postoperative outcomes in reverse shoulder arthroplasty

Kunal M. Kirloskar, MS^a, Paulina M. Szakiel, MS^a, Maxwell D. Gruber, MS^b, Brian C. Werner, MD^c, Patrick J. Denard, MD^{d,*}

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Results:

- No correlation with RTC cross-sectional area & postoperative ASES & ROM
- Preop ABD, ER, & BP strength correlated with postoperative strength
- Preop strength negatively correlated with Δ Strength

Clinical Application:

- Outcomes following RSA less dependent upon RTC integrity & more dependent upon deltoid and periscapular musculature when using 135° NSA inlay, lateralized glenoid system
- Use of lateralized glenoid design is a powerful mechanism to improve ER ROM, postoperative outcomes & potentially strength

Who is a candidate for a Hemi or TSA? (in my practice, must impress me)

- PRISTINE cuff
- “Younger” active patient
- Preop range of motion – “cuff may be intact, but is it healthy?”
- No Tobacco – healing of subscapularis
- Willing to have a slower rehab schedule

Hemiarthroplasty/Resurfacing:

- Younger patient
- Minimal glenoid deformity, concentric wear
- **Resurfacing**
 - retain bone stock
 - easy to revise
 - native glenoid for revision
 - **Revision of TSA is tough!!**





Surgical Options

35 YO M nonsmoker, laborer, with post-traumatic OA, cuff intact

- Arthroscopy
- Arthroplasty
 - Hemiarthroplasty/Resurfacing
 - Total Shoulder Arthroplasty (TSA)
 - Reverse Total Shoulder Arthroplasty (RTSA)

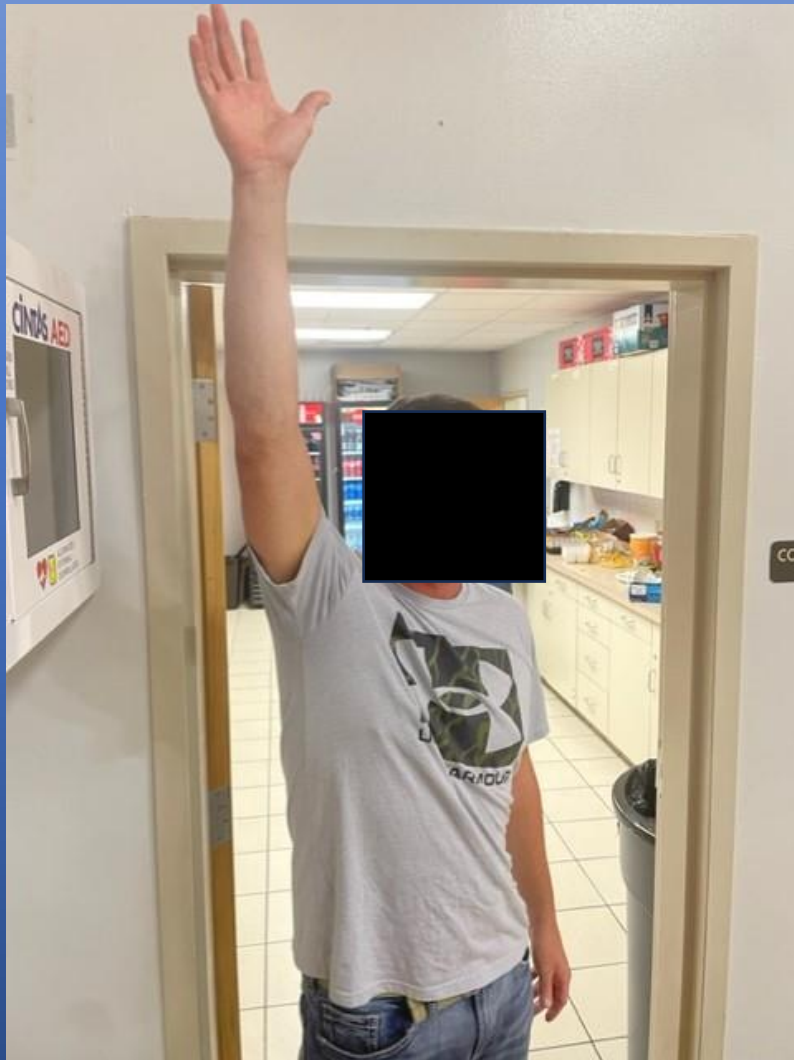
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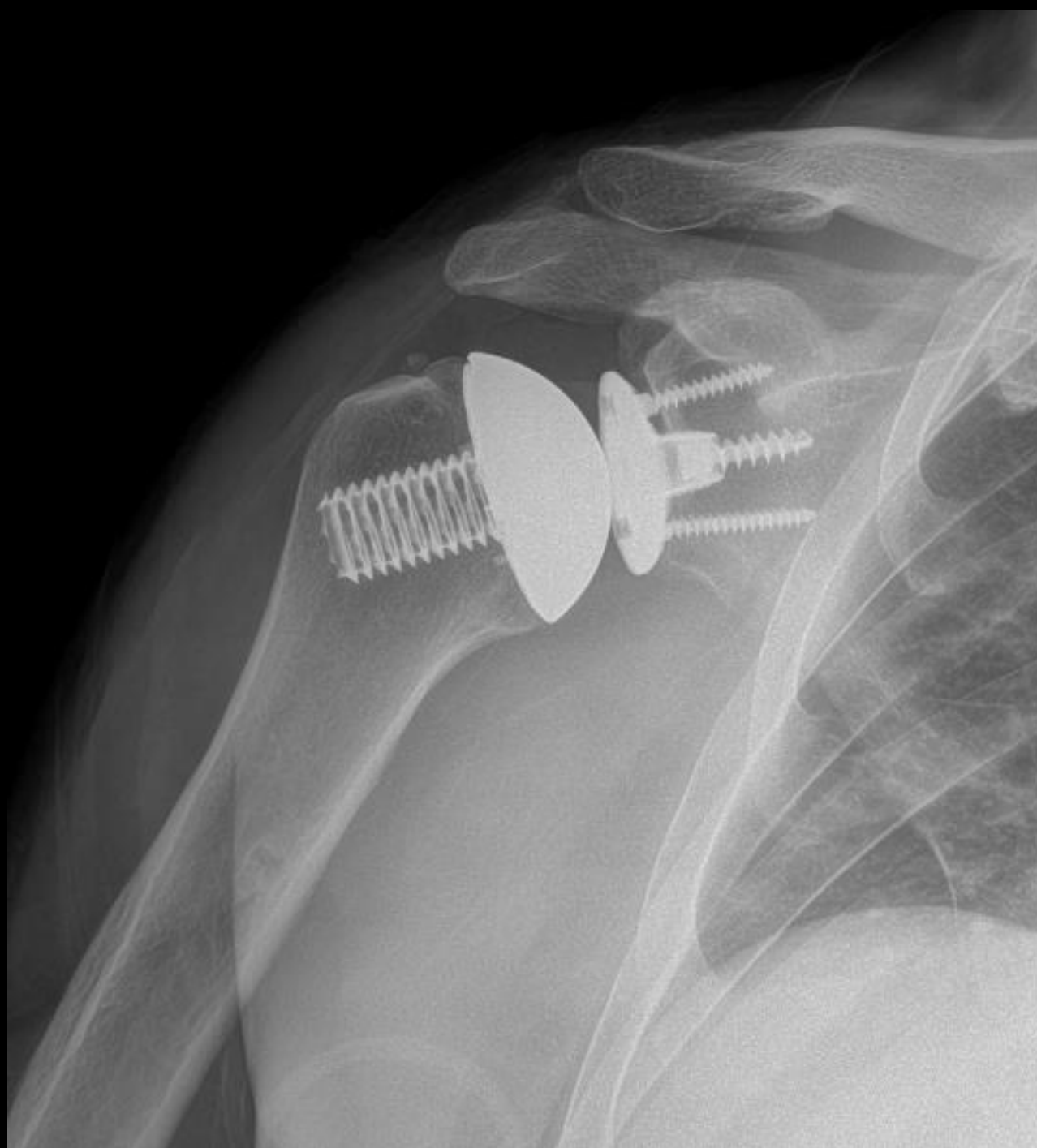
HC



5 years postop



TSA



REVERSE TSA

EVERYONE ELSE!!

25:1 in my practice

REVERSE TSA

- Advantages:
 - One surgery
 - Rotator cuff failure postop
 - Similar motion
 - Pain control
 - Faster rehab



Implant Design

- 155°

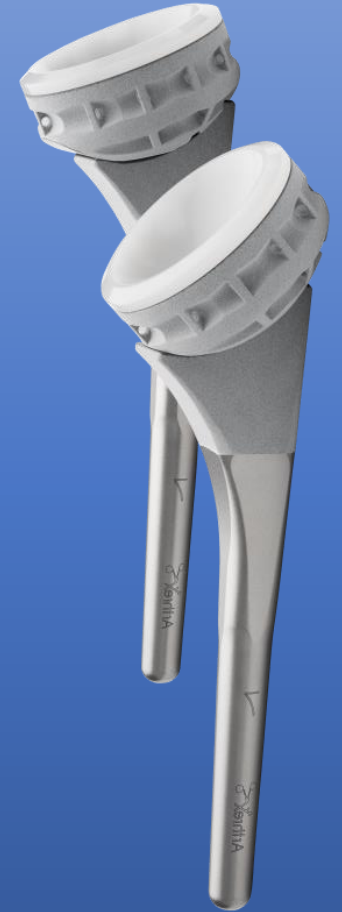
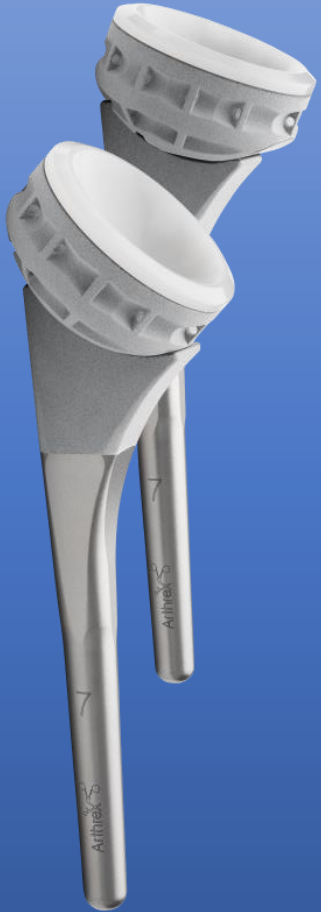
- Original “Grammont” design
- Deltoid lengthening = greater forward flexion?
- Associated with Scapular Notching and Adduction Deficit
- *Acromial Stress fracture*



- 135°

- Newer “Frankle” design
- More anatomic
- Less Scapular Notching and Adduction Deficit
- Associated with Abduction Impingement and potentially less stable (**constrained liner**)

Goal



Day of Surgery:

- Outpatient surgery – insurance, comorbidities
 - ASC – Medicare has yet to approve
 - Hospital
- Interscalene nerve block
- Sling with abduction pillow
- Preop med protocols, Routine postop narcotics
- Big 3 instructions...



“Bad things happen in the first week”

Interscalene Nerve Block - Exparel

- Encapsulates bupivacaine in a suspension of multivesicular liposomes.
- Bupivacaine is released over time
- **GAMECHANGER** for postop



STEPS in RTSA

(How I do it)

Positioning

- “Why are my ribs sore?”



Positioning



Toolbox



Setup

- 3 assistants
- Arm holding device



Humeral Head Exposure

- Deltopectoral approach
- Biceps tenodesis to pec tendon
- Subscapularis “peel” with progressive external rotation
- Complete capsular release - IGHL
- Osteophyte removal
- Adequate humeral head cut



Glenoid Exposure

- Predicated on previous
- **Capsulotomy**, labral & biceps stump excision
- Large, young, muscular arthritic male is a nightmare





2023

R J



Loss of Internal Rotation

- Common complaint postop – “my therapist said I’d never get it back?”
- Could the patient do it preop?

Etiology:

- Musculature imbalance?
- Repair of Subscapularis?
- Implants design – version of implants, lateralization

The more you work at it, the better it gets!

Patient reported outcomes and ranges of motion after reverse total shoulder arthroplasty with and without subscapularis repair

Sameer R. Oak, MD^a, Evangeline Kobayashi, MD^a, Joel Gagnier, PhD^a,
Patrick J. Denard, MD^b, Benjamin W. Sears, MD^c, Reuben Gobezie, MD^d,
Evan Lederman, MD^e, Brian C. Werner, MD^f, Asheesh Bedi, MD^a, Bruce S. Miller, MD^{a,*}



Background:

Effect of subscap. repair in reverse TSA has not been fully elucidated
Repair may improve stability & IR, but at the expense of ER & abduction

Aim:

Determine the effect of subscap. repair on ROM & patient-reported outcomes in rTSA

Methods:

Retrospective cohort of 143 patients from the Arthrex Arthroplasty Registry
68% of patients had subscap. repair; 135° neck-shaft angle implant in all cases

Outcomes:

Active ROM, IR strength, PROs

Patient reported outcomes and ranges of motion after reverse total shoulder arthroplasty with and without subscapularis repair

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Results:

- Subscapularis repair was NOT associated with 2-year postoperative ROM, strength, or any of the PROs studied
- No dislocations in either group
- Higher glenoid lateralization independently predicted improved active IR and improved Constant Score

Clinical Relevance:

- No apparent benefit of subscapularis repair
- There is a functional benefit of **glenoid lateralization** in rTSA

The Problem:

IR is not predictable after RSA

Question:

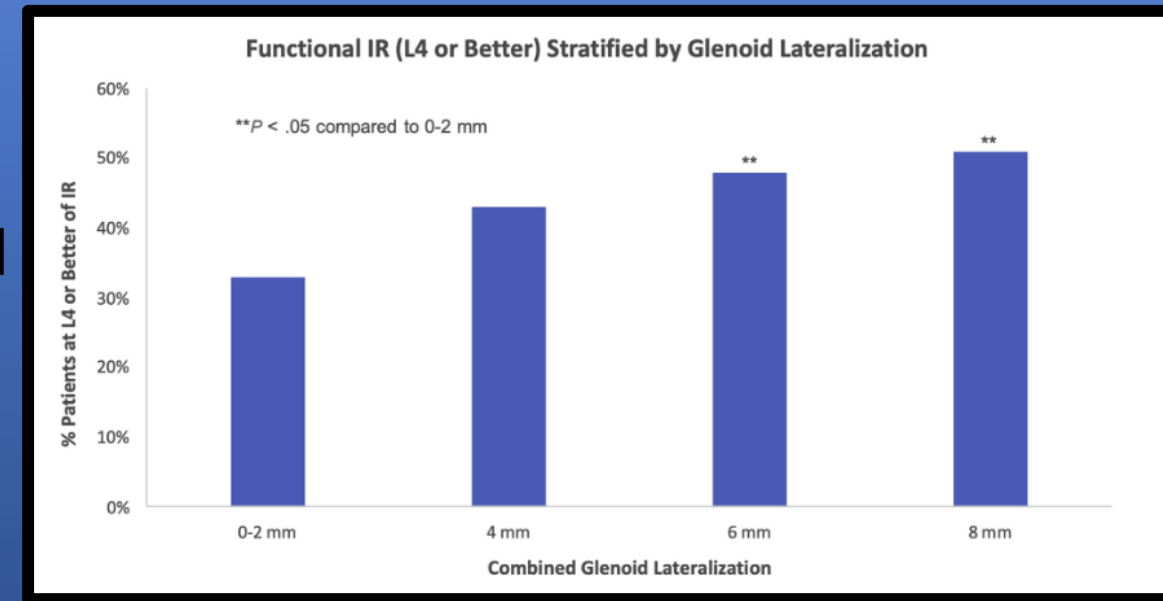
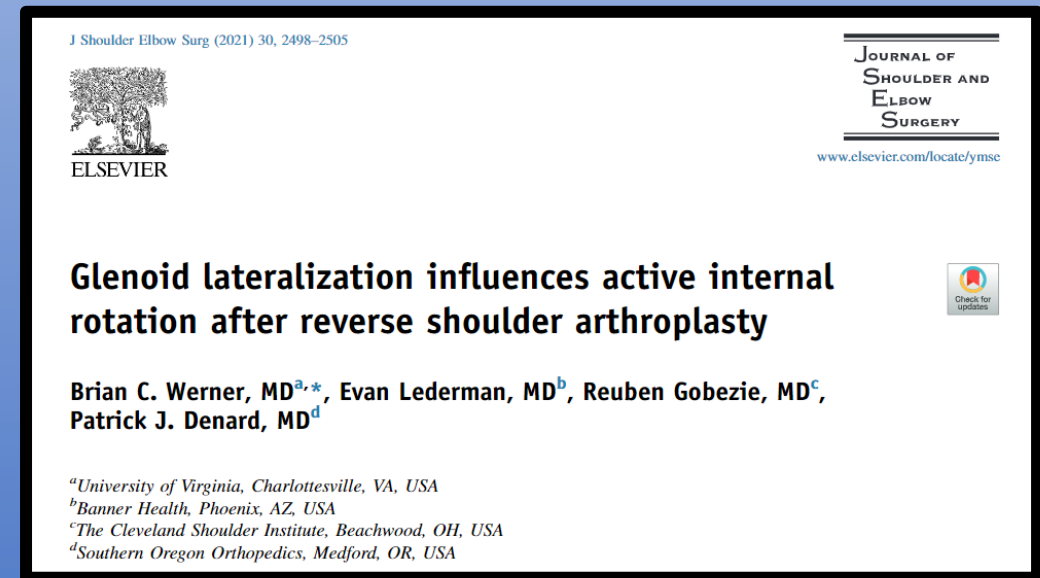
Does Glenoid Lateralization influence IR in RSA?

Methods:

Multicenter 455 patients; Retrospective, measured IR, correlated with implant choice via lateralization

Results:

- Glenoid Lateralization of 6 – 8 mm correlated with IR improvements at 1 year
- Humeral Retroversion also correlated
- Lateralization did not affect other ROMs



Strengths/Limitations

Strengths: Many

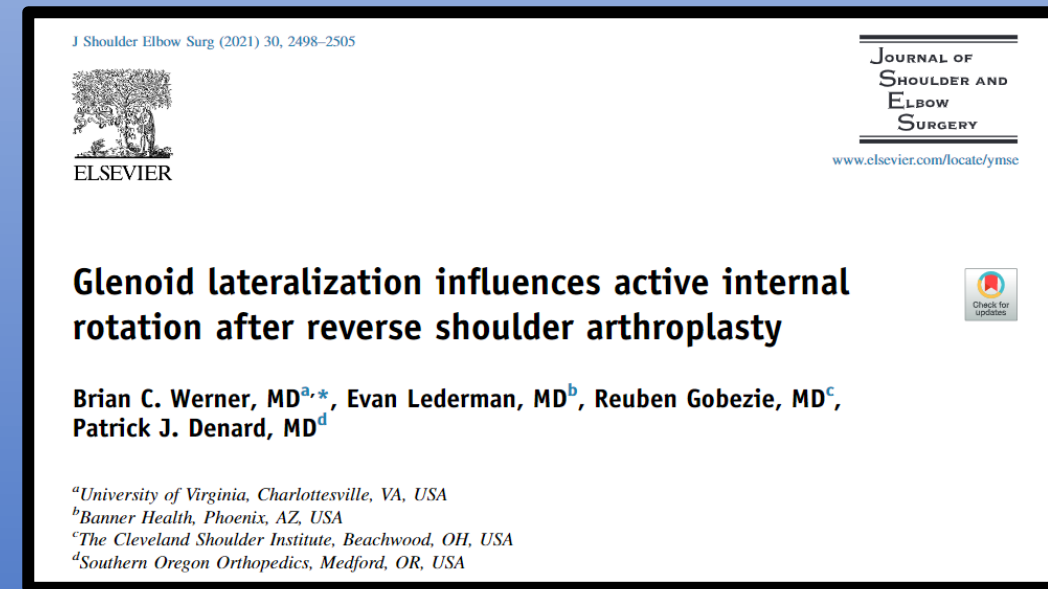
- Multi-center
- Big number, 14 surgeons 455 pts
- Independent ROM by goniometer
- Stats solid: Evaluated data from several perspectives (% of achievement)

Limitations:

- Retrospective, IR not standardized, nor pain standardized
- Biggest: Lateralization based on implant size, not true lateralization
 - Head cut, glenoid ream, both affect, so “2mm lateralization” may be different in different patients

Impact:

Should lateralize as much as possible - Should we have MORE as an option in the system??





A comprehensive evaluation of the association of radiographic measures of lateralization on clinical outcomes following reverse total shoulder arthroplasty

Brandon J. Erickson, MD^{a,*}, Brian C. Werner, MD^b, Justin W. Griffin, MD^c, Reuben Gobezié, MD^d, Evan Lederman, MD^e, Benjamin W. Sears, MD^f, Easton Bents, BS^f, Patrick J. Denard, MD^g

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^fWestern Orthopaedics, Denver, CO, USA

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Problem:

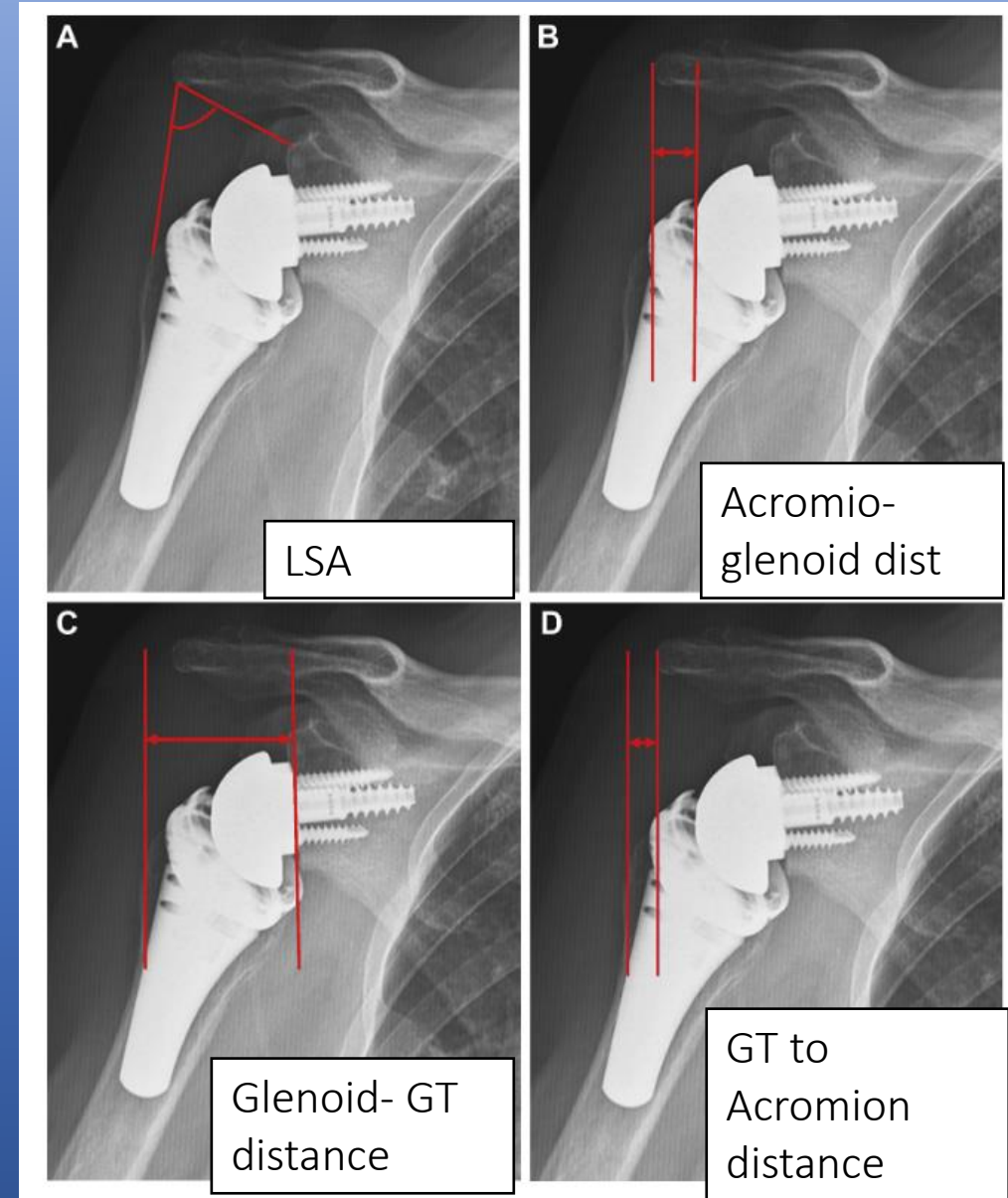
We believe Lateralization may aid in outcomes
We don't know how to best measure this

Question:

Are there Post-op X-ray measures of lateralization that correlate with PROs?

Results:

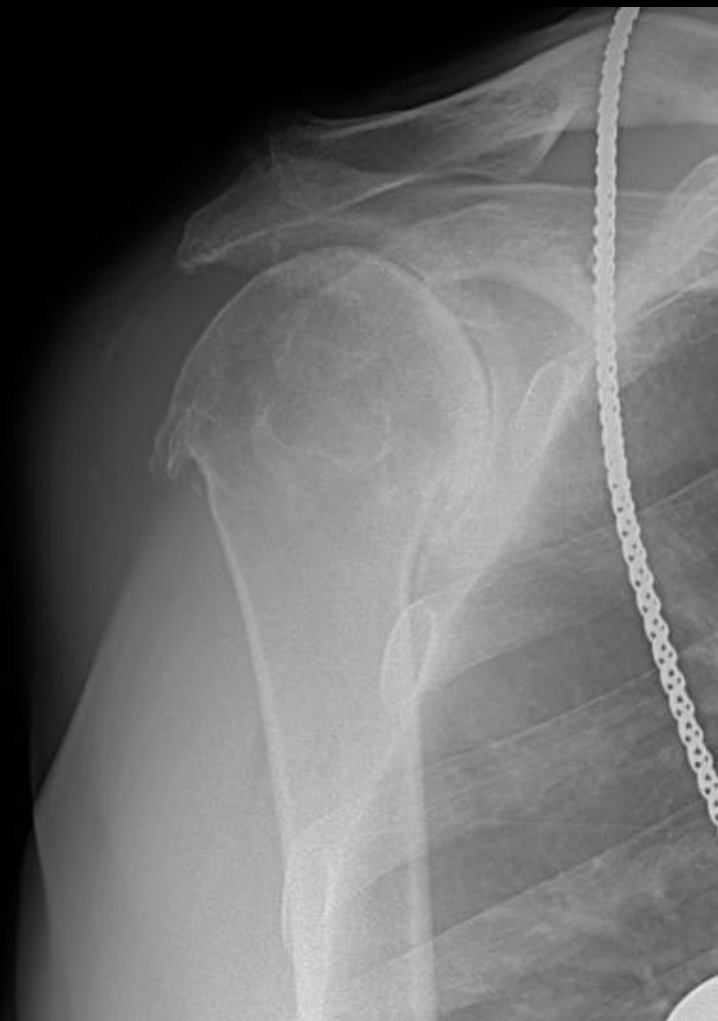
Lateralizing means better IR, but at expense of FF and ASES; all magnitudes were small



SW

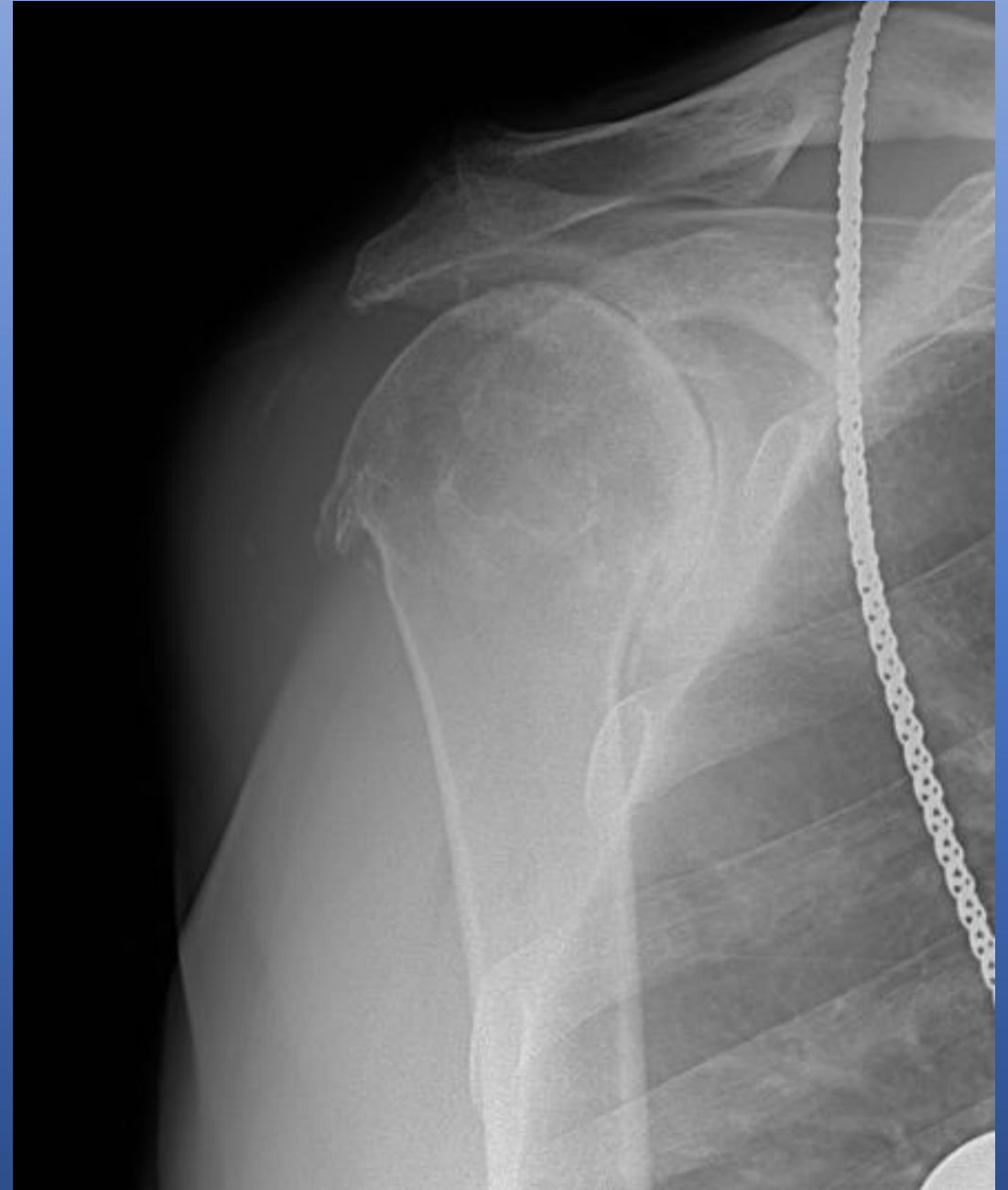
B:08/26/1963

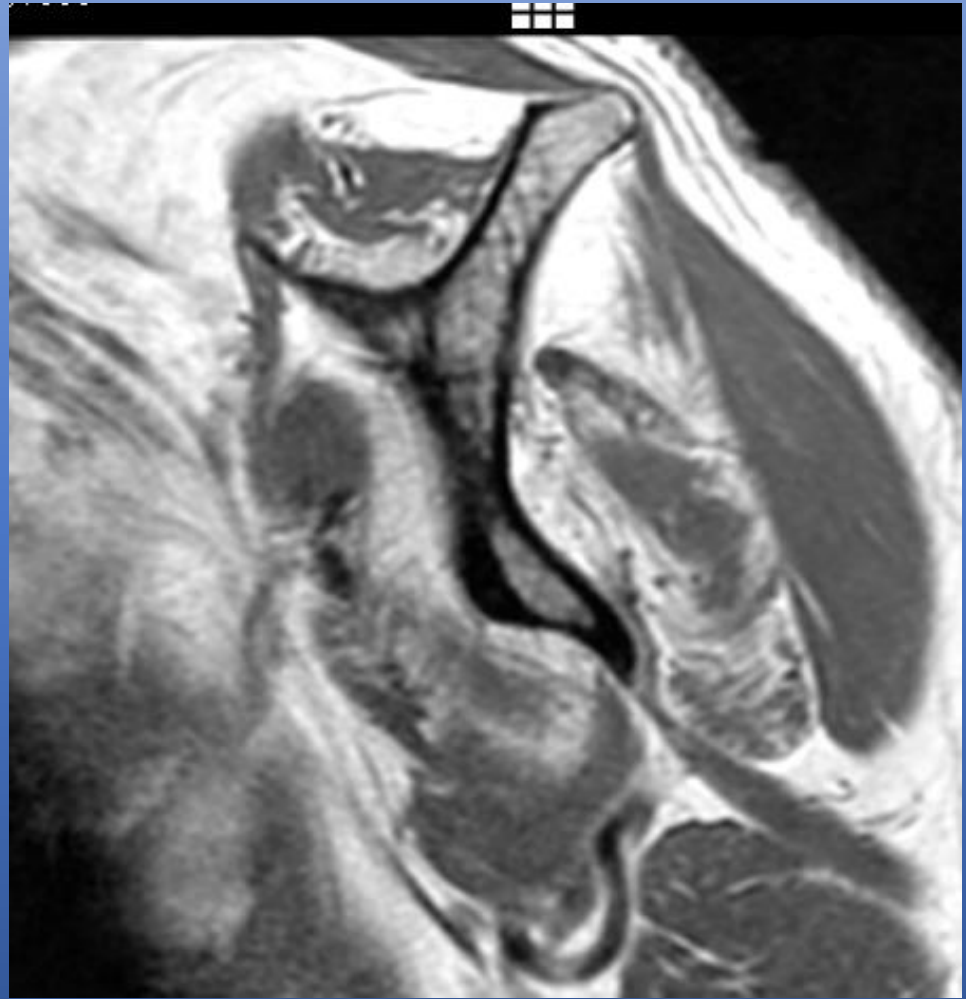
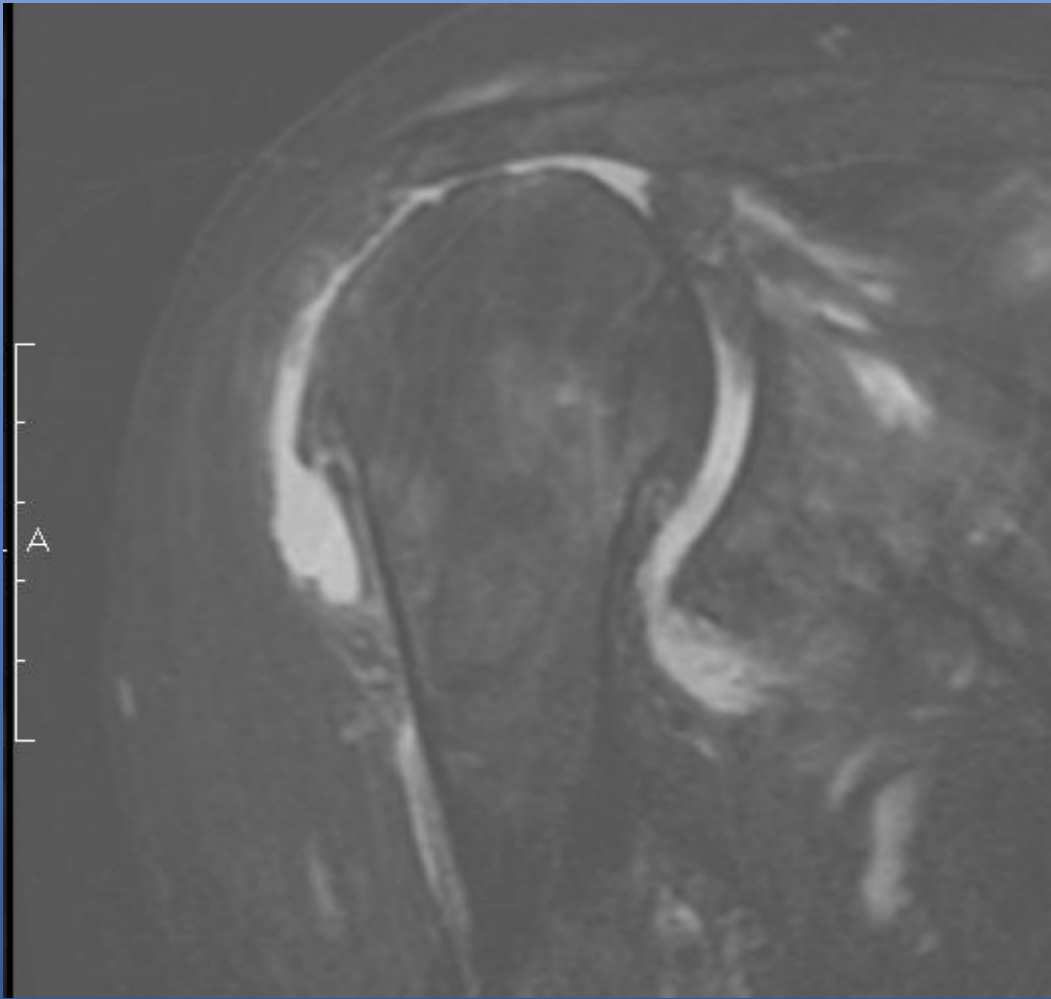
X:M



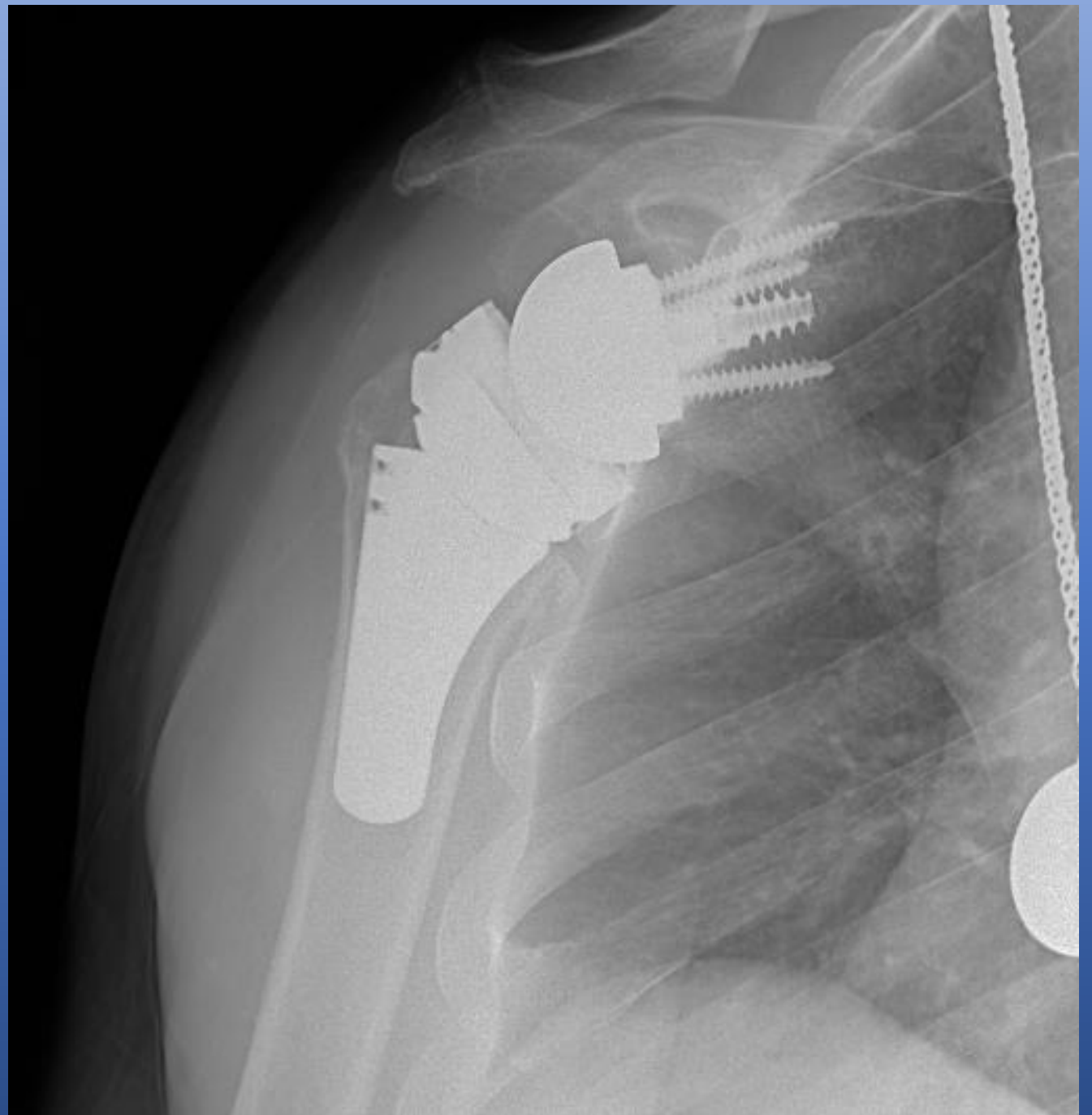
SW:

- 59 YO M
 - Hx of instability surgery (2000)
 - No PMHx, no meds
- Pickleball, racquetball (below shoulder level...)
- cyclist
- 0-90 FF with severe crepitance, ER 20, IR buttock





- 6 weeks postop
 - elevates 160 deg
 - playing pickleball - overhand
 - used right hand to wash hair
- Should I have waited until he was 70 YO?



3 months postop

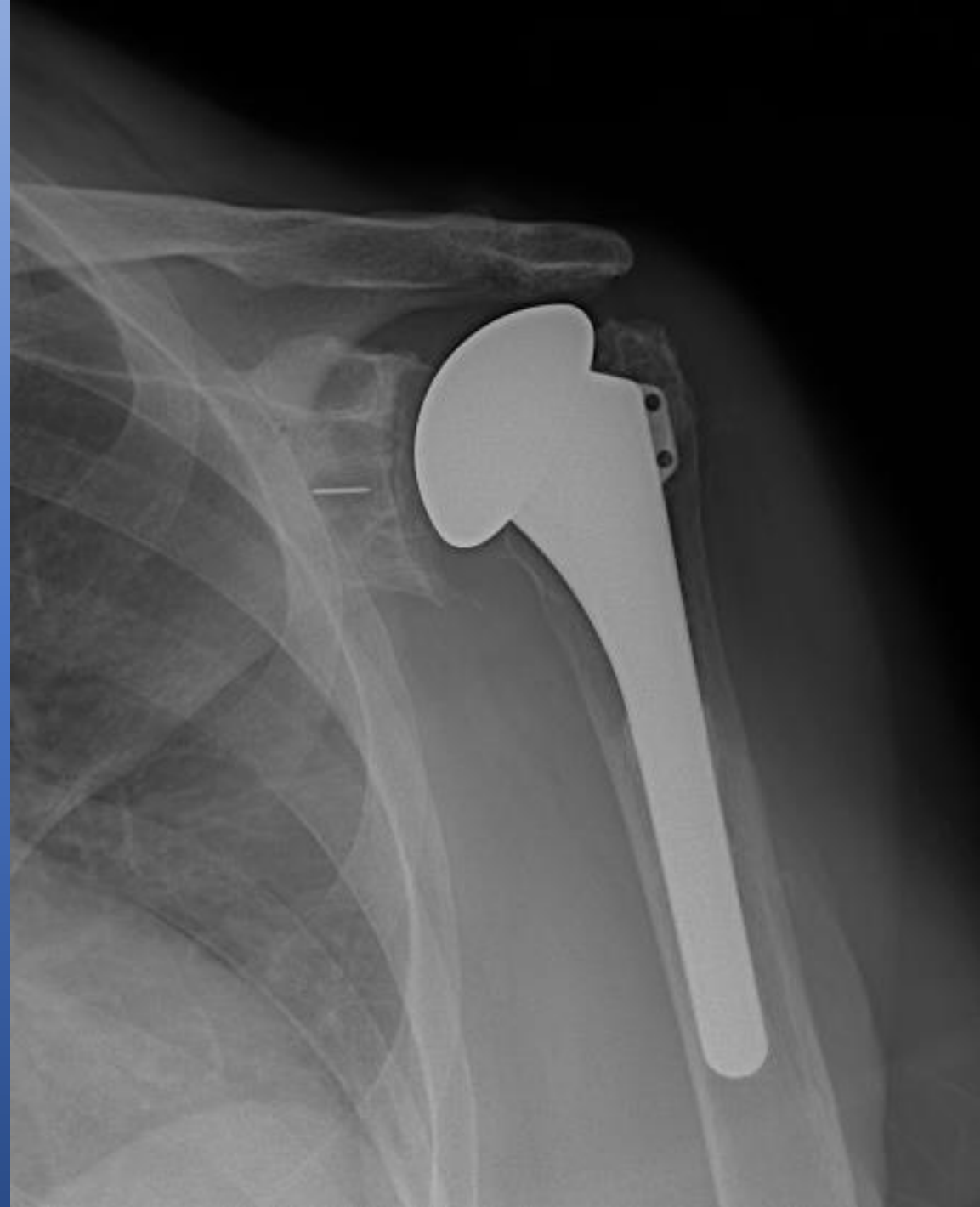


CM



CM

- 73 YO F, severe OA elsewhere
- TSA 2010 in Nashville
- 45 deg FF, drop arm
- DDx
 - cuff failure
 - loosening of poly
 - infection



CM

- Conversion to **RTSA**
- **Risks** - Lots of Bad
 - removal
 - bone quality
 - bone stock
 - intraoperative fracture





BM:

- 66 YO M, failed open RCR
- Original RTSA 2014

- RTC 2022
 - chronic infection (2 yrs)
 - draining sinus

- O2 dependent COPD
- CAD
- Frail, 140 lbs

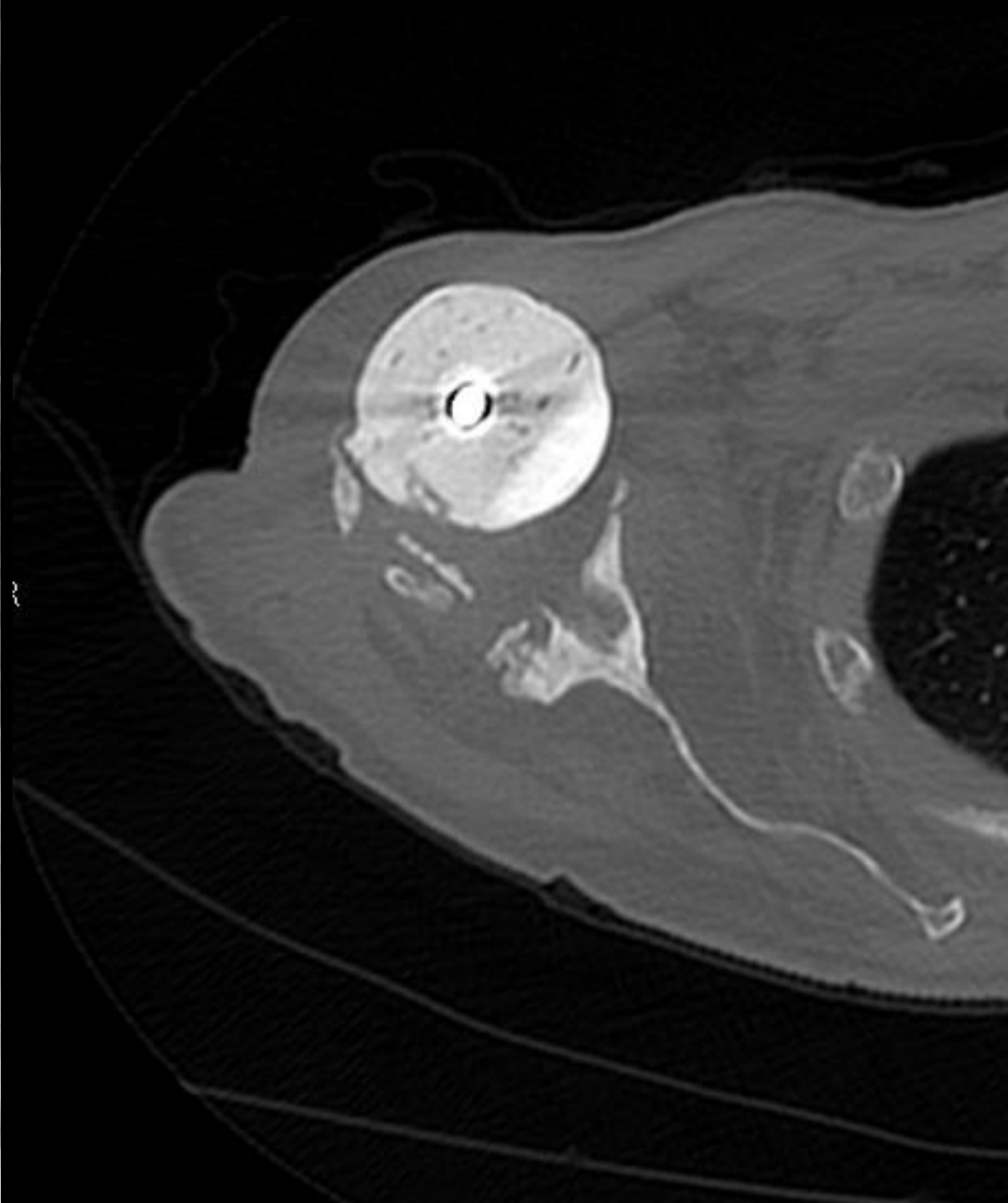


BM:

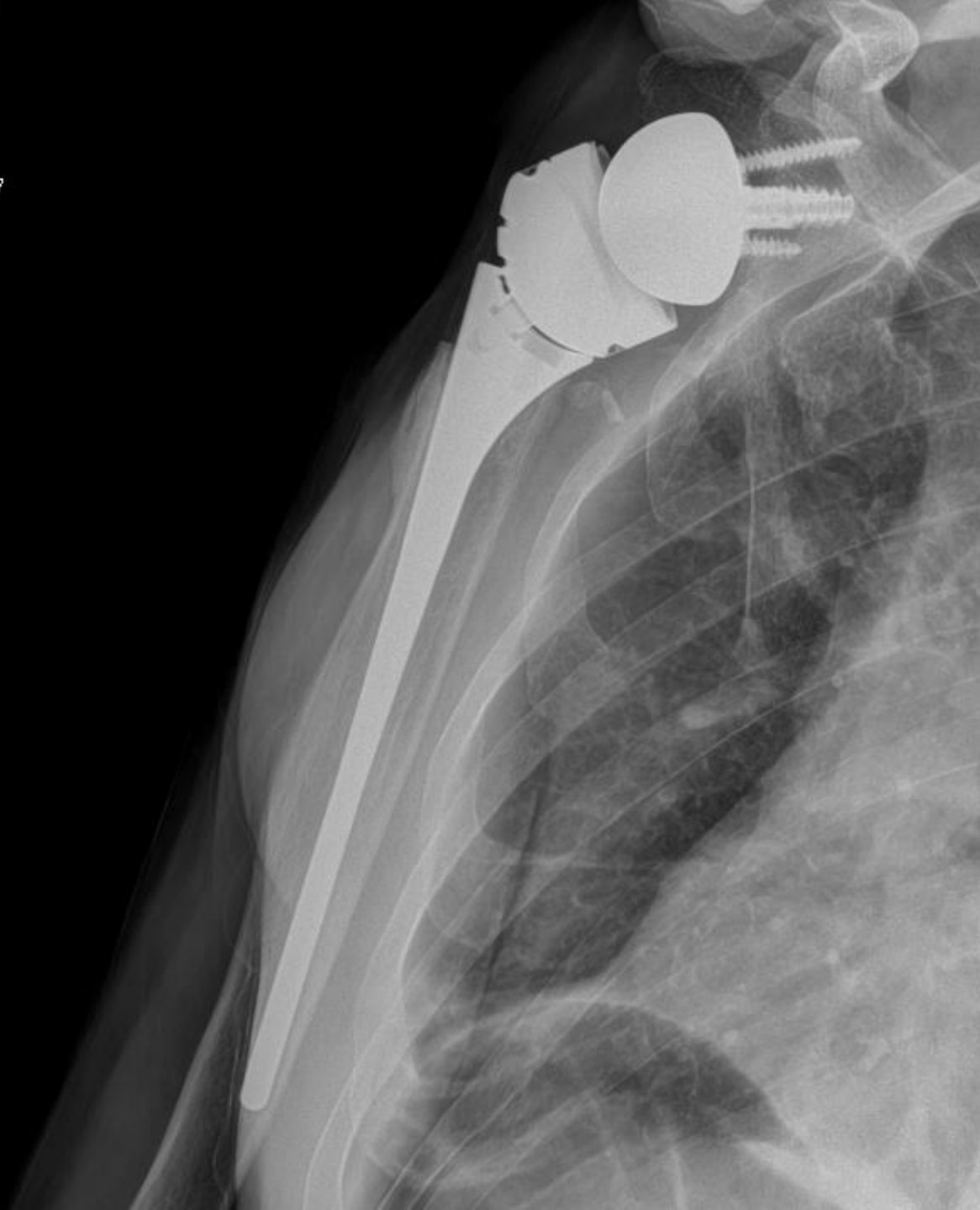
- 3 months for surgical clearance
- Plan: 2 stage revision
 - explant
 - Antibiotic spacer
 - ID consult – 6 weeks IV Abx

Importance of early recognition
potential infection

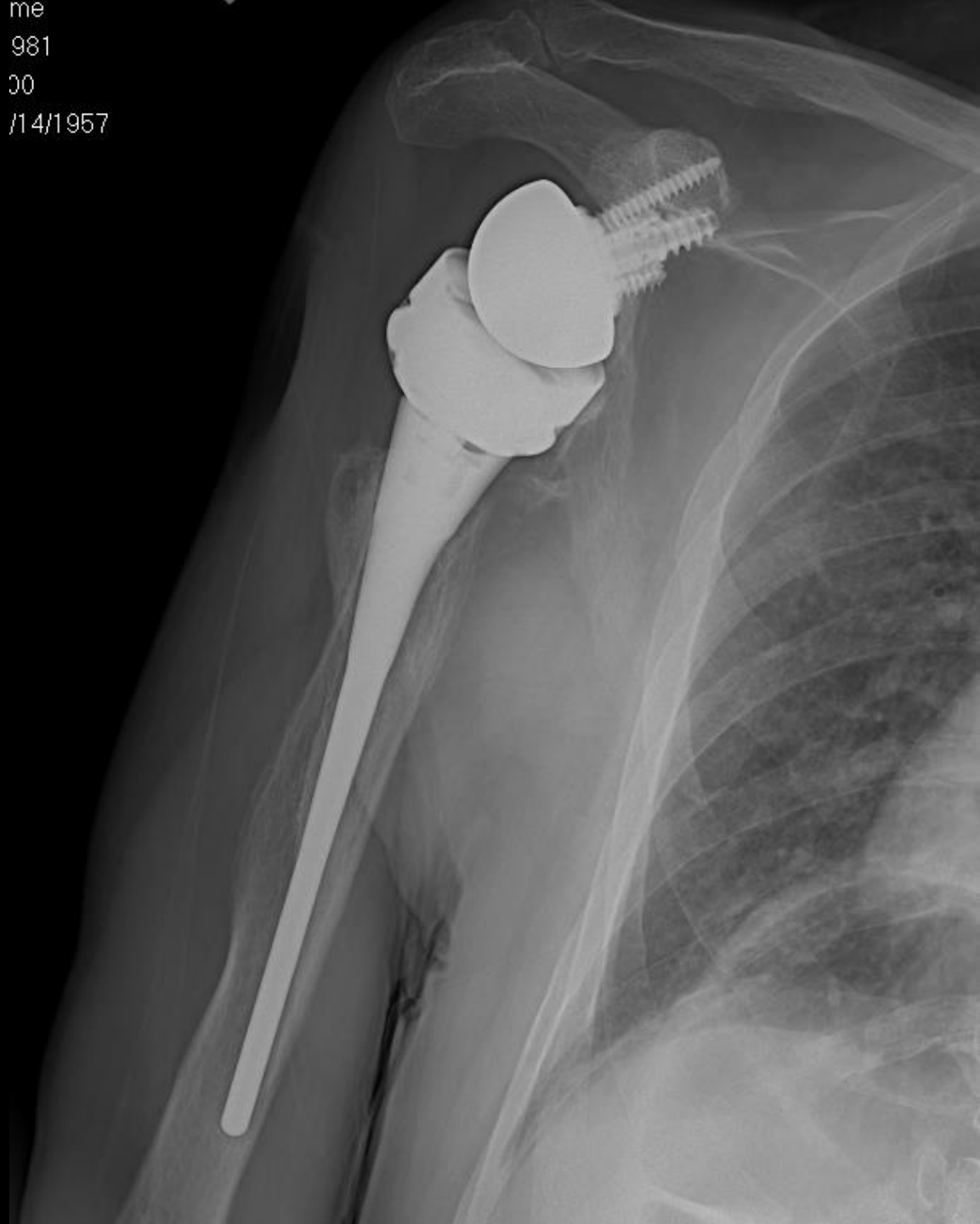




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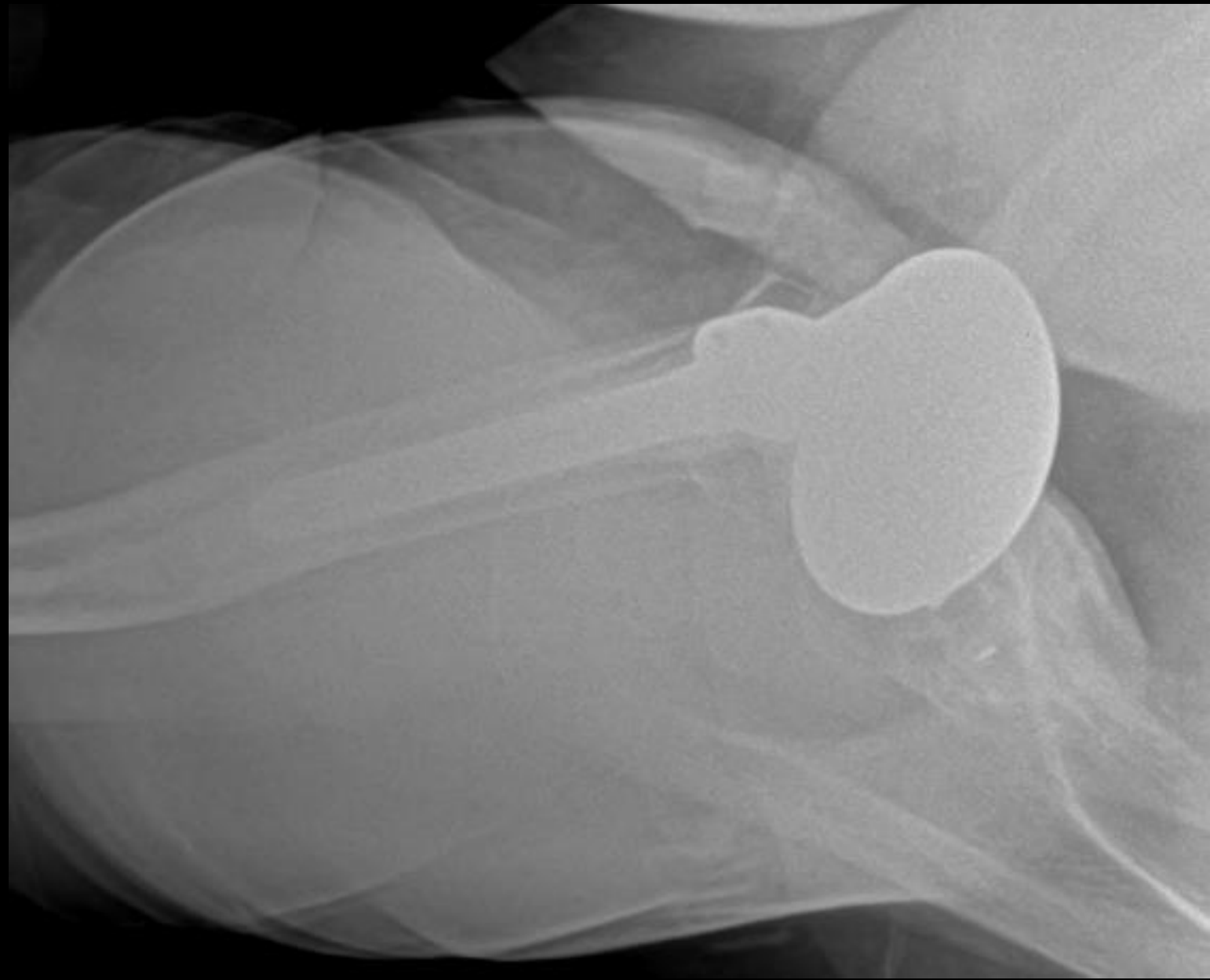


ST

- 79 YO F
- Hemi vs TSA 2005

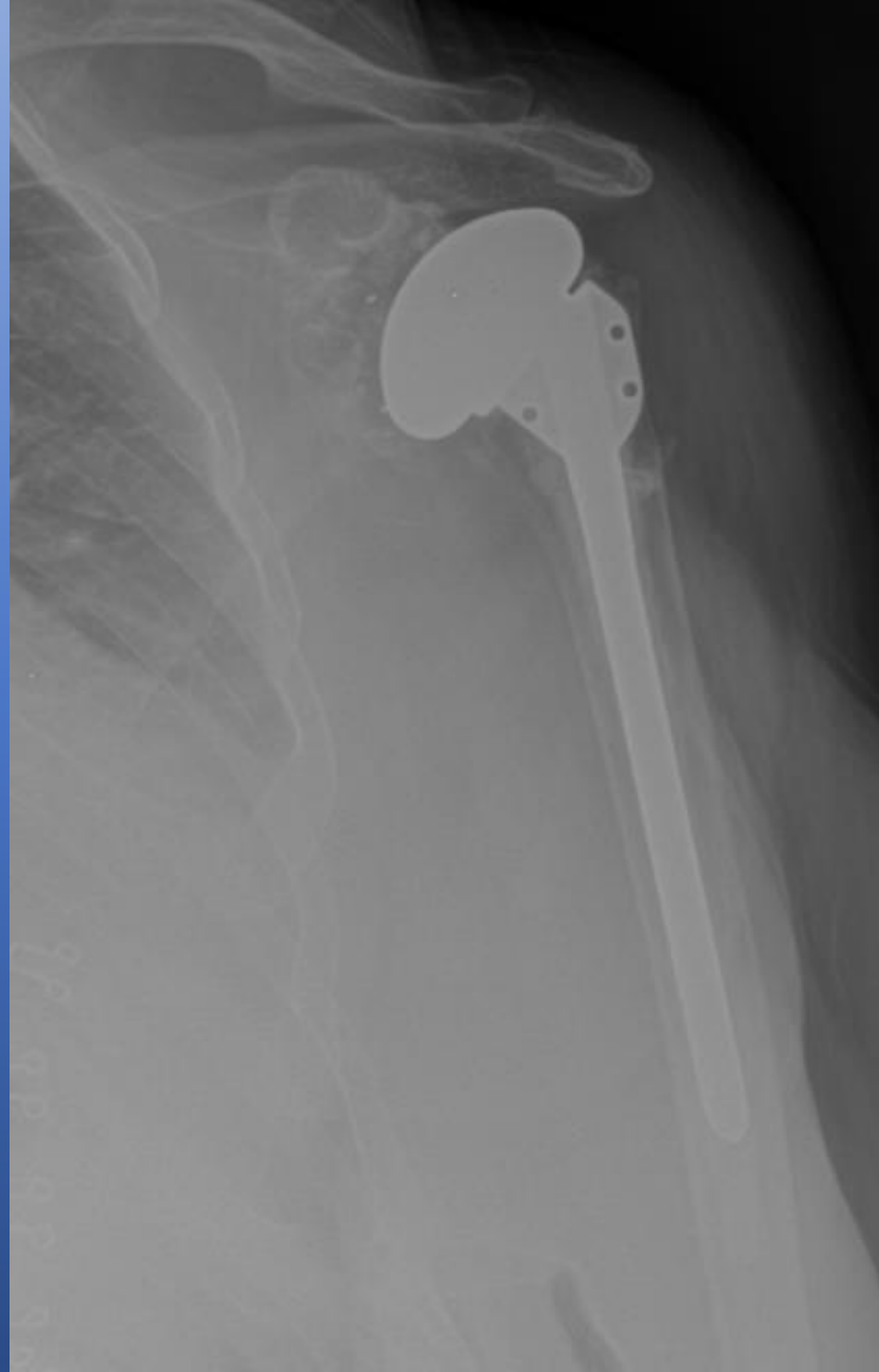
- Severe pain x 2 years
- FF 70 degrees



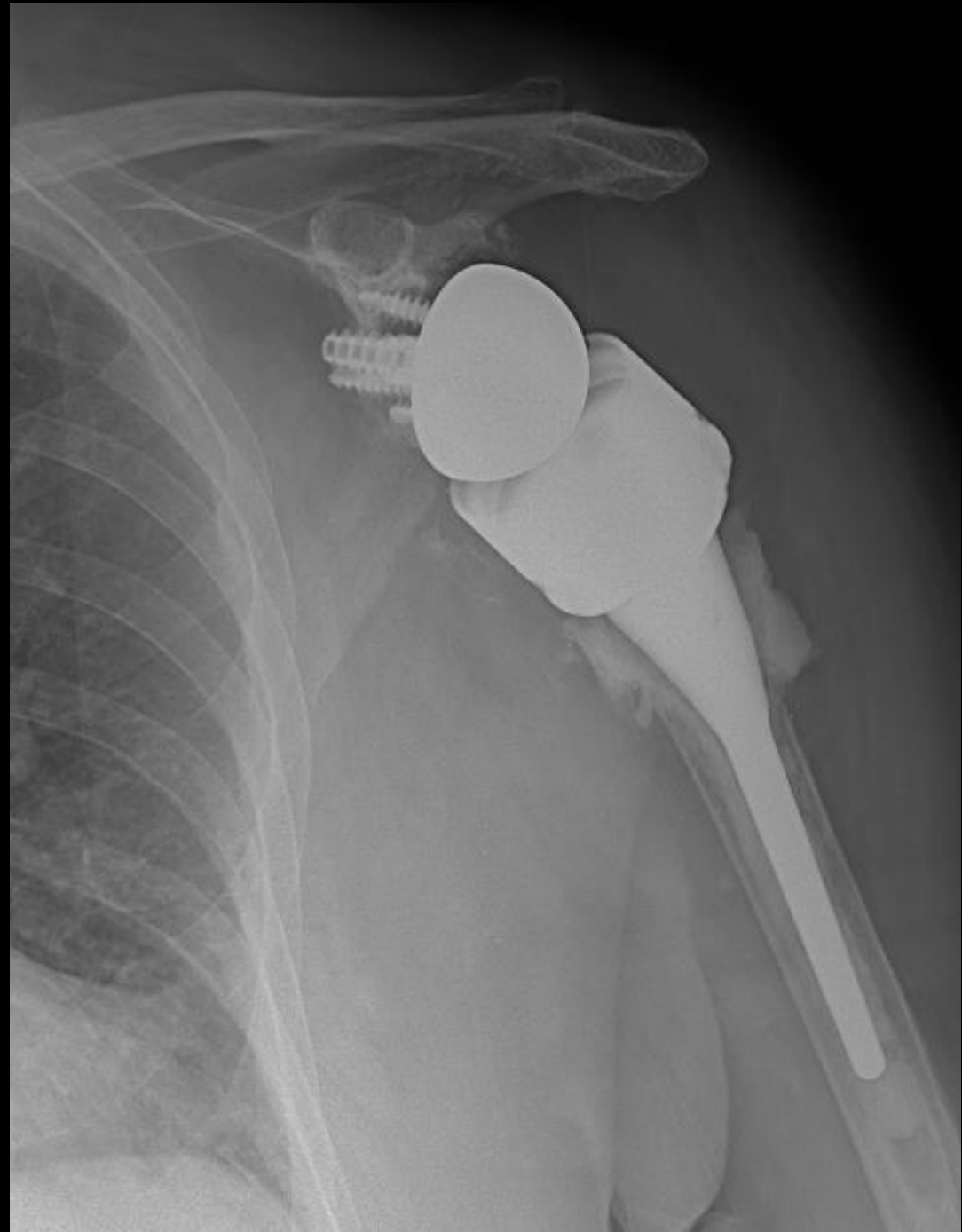
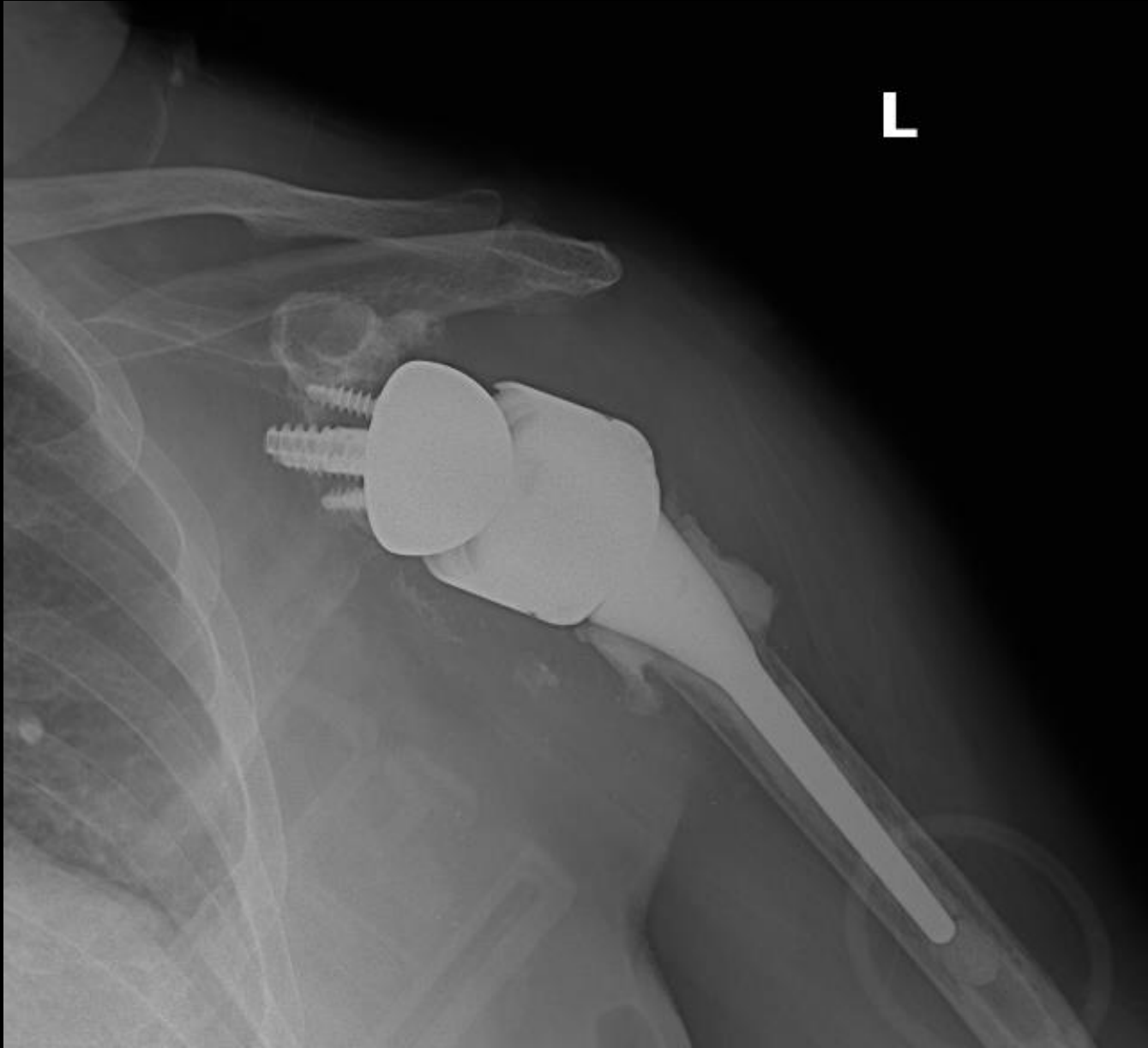


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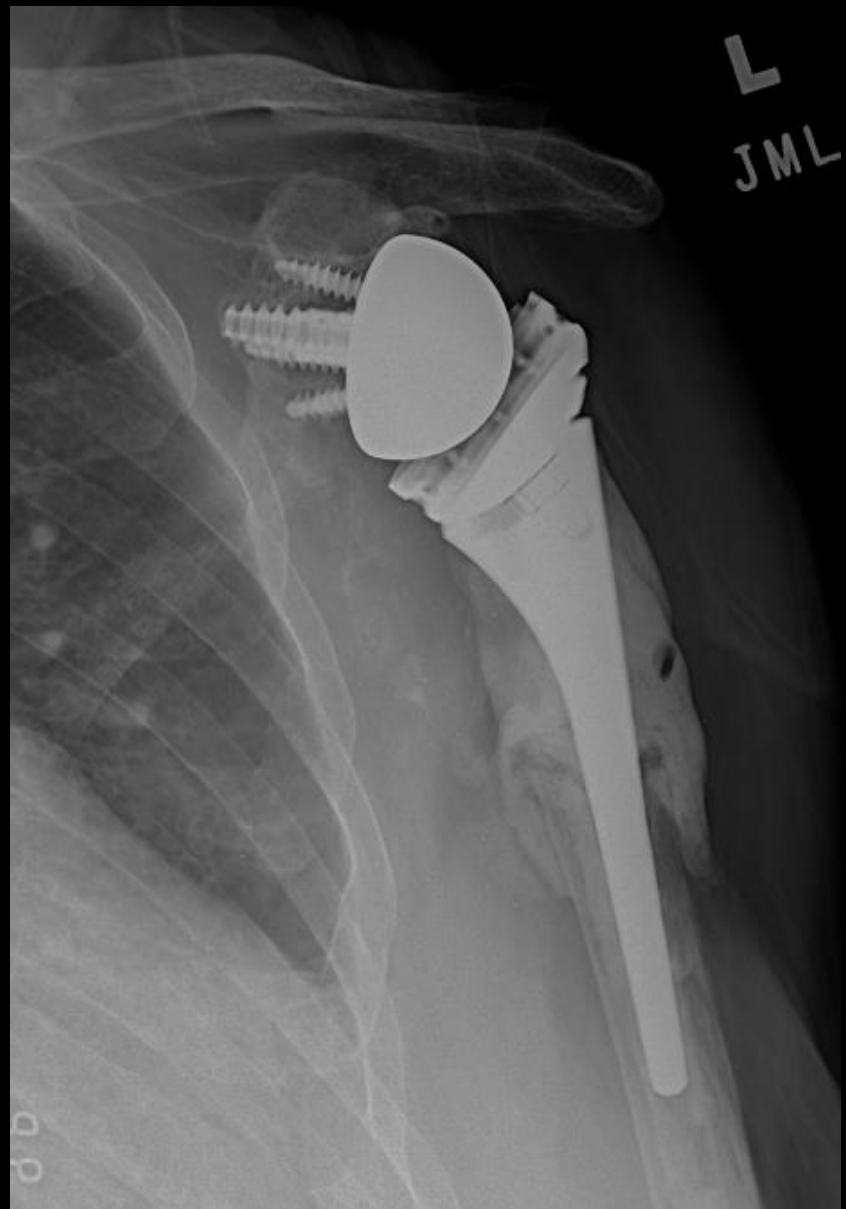
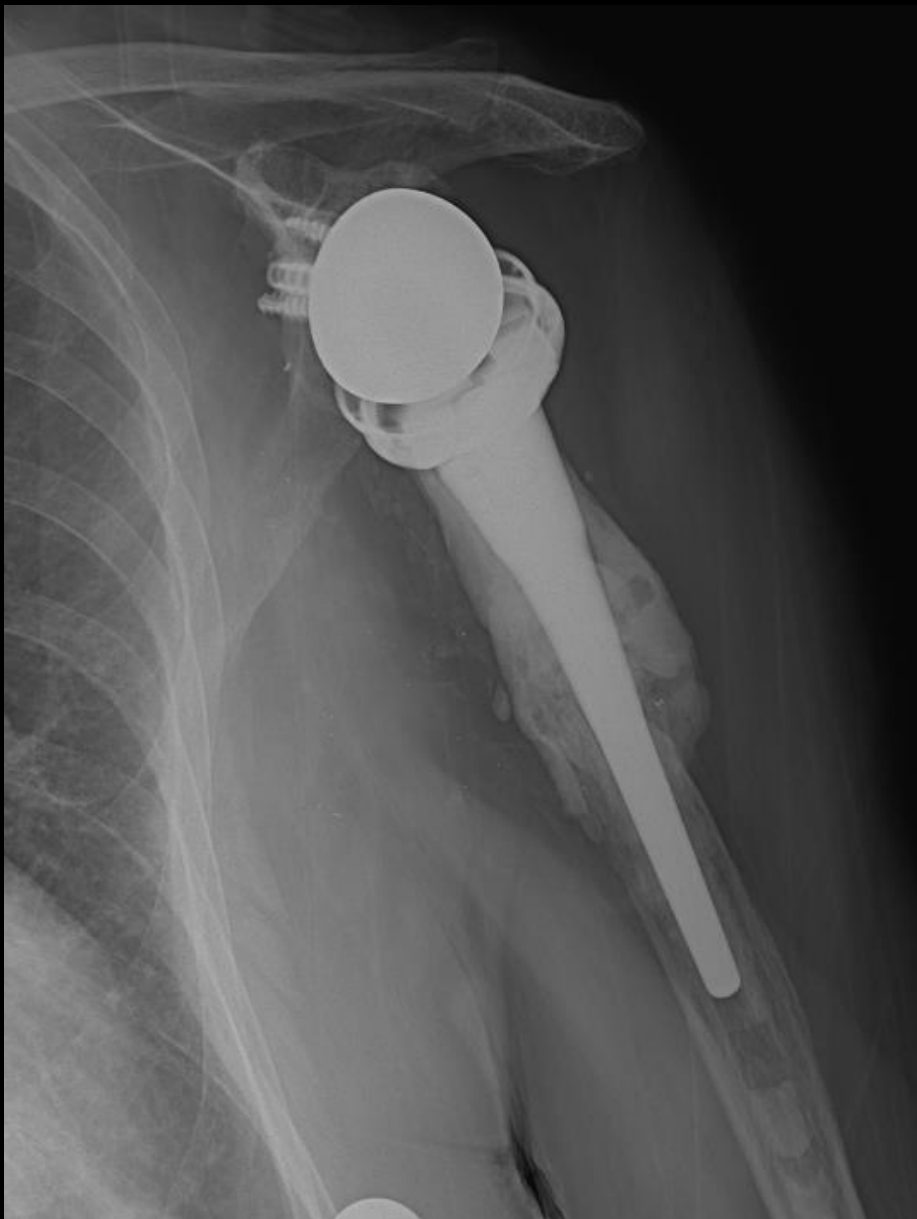
- Revise to RTSA
- Surgical Concerns
 - bone quality/stock
 - cement mantle
 - **stability of implants**



L







DL

- 77 YO active F (recent L RTSA)
- Fall at home
- 4 part proximal humerus
- Options:
 - Nonop
 - Hemi
 - RTSA



Hemi vs. RTSA for Proximal Humerus Fractures

- Hemi

- dependent on tuberosity healing/positioning
- historical

- RTSA

- better clinical scores
- less pain
- better ROM
- more patient satisfaction

EXPERIMENTAL AND THERAPEUTIC MEDICINE 24: 637, 2022

Reverse shoulder arthroplasty vs. hemiarthroplasty for the treatment of osteoporotic proximal humeral fractures in elderly patients: A systematic review and meta-analysis update

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¹Department of Orthopedics, Heping Hospital Affiliated to Changzhi Medical College; ²Graduate School, Graduate Student Department of Changzhi Medical College, Changzhi, Shanxi 046000, P.R. China

Received March 30, 2022; Accepted August 1, 2022



THERAPY





Therapy Pearls: What I've learned during my first 1000...

- Speed of therapy is dictated by pain, bone quality, and motivation
 - passive ROM, active ROM, strengthening
 - Different for different patients and diagnoses (RCA > OA > Fx)
- Bone quality is extremely important – **drywall vs. stud**
- Listen to your patient – “**what is your goal?**”
 - **as a surgeon, I'm happy if my patient is happy**

Therapy Pearls: What I've learned during my first 1000...

- Preop function dictates postop function!!
- Preop deltoid strengthening
- “When should I do this?”

Association Between Preoperative Shoulder Strength and Clinical Outcomes After Primary Reverse Total Shoulder Arthroplasty

 Hao, Kevin A. BS;  Wright, Thomas W. MD; Schoch, Bradley S. MD;  Wright, Jonathan O. MD; Dean, Ethan W. MD; Struk, Aimee M. MEd, MBA, ATC, LAT;  King, Joseph J. MD

Author Information 

Journal of the American Academy of Orthopaedic Surgeons 30(9):p e730-e740, May 1, 2022. | DOI: 10.5435/JAAOS-D-21-00945

Conclusion:

Preoperative shoulder strength, especially abduction strength, predicts superior postoperative outcomes and greater improvement in shoulder strength, ROM, and outcome scores after primary rTSA. However, a minority of patients with well-preserved strength may lose strength after surgery, and patients who are weaker preoperatively tend to see larger improvements in postoperative outcomes.

Therapy Pearls

- Never do therapy on consecutive days, especially while strengthening
 - “got my 3 days in this week doc – went Monday, Tuesday, and Wednesday”
 - “whatever I do in therapy, I do the same thing at home 3 times a day”
- Strengthening is at most 2 days a week – M/Th, T/Fri
 - “I just cant seem to get any stronger – I do the exercises everyday”
- Push a home exercise program (2x/week) once therapy is completed
 - “I just started having more pain for some reason”

Therapy Pearls

- Reason to notify the surgeon, **STOP therapy**
 - **wound drainage/hematoma** – a draining wound is an infection waiting to happen
 - **sudden increase in pain, change in function - ACROMIAL STRESS FRACTURE**
 - 1) pain over acromium
 - 2) initial x-rays often normal
 - 3) shut them down to prevent deformity



QUESTIONS?

