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Shoulder Arthroplasty

Current Concepts

Ian R. Byram, MD

Bone and Joint Institute of Tennessee

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Disclosures

- Exactech Inc: Medical education consultant

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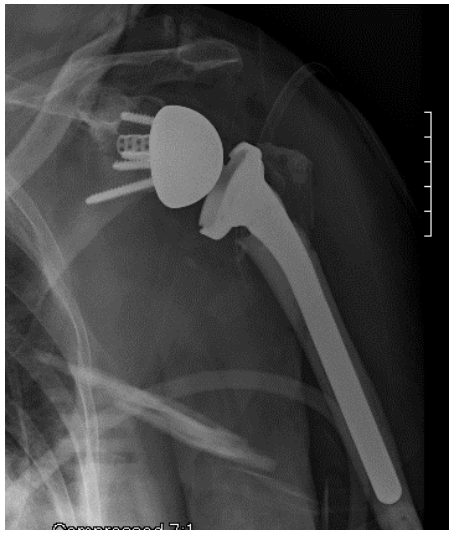
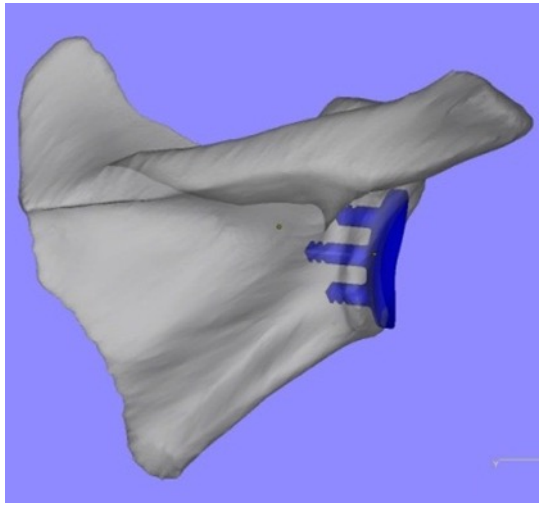
TSA Current Concepts

- Historical perspective
- Reverse TSA
  - Implant/technique trends
  - Expanded indications
  - Arthroplasty for fracture
- Anatomic TSA
  - Augmented glenoid
  - Platform stem
- New technology





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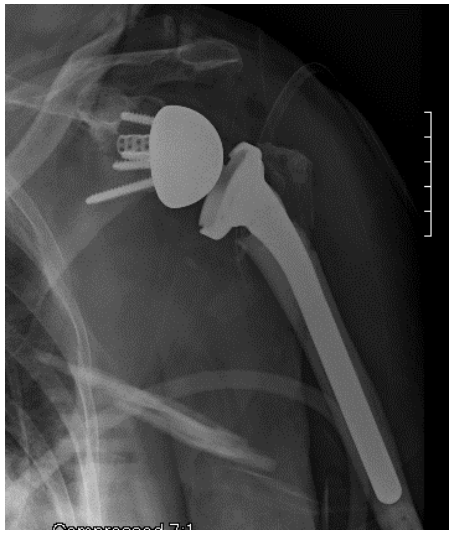

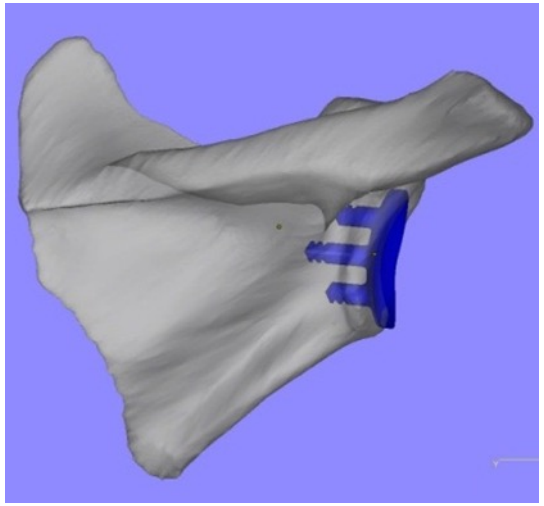

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“Those who fail to learn from history are doomed to repeat it.”

- Sir Winston Churchill

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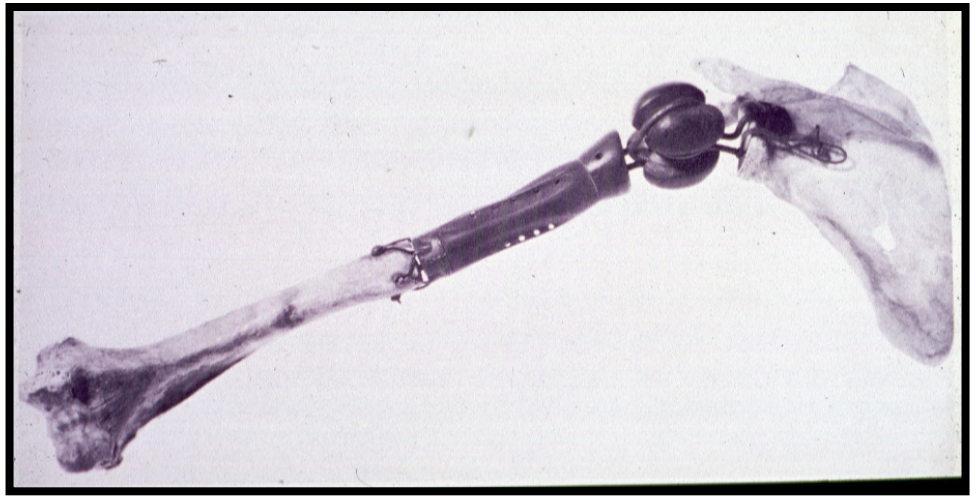
History

- 1893 Emile Jules Péan



- Platinum shaft, 2 metal loops
- Rubber ball with 2 grooves
- Placed for TB, removed after 2 years due to persistent infection

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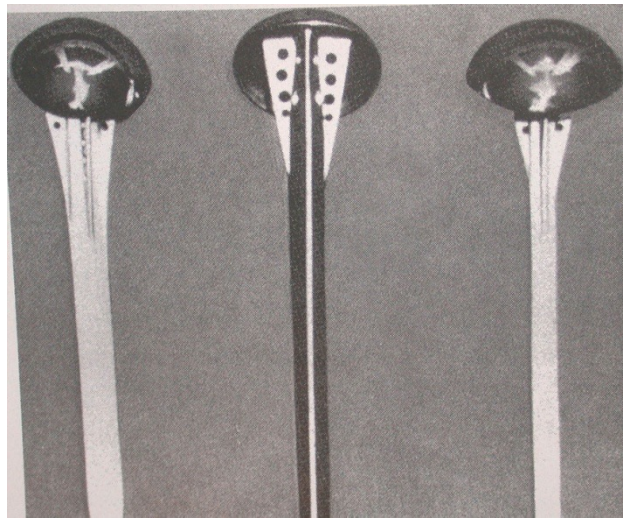
Charles S. Neer II

- 1953 – Vitallium HHR
- 1970 – Fixed-fulcrum designs
- 1973 – Neer II system



The Journal of
Bone and Joint Surgery

American Volume

ARTICULAR REPLACEMENT FOR THE HUMERAL HEAD

BY CHARLES S. NEER, II, M.D., NEW YORK, N. Y.

From the Department of Orthopaedic Surgery, College of Physicians and Surgeons, Columbia University, and the Fracture Service, Presbyterian-New York Orthopaedic Hospitals, New York

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Neer I Prosthesis – 1950s

- Monoblock prosthesis
- Flange fenestration (ingrowth)
- 44 mm head radius
- Press fit
- Multiple stem diameters
- No glenoid (HHR)

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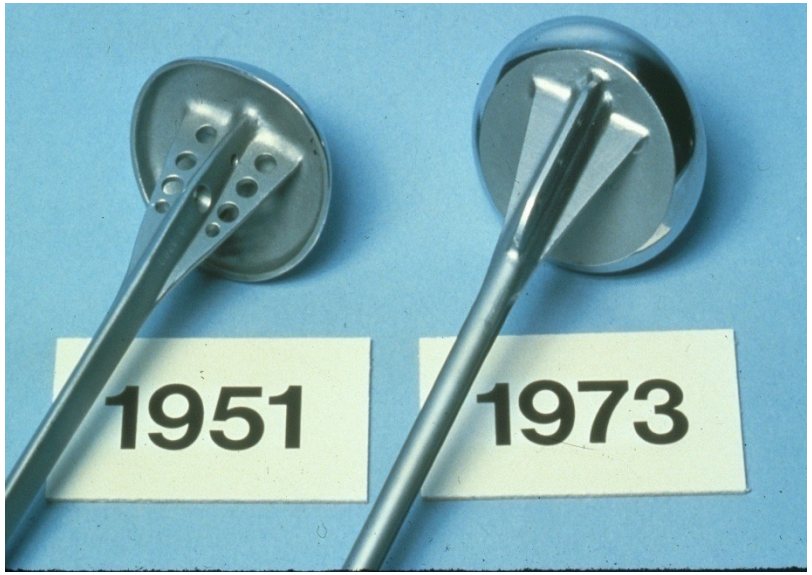
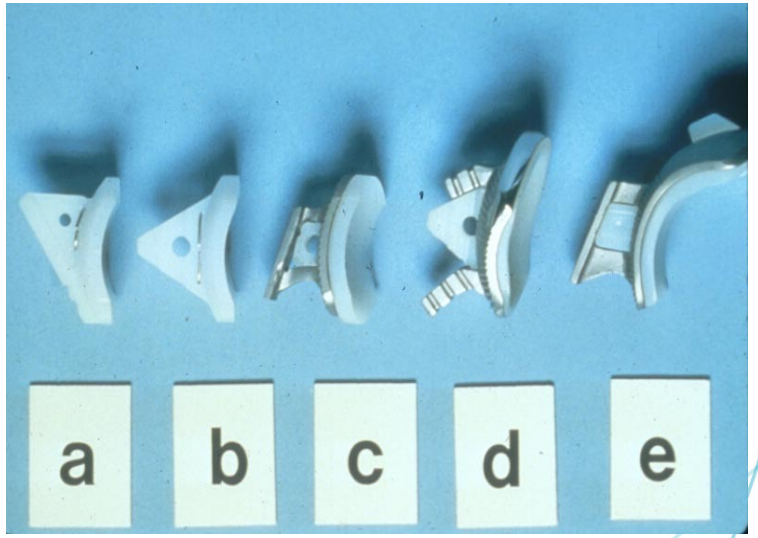
Neer II Prosthesis – 1973

- Monoblock
- Conforming surfaces
- Modified previous head
- Stem modifications
- HDPE glenoid





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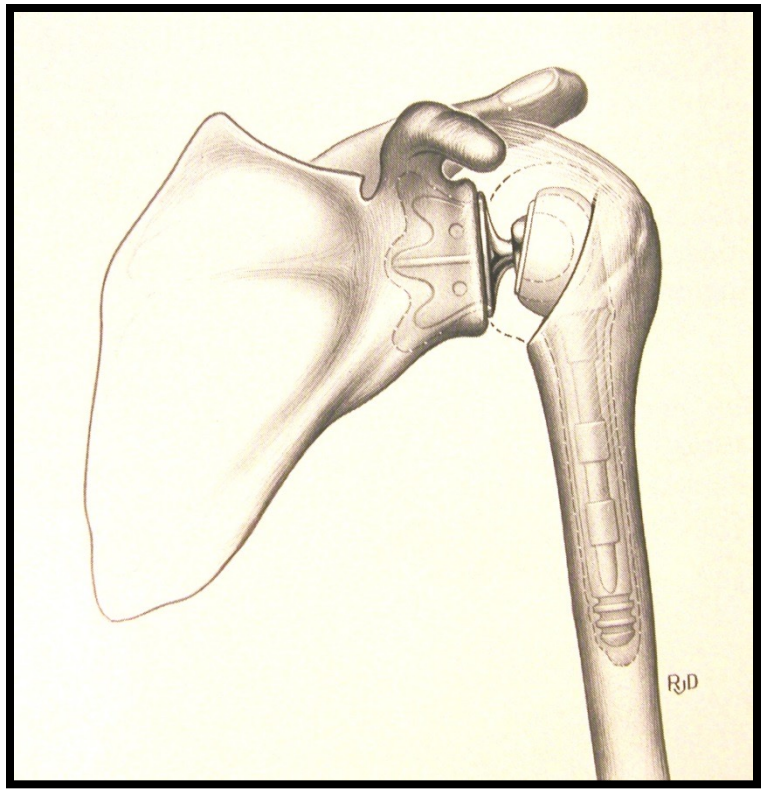
Fixed-Fulcrum Design

- Constrained shoulder replacement 1970
  - Mark I: Oversized ball
  - Mark II: Smaller ball
  - Mark III: axial rotation
- Abandoned 1974



"The only safe fixed-fulcrum device…is one buried in dense scar tissue to protect it from breakage and loosening" C.S. Neer II

Flatow, Clin Orthop Relat Res. Sep 2011; 469(9): 2432–2439.

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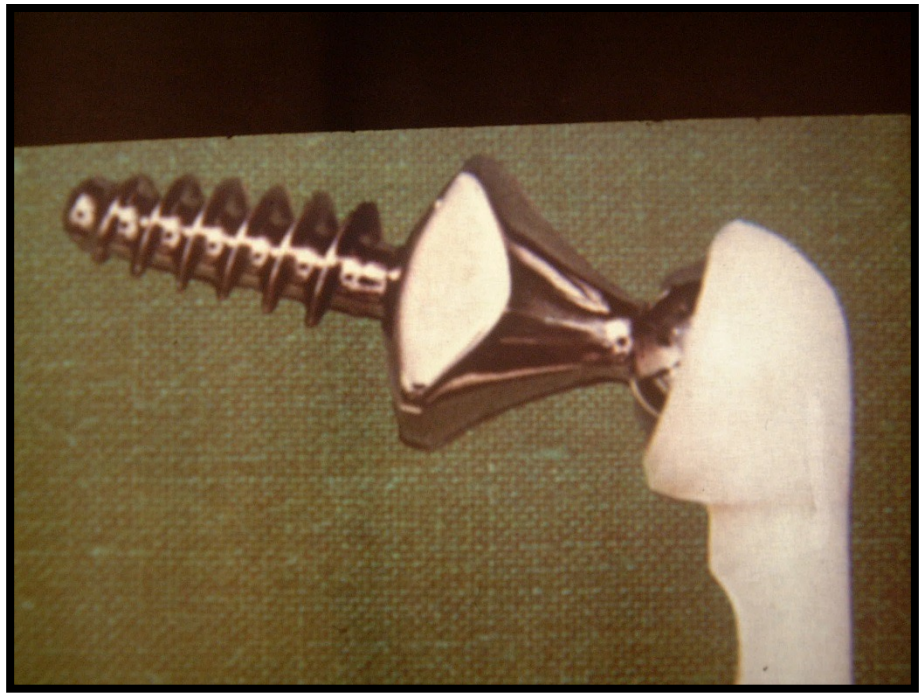
History

Liverpool Shoulder 1969



Kessel Shoulder 1973

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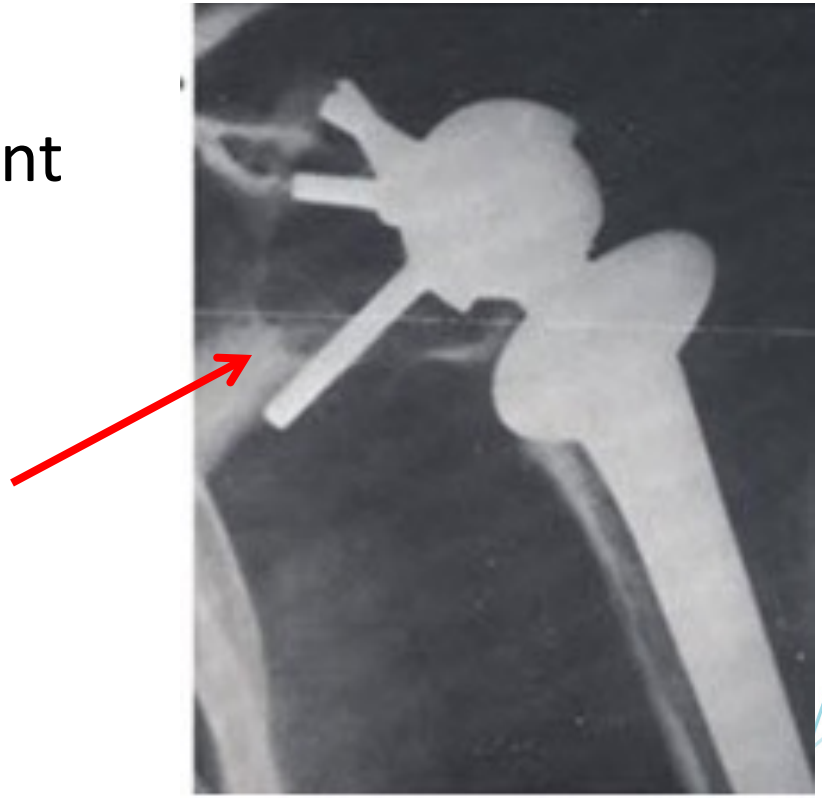
How did initial CONSTRAINED prostheses fail?

- COR lateral to the scapula
- Torque on glenoid component
- **Loosening** of the glenoid component, osteolysis



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History – Reverse Total Shoulder

- Grammont 1985: **Medialized COR**
- Large glenoid hemisphere, horizontal humeral cup
  - COR within scapular neck, placing less torque on glenoid component
  - Recruits more deltoid for increased abduction (acts on longer fulcrum)
  - Humerus is **more distal** relative to acromion, increasing deltoid tension

Flatow, Clin Orthop Relat Res. Sep 2011; 469(9): 2432–2439.

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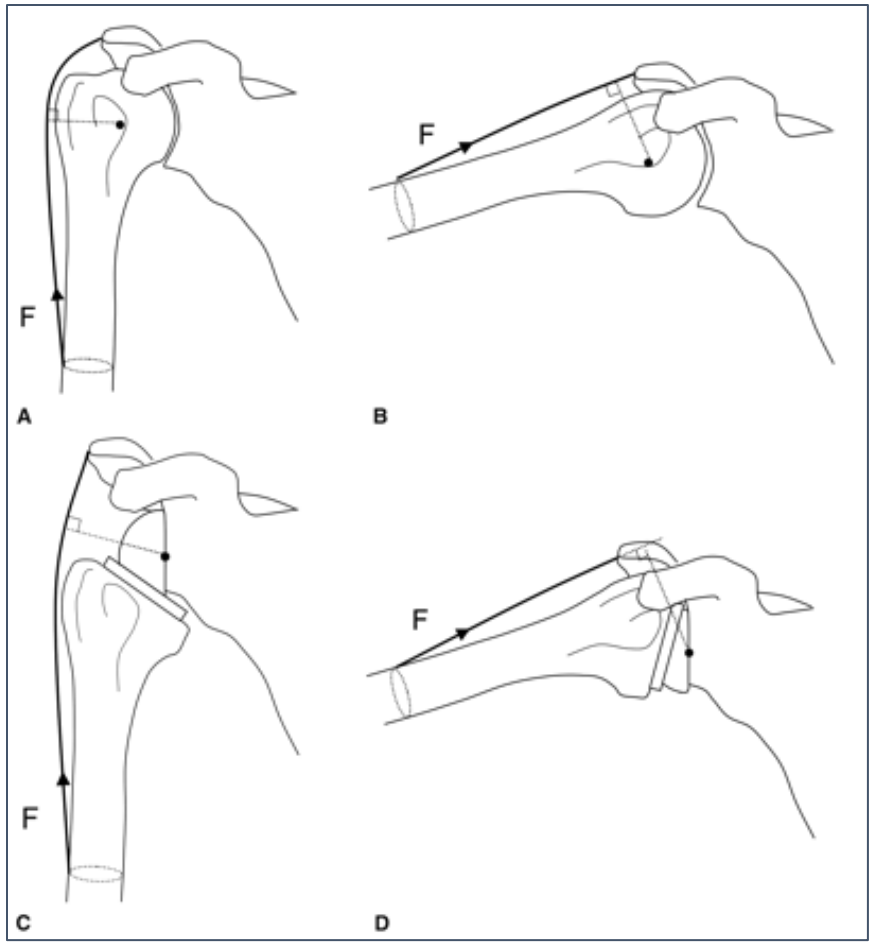
Biomechanics - RTSA



Gerber et al *J Am Acad Orthop Surg* 2009;17: 284-295

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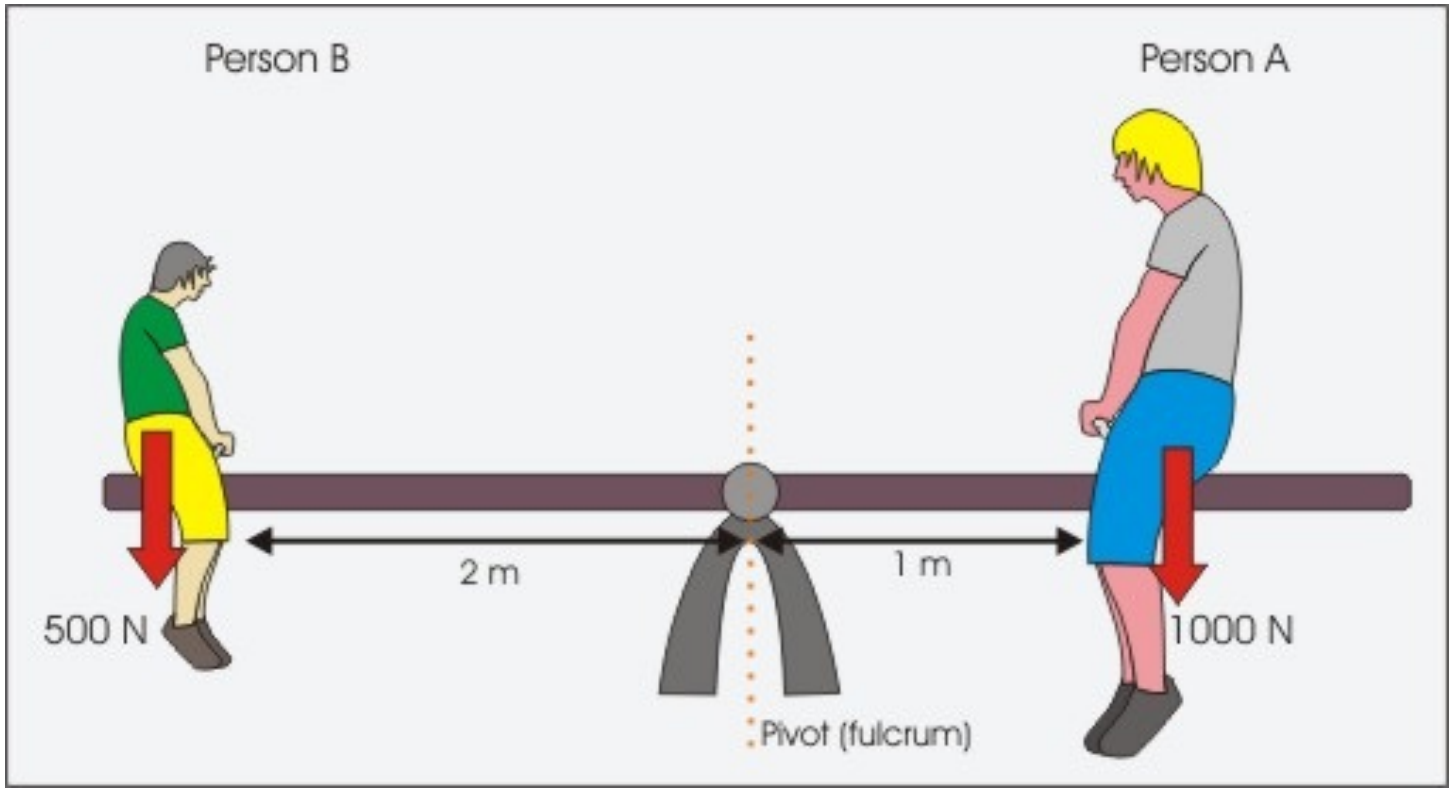

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Benefits RTSA

- Allows deltoid to raise the arm in absence of functional rotator cuff
- Constrained design prevents anterosuperior escape of humerus
- Does not require tuberosity healing in 3-4 part proximal humerus fractures

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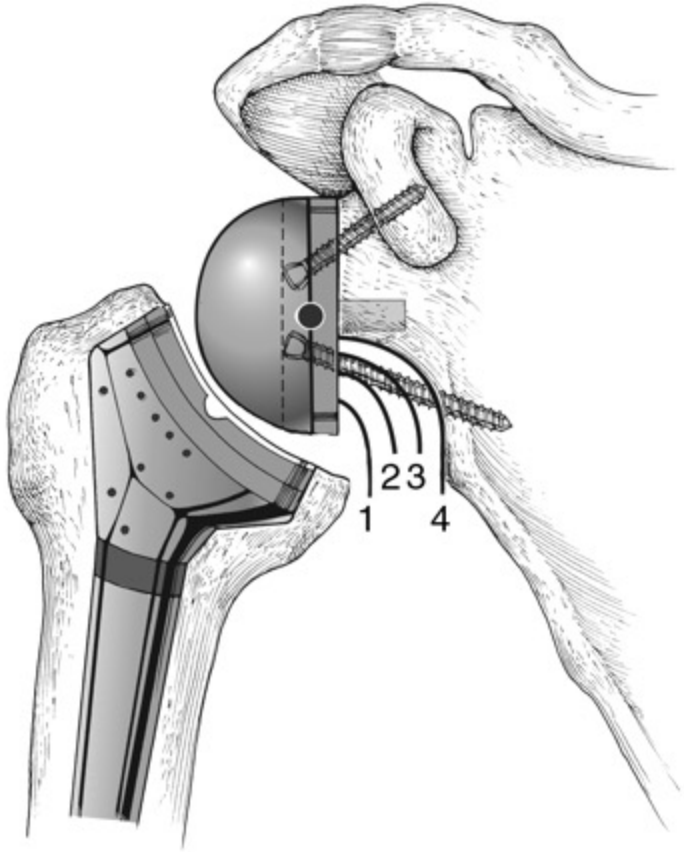
Limitations

- Scapular notching
- Internal or external rotation
  - Loss of internal, external moment of the anterior and posterior deltoid
  - Lack of functional rotator cuff



Cheung et al. *J Am Acad Orthop Surg* 2011;19: 439-449

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Complications (19-68%)

- Component loosening
  - Malposition
  - Notching
- Infection
- Intraoperative fracture
- Scapular spine fracture
- Dislocation
- Hematoma formation

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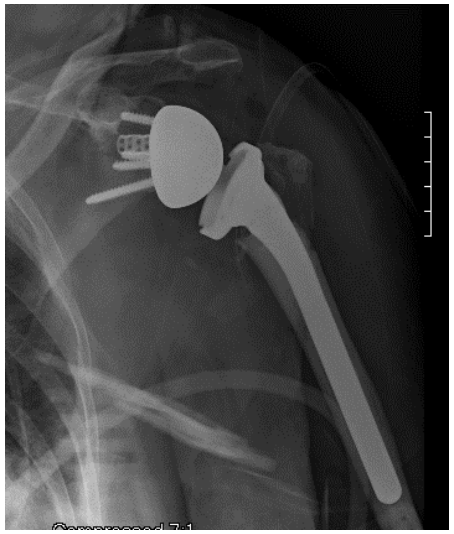

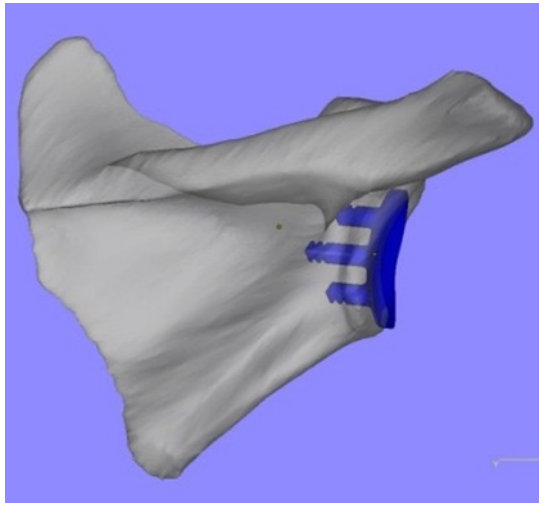

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Lateralization

- Lateralization of COR
  - Increased force required by deltoid to abduct
  - Increased stability (less lateralized pull by deltoid)
- When to consider
  - Loss of glenoid bone stock resulting in medialization
  - Concern for notching
  - Need for stability

Effect of lateral offset center of rotation in reverse total shoulder arthroplasty: a biomechanical study.
Henninger et al *J Shoulder Elbow Surg*. 2012 Sep;21(9):1128-35

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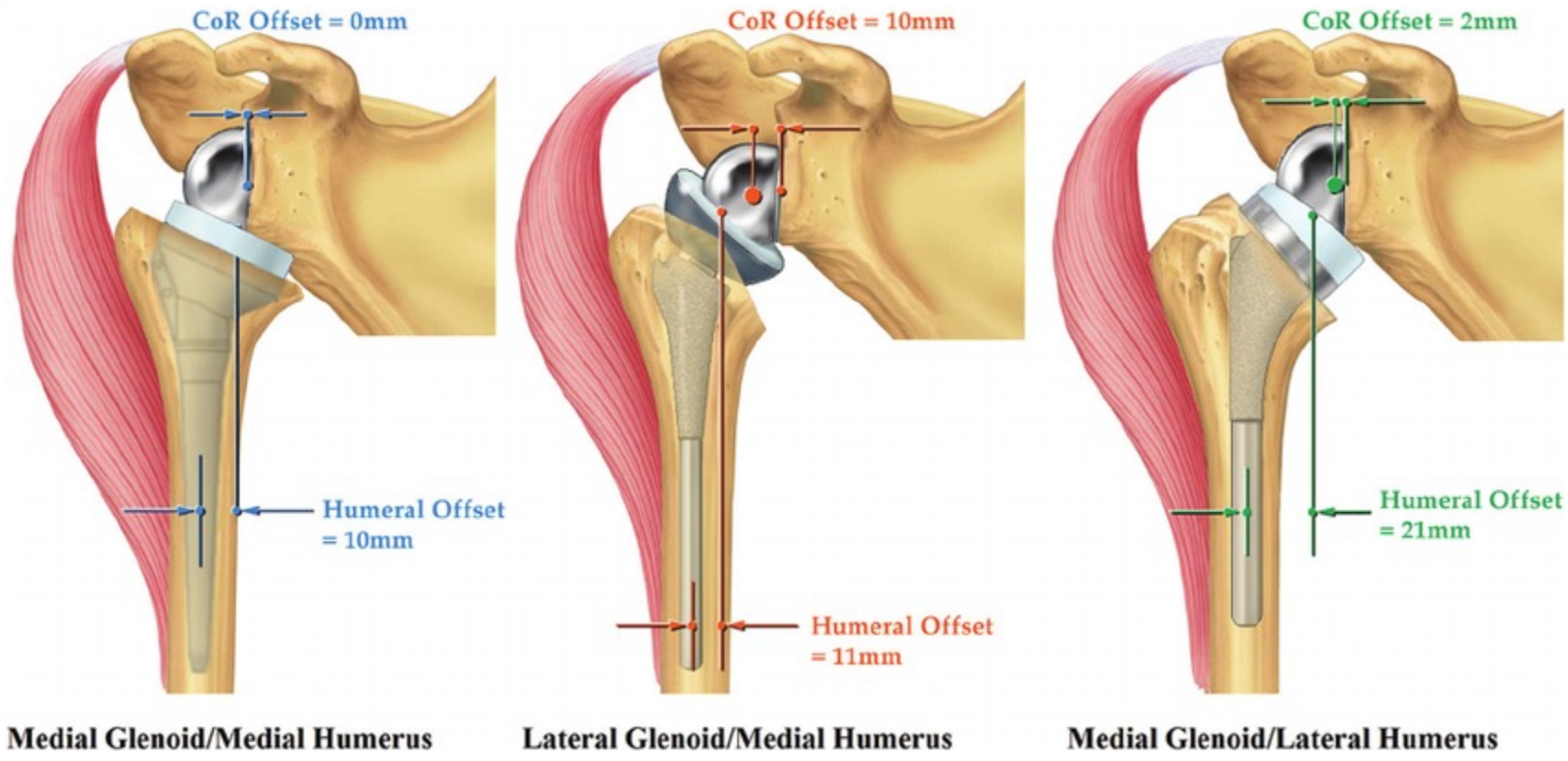

Routman, H. et al. Reverse Shoulder Arthroplasty Prosthesis Design Classification System. *Bulletin for the Hospital for Joint Diseases*. Vol. 73: S5-14. 2015.

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Points of debate…

- Proper tension
  - Too tight: scapular spine stress fracture
  - Too loose: dislocation
- Subscapularis repair?
- Lateralized versus medialized glenosphere
- Augmented glenosphere baseplate

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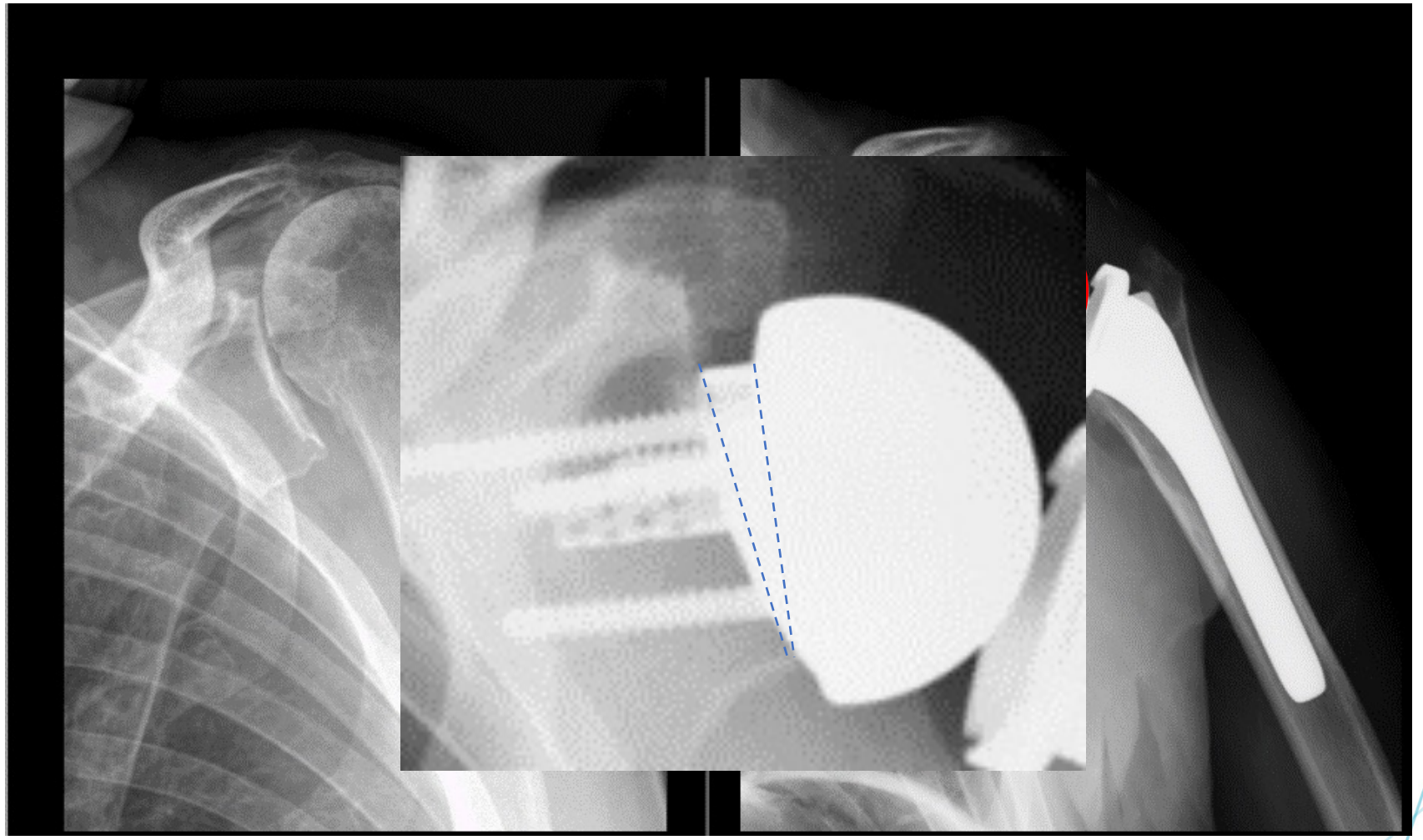
Superior augment baseplate



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Expanding Indications

- **Rotator cuff deficient arthropathy**
- Proximal humerus fractures in elderly
- Revision shoulder arthroplasty
- Massive rotator cuff tear with pseudoparalysis
- Late sequelae of fracture (+/- ORIF)
- GH osteoarthritis with intact cuff
  - Inflammatory OA
  - B2 glenoid

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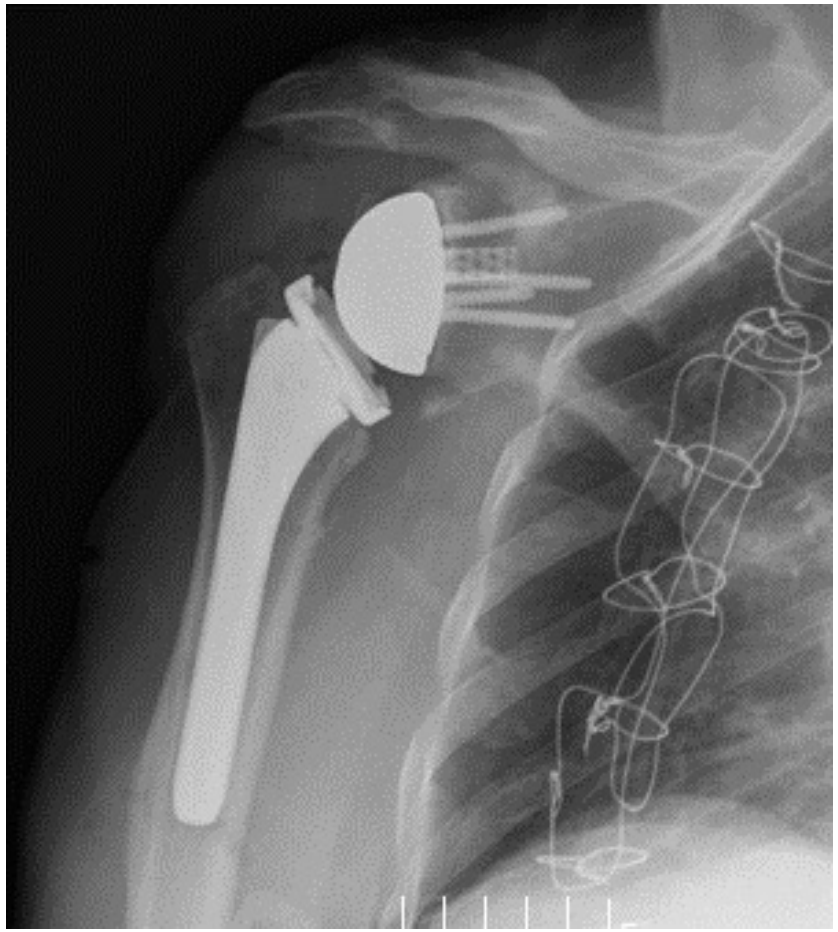
Rotator Cuff Arthropathy



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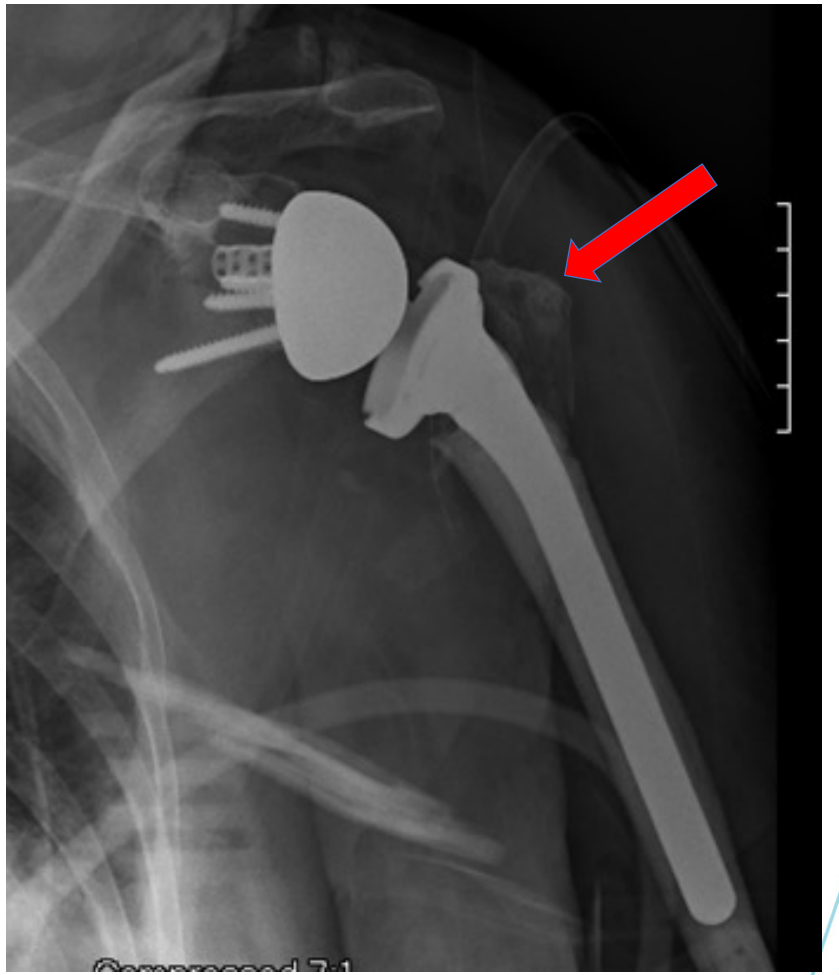
Proximal Humerus Fractures



77 yo female with 4 part fracture

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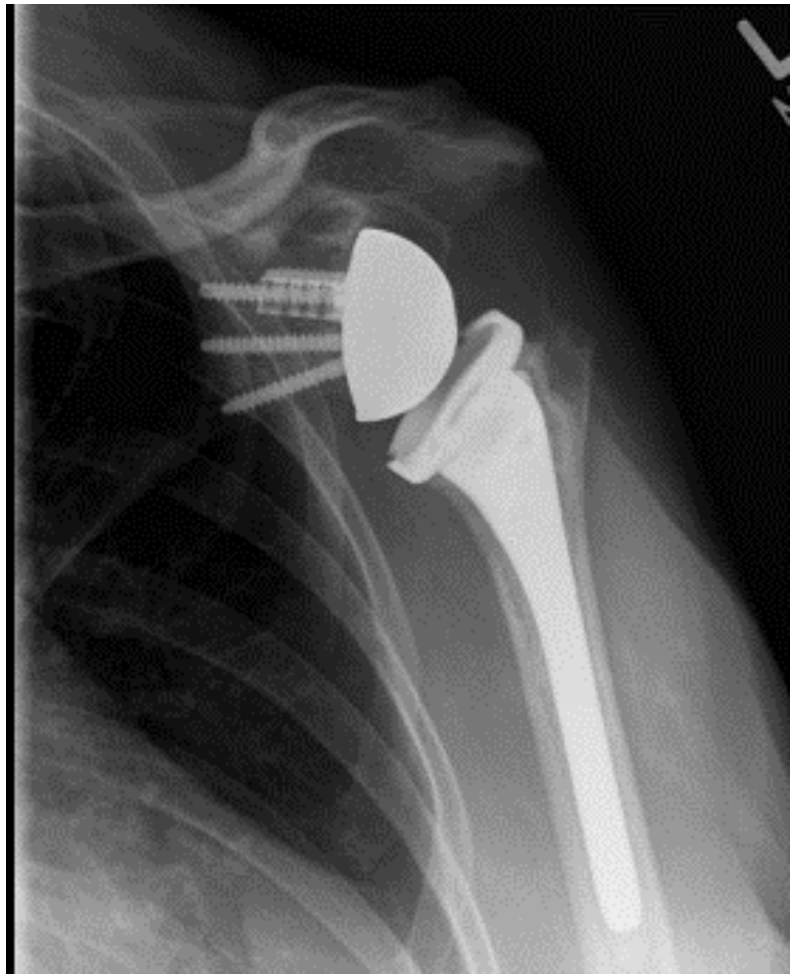
Failed Arthroplasty



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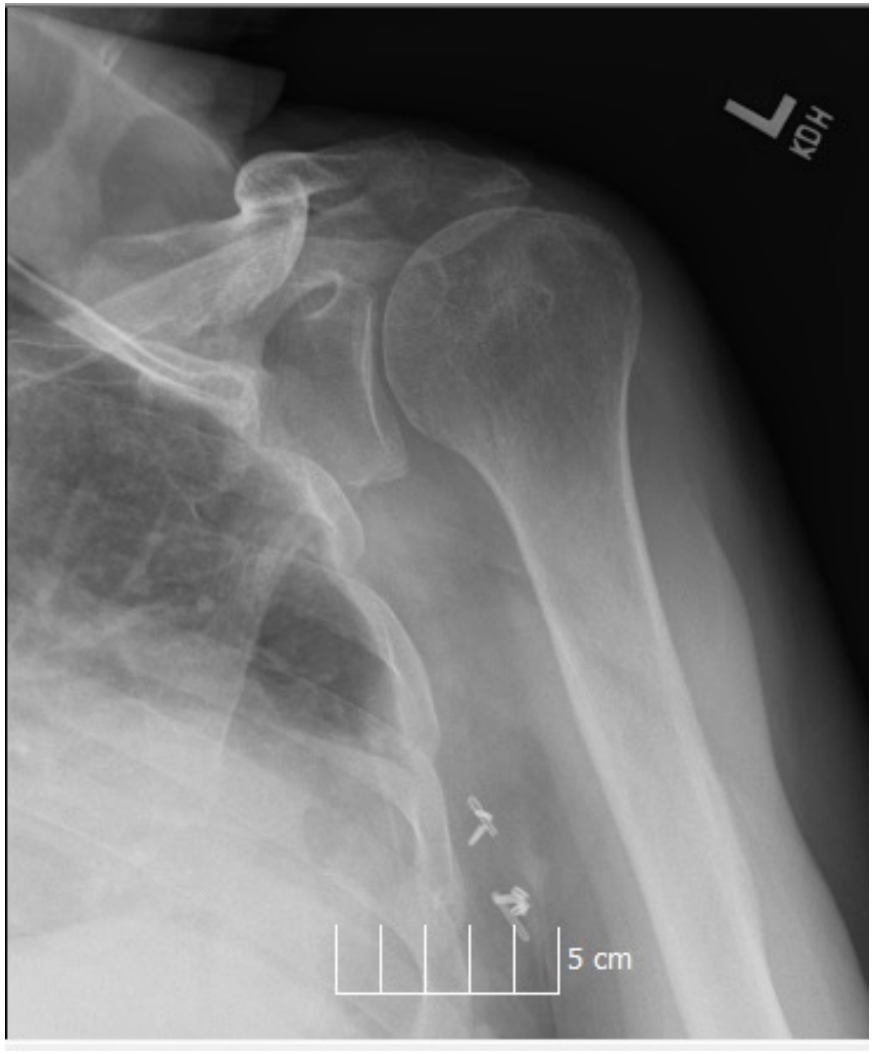
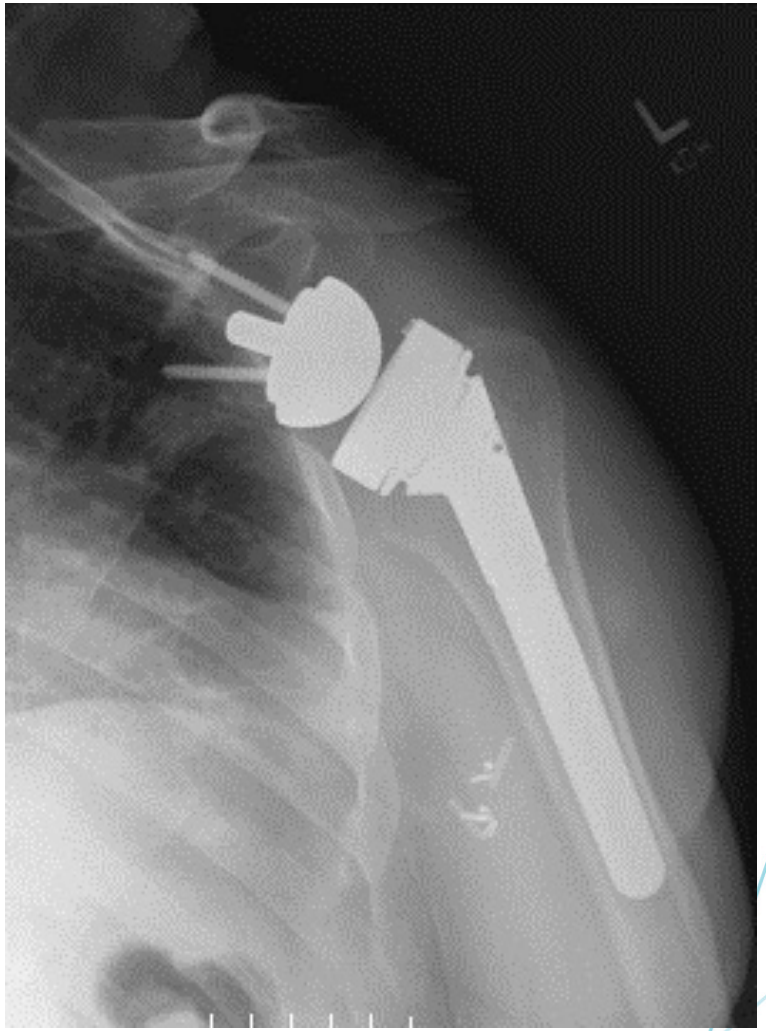
Massive RCT with psuedoparalysis





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Late sequelae of fracture

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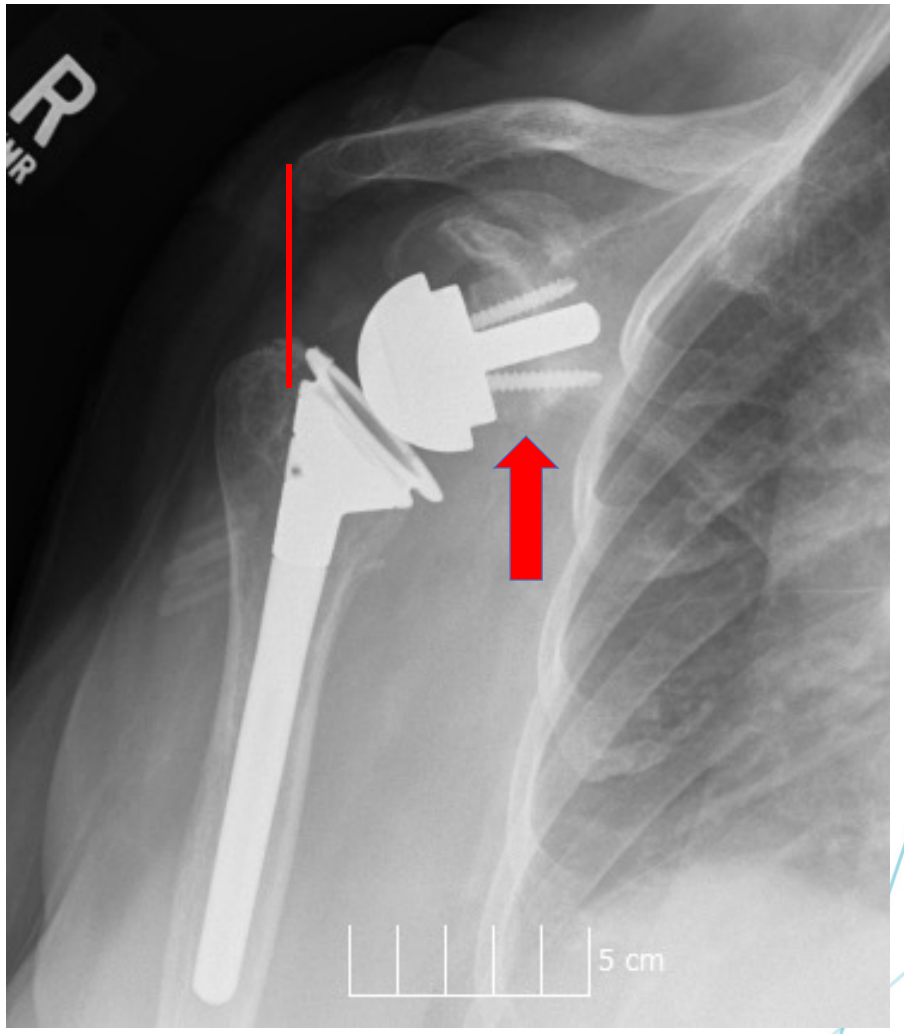
GH OA with intact Cuff



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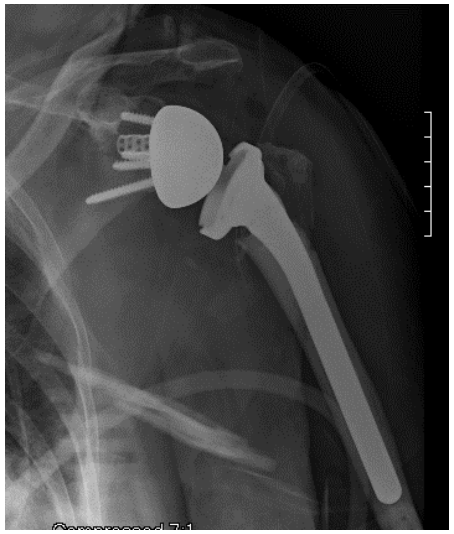

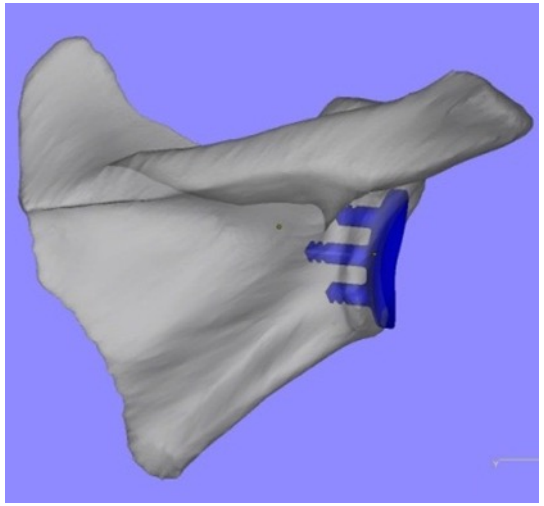

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ORIF versus nonop

- Olerud et al, JSES 2011

	ORIF	Nonop	P Value
Constant Score	61	58	.36
DASH	26	35	.19
EQ–5D	0.7	0.59	.26
FE	120 deg	111 deg	.36

- 60 pts, mean age 74, 2 year f/u
- Displaced 3 part proximal humerus fractures
- **30% reoperation rate**!!

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Hemiarthroplasty vs RSA

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Comparison of Hemiarthroplasty and Reverse Shoulder Arthroplasty for the Treatment of Proximal Humeral Fractures in Elderly Patients

Derek J. Cuff, MD, and Derek R. Pupello, MBA

Investigation performed at Suncoast Orthopaedic Surgery and Sports Medicine, Venice, and the Foundation for Orthopaedic Research and Education, Tampa, Florida

- 53 consecutive pts, mean age 74.4
- 26 HA followed by 27 rTSA
- 89% follow up at 2 years (47/53)
- Level II study

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Hemiarthroplasty vs RSA

	HA	rTSA	P value
ASES	62	77	.0001
SST	5.8	7.4	.0062
Satisfaction	61%	91%	.038
Tuberosity healing	61%	83%	.17
Forward elevation	100 deg	139 deg	.0002

- 13% crossover (HA converted to rTSA for failed tuberosity healing)

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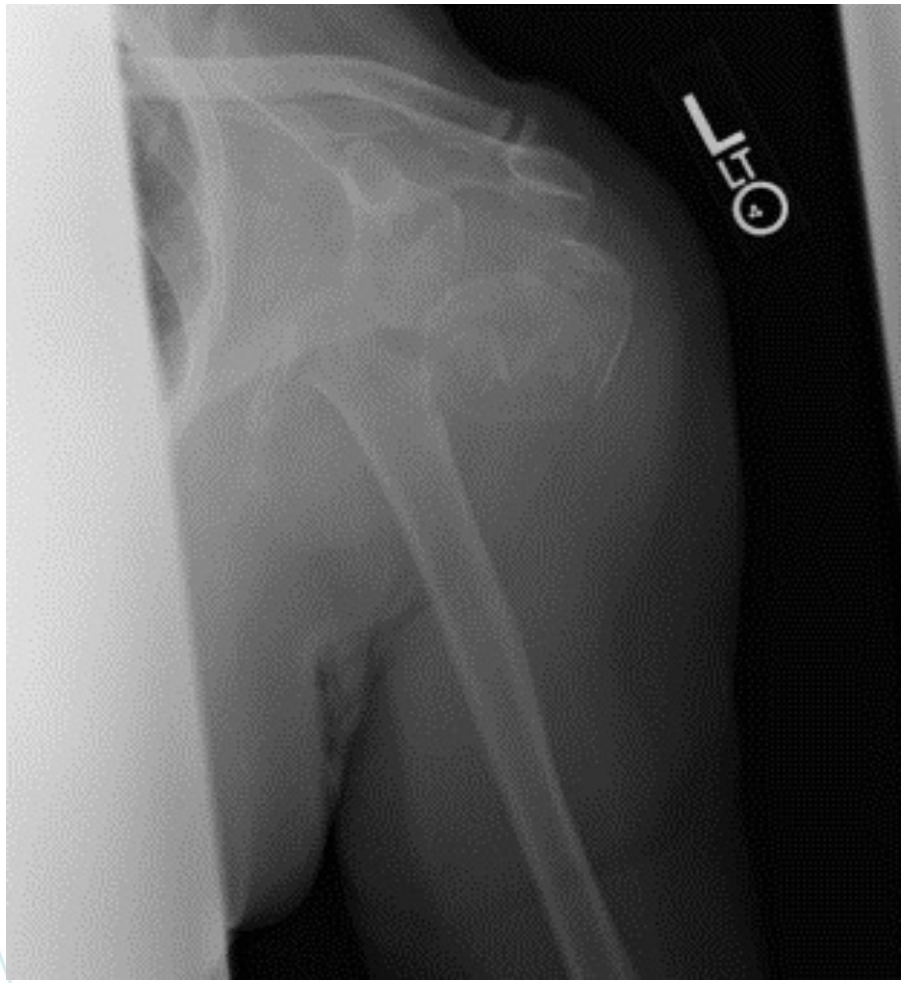
3,4 part fractures in elderly



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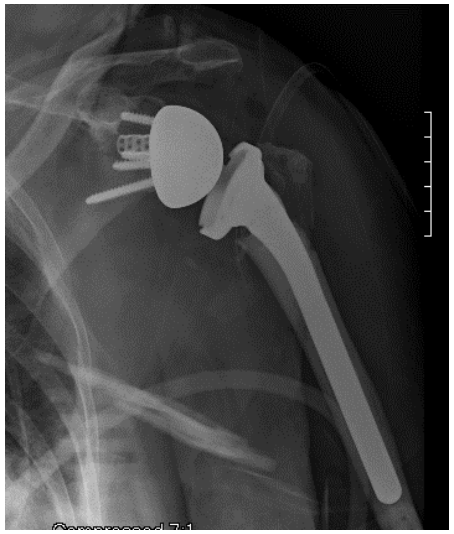

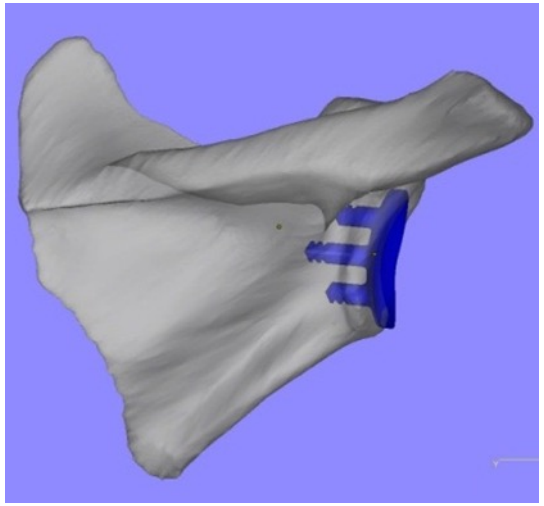

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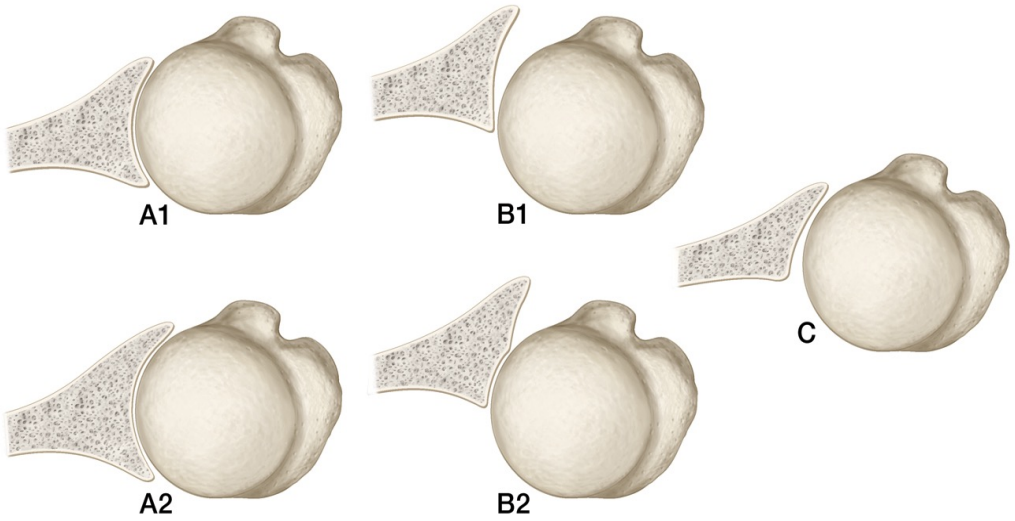
Posterior Glenoid Wear

- Common wear pattern seen in shoulder osteoarthritis
- Results in posterior subluxation of the humerus
- Decreases the volume of bone in the glenoid vault



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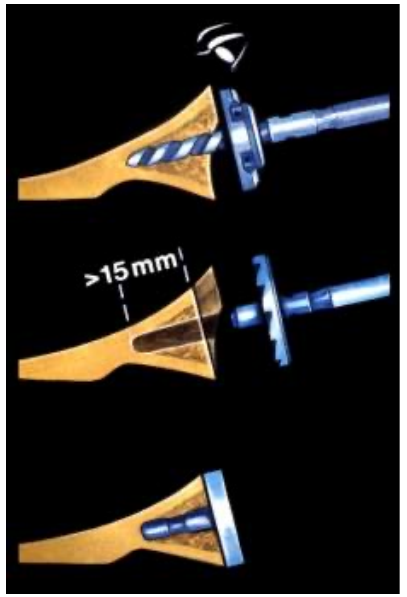
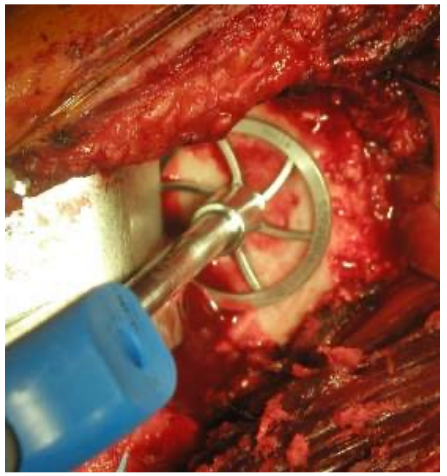
Posterior Glenoid Wear Techniques

- Anterior eccentric reaming
- Decreased humeral retroversion
- Offset humeral head
- Posterior plication
- **Augmented glenoid**





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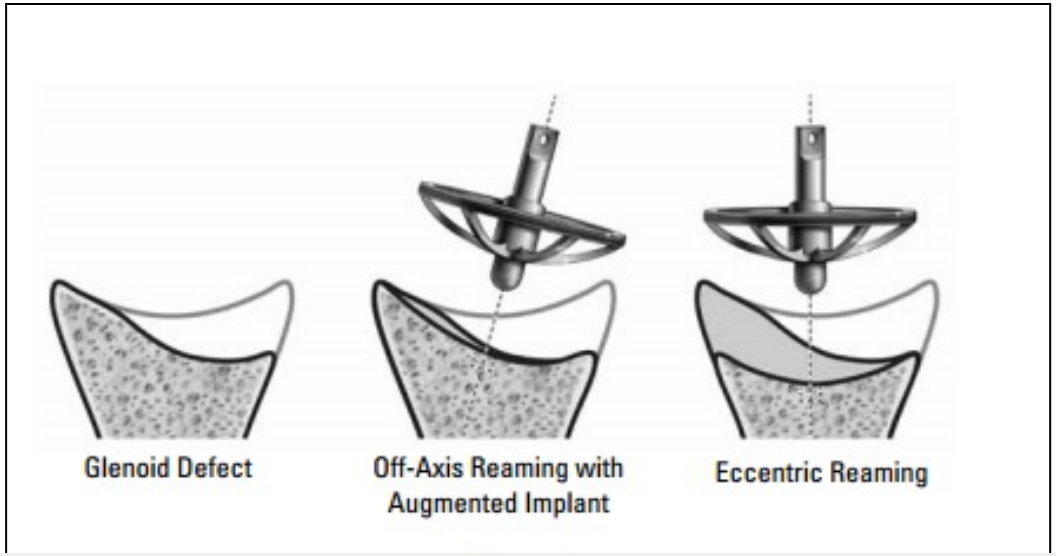
Augmented Glenoid



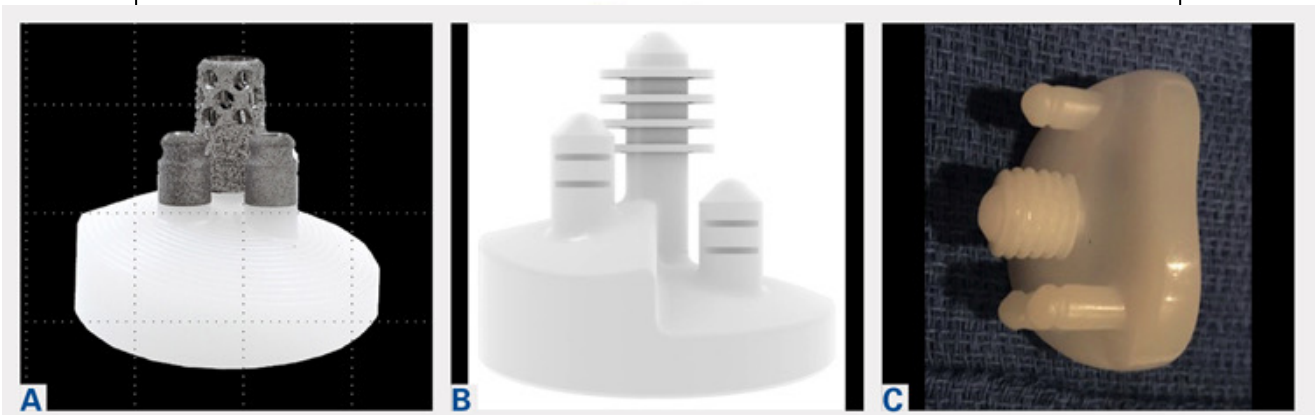


Figure 1. (A) Exactech Equinoxe 8° posterior augment composite glenoid, (B) DePuy Synthes Step posterior augmented glenoid, (C) Wright Medical Group hemi-wedge.

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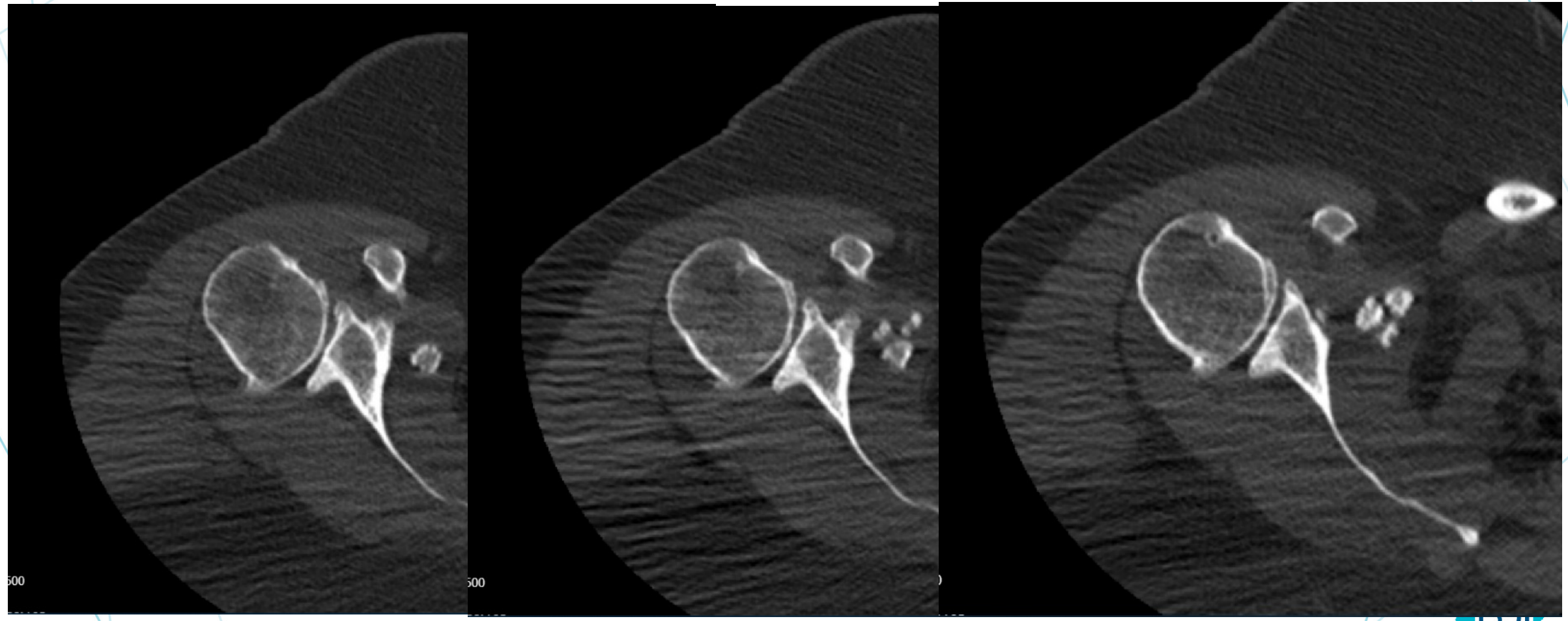
46 yo female, B2 glenoid



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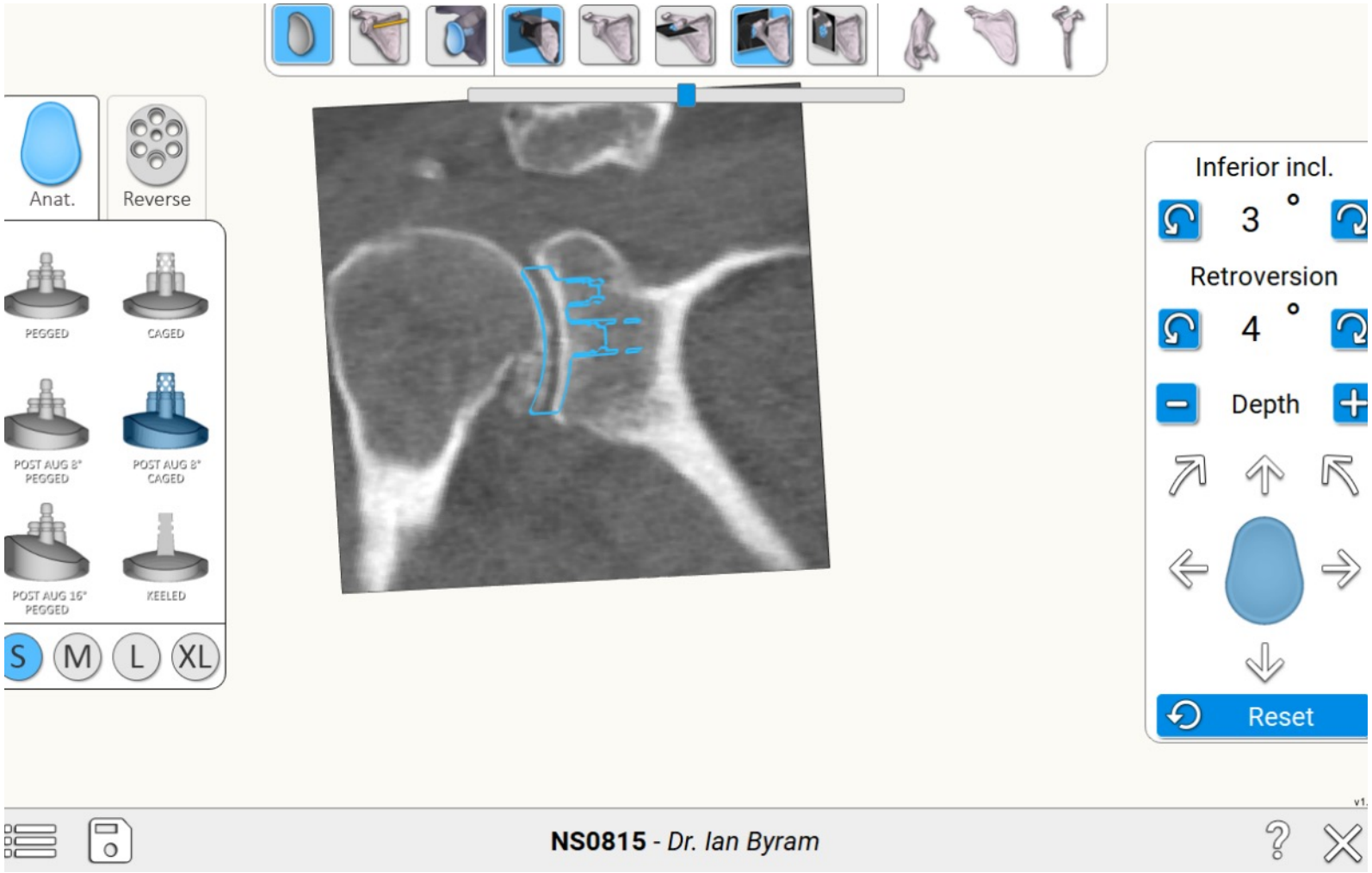
Preop planning software



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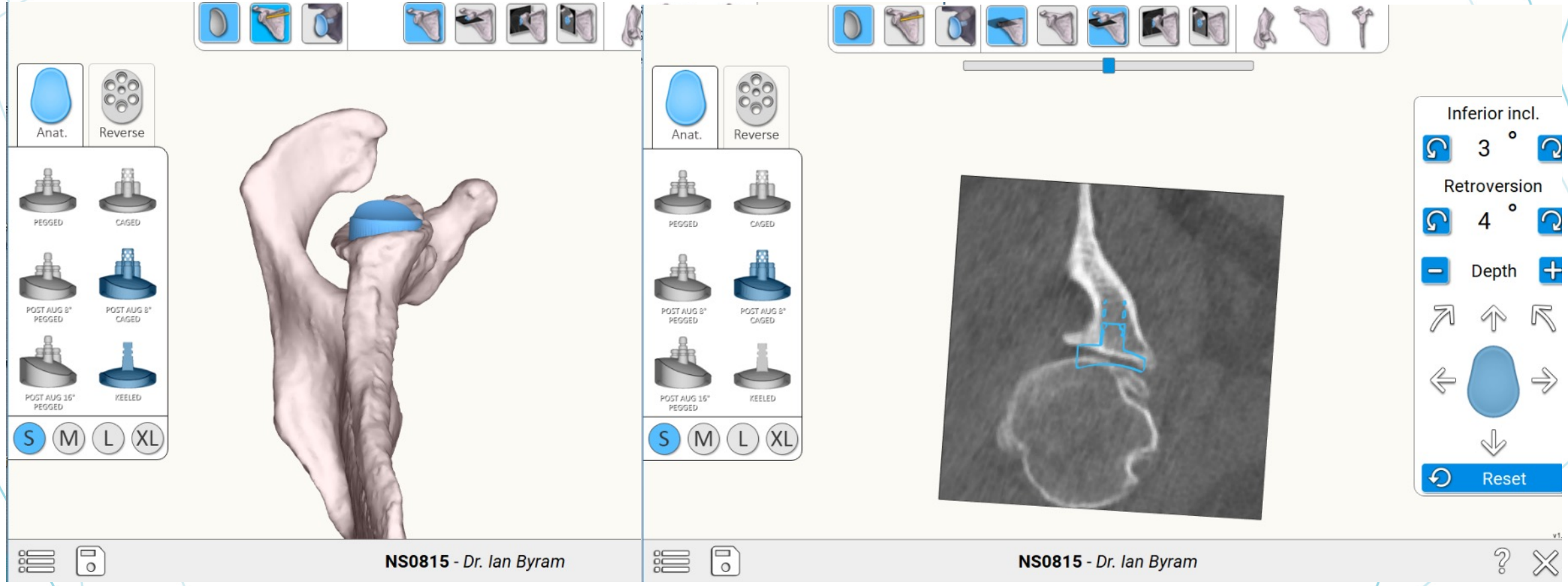

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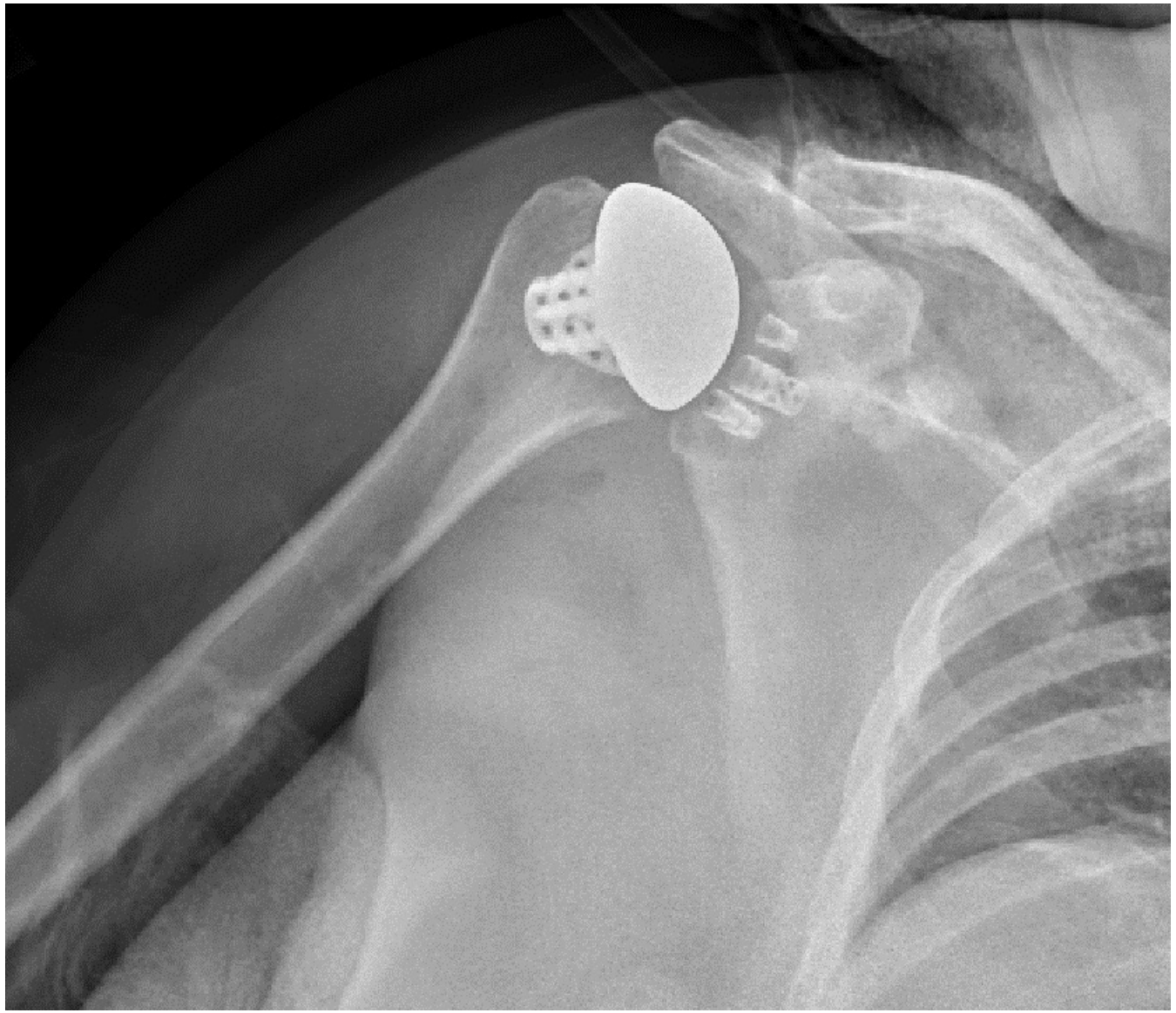

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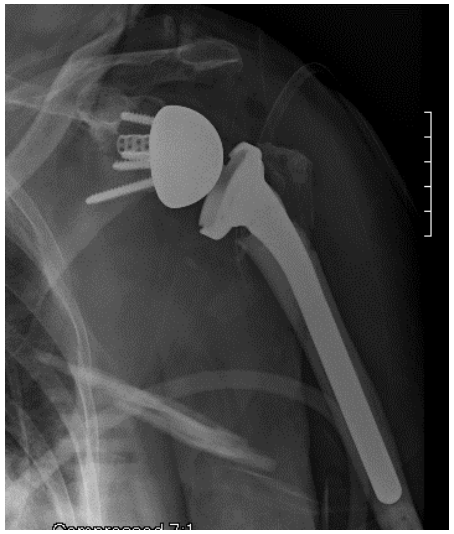

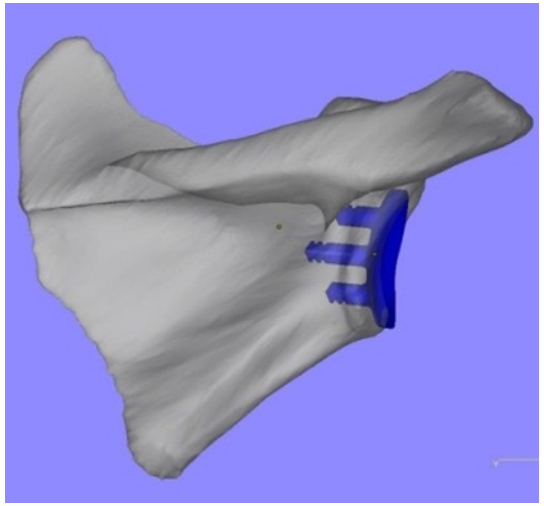

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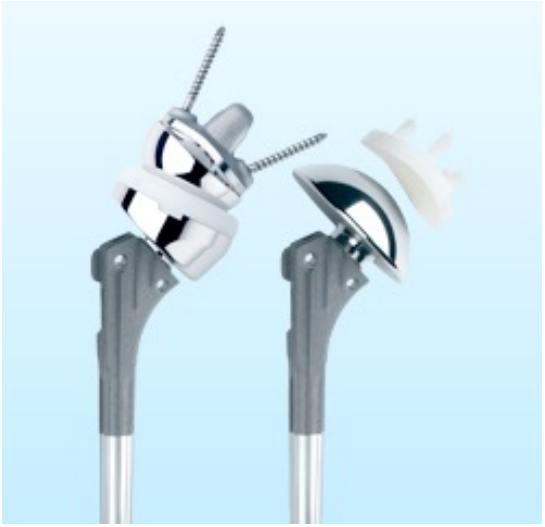
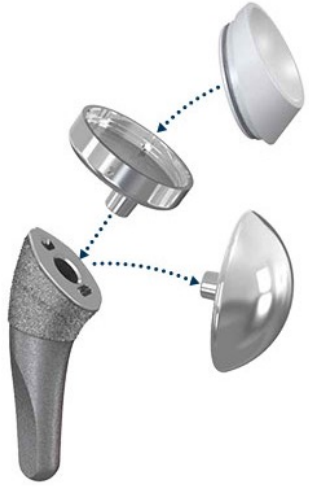
Platform Stem – 1°TSA or RSA





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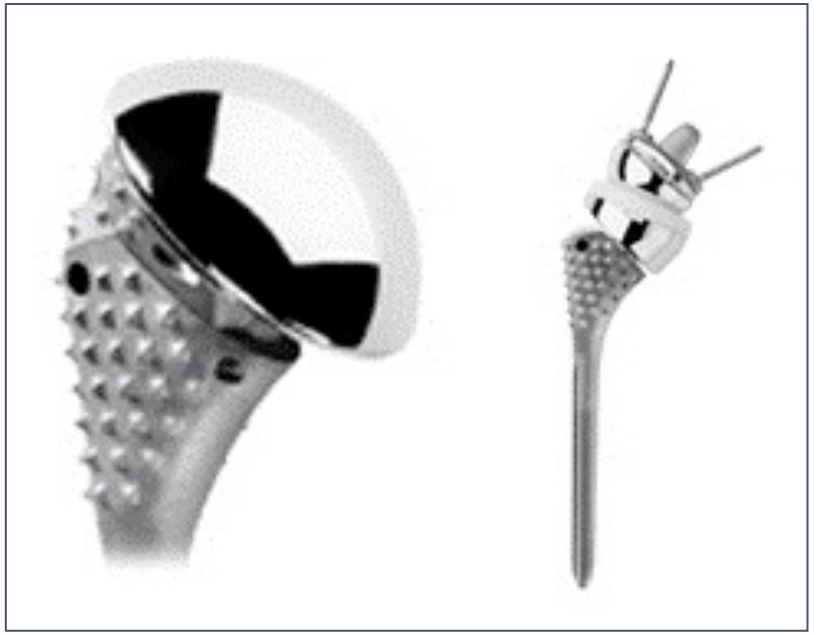
Platform Stem – Fractures



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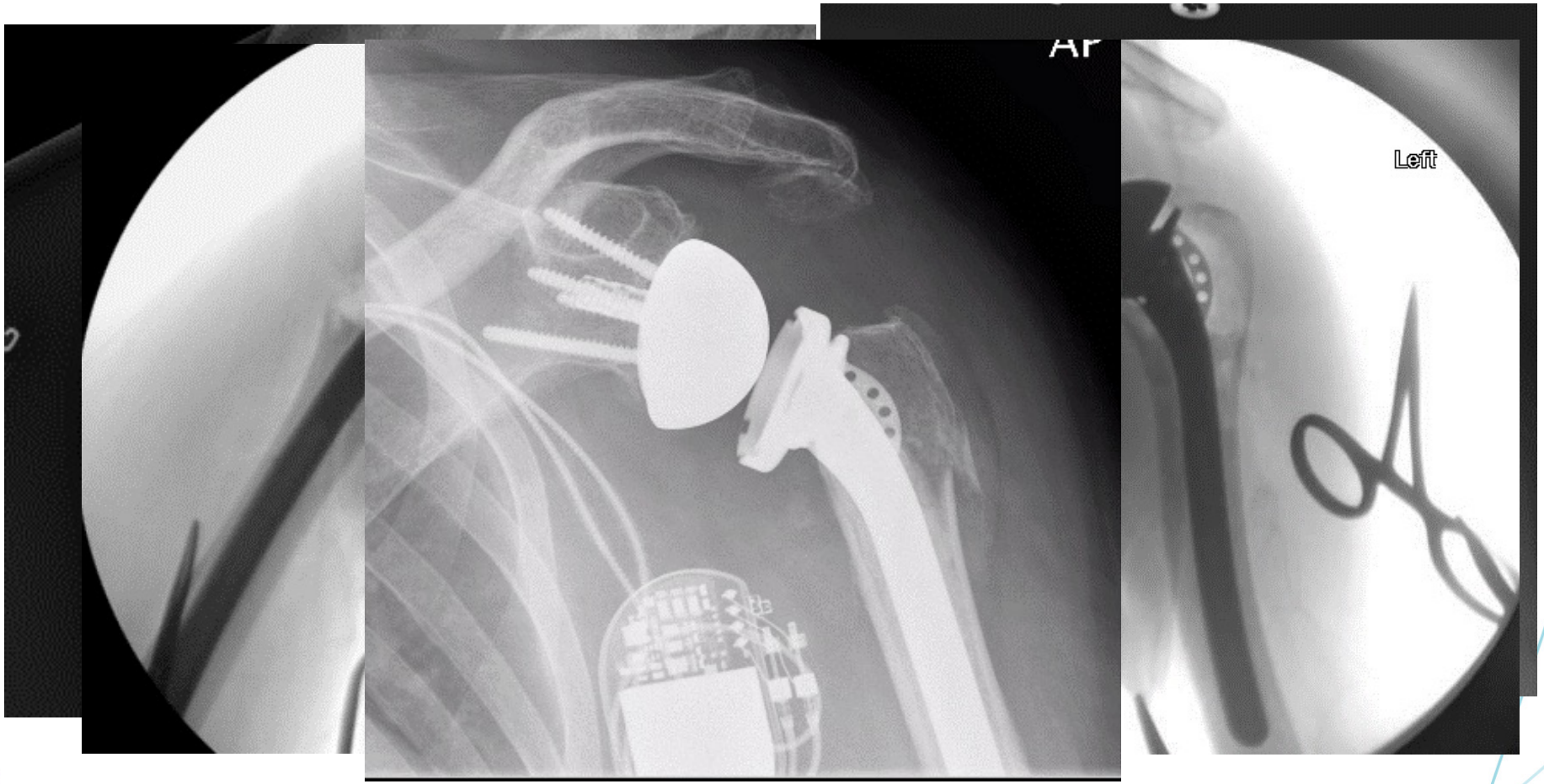
Platform Stem - Fractures



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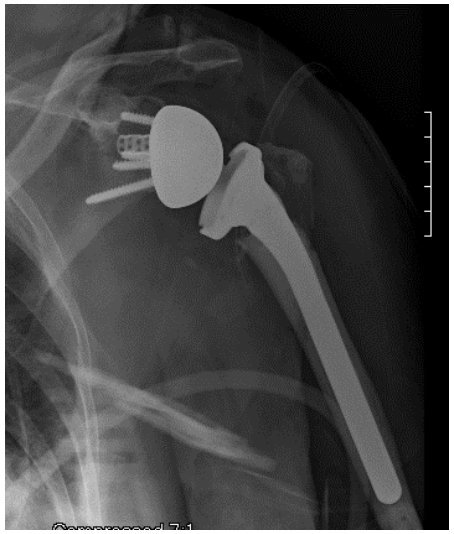
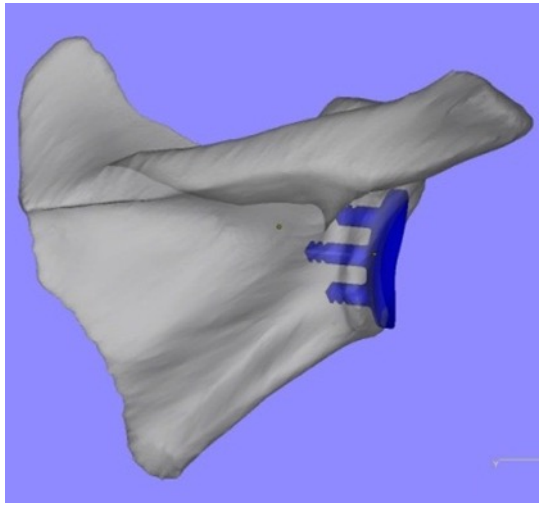
TSA Current Concepts

- Historical perspective
- Reverse TSA
  - Implant/technique trends
  - Expanded indications
  - Arthroplasty for fracture
- Anatomic TSA
  - Augmented glenoid
  - Platform stem
- **New technology**





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Future of the “difficult” glenoid…

- 3-D pre-operative templating
- Navigation and/or instrumentation for real-time guidance

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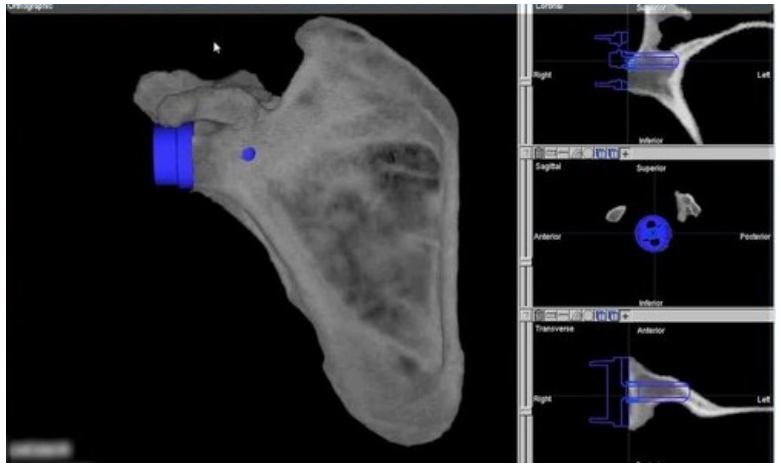
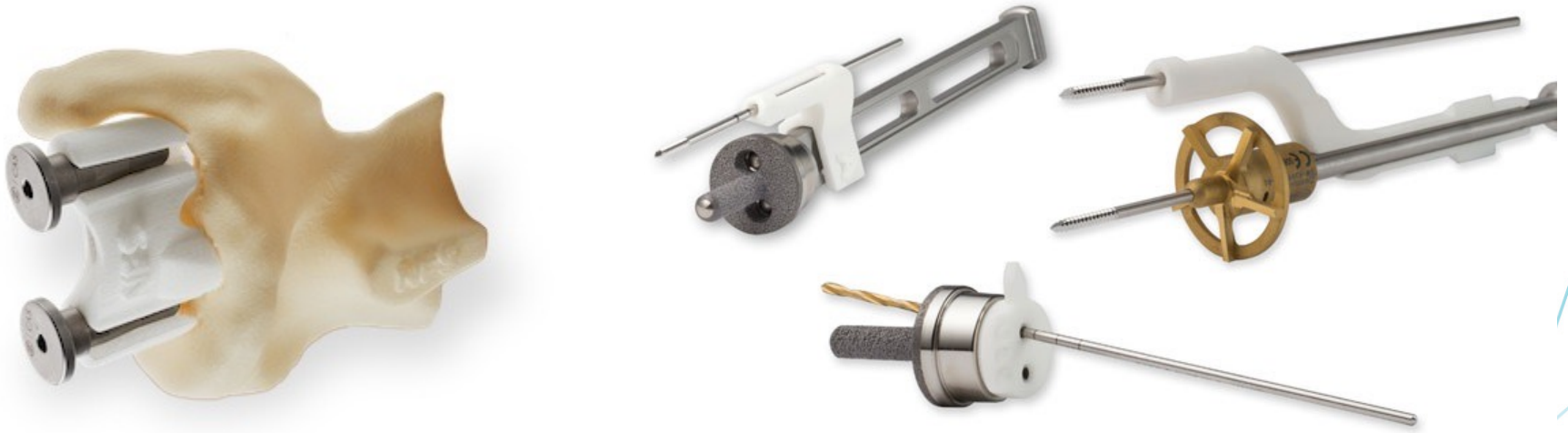
Custom “patient specific” instrumentation





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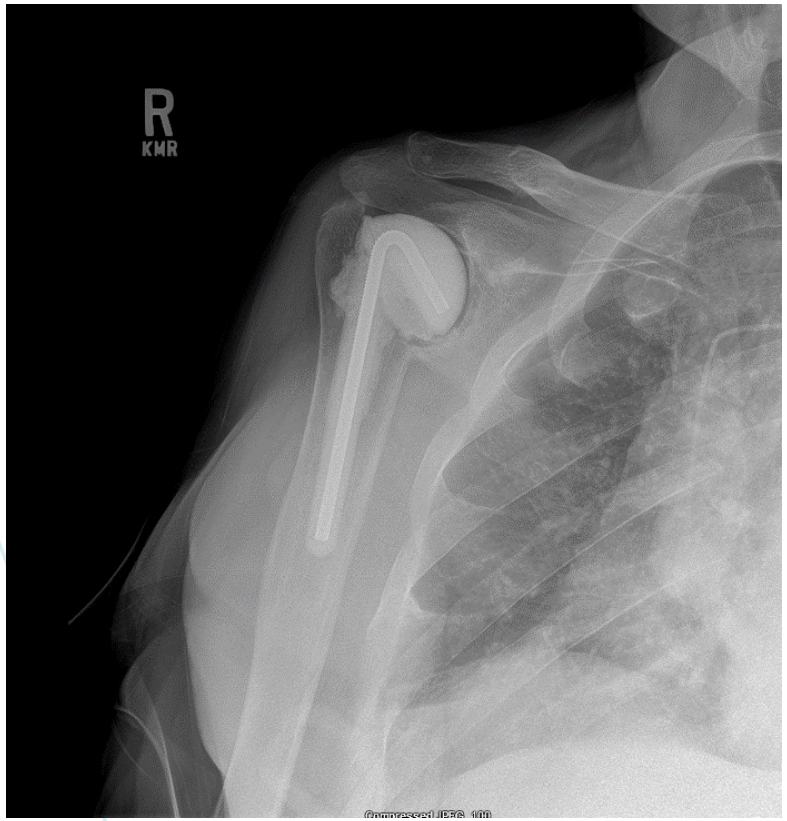
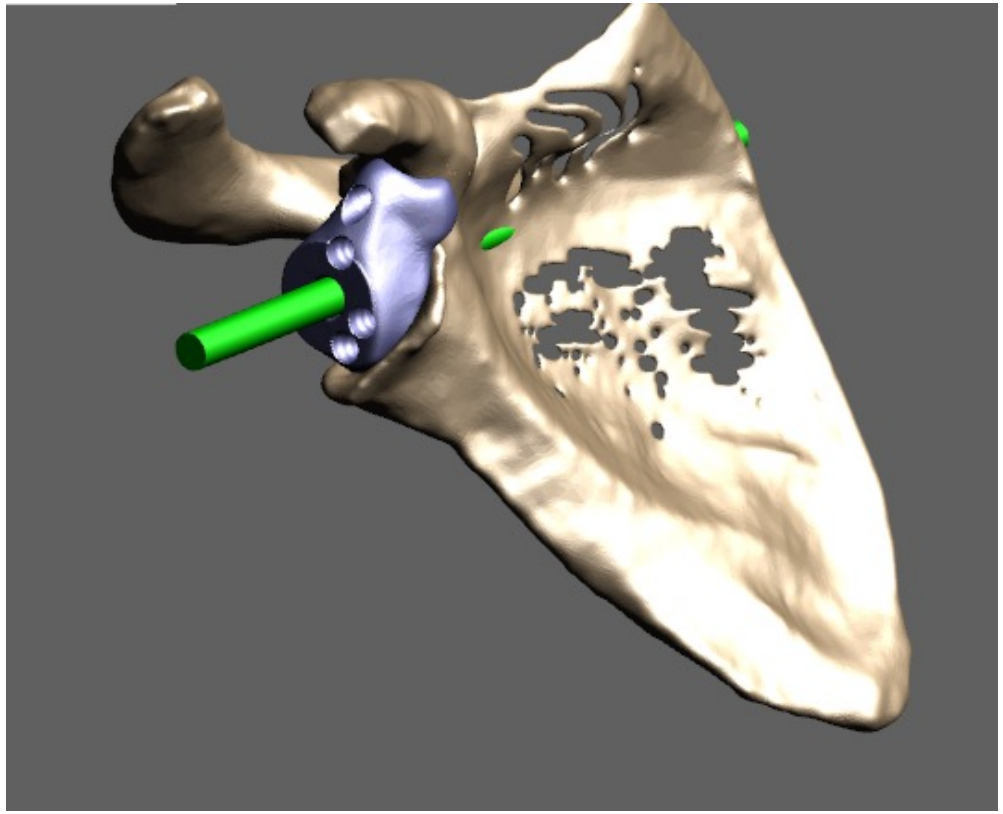
Custom Implants





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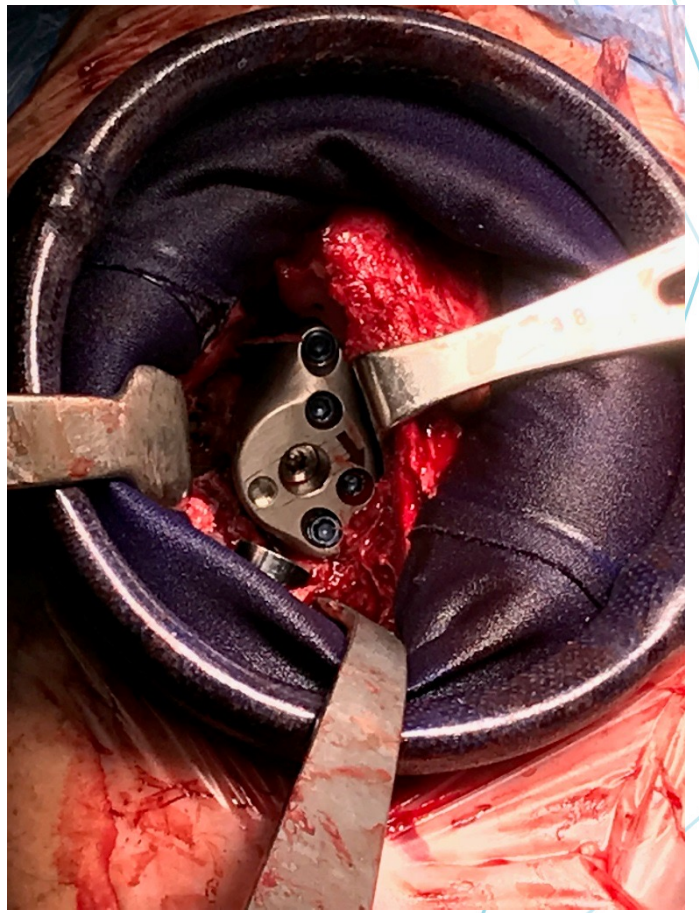

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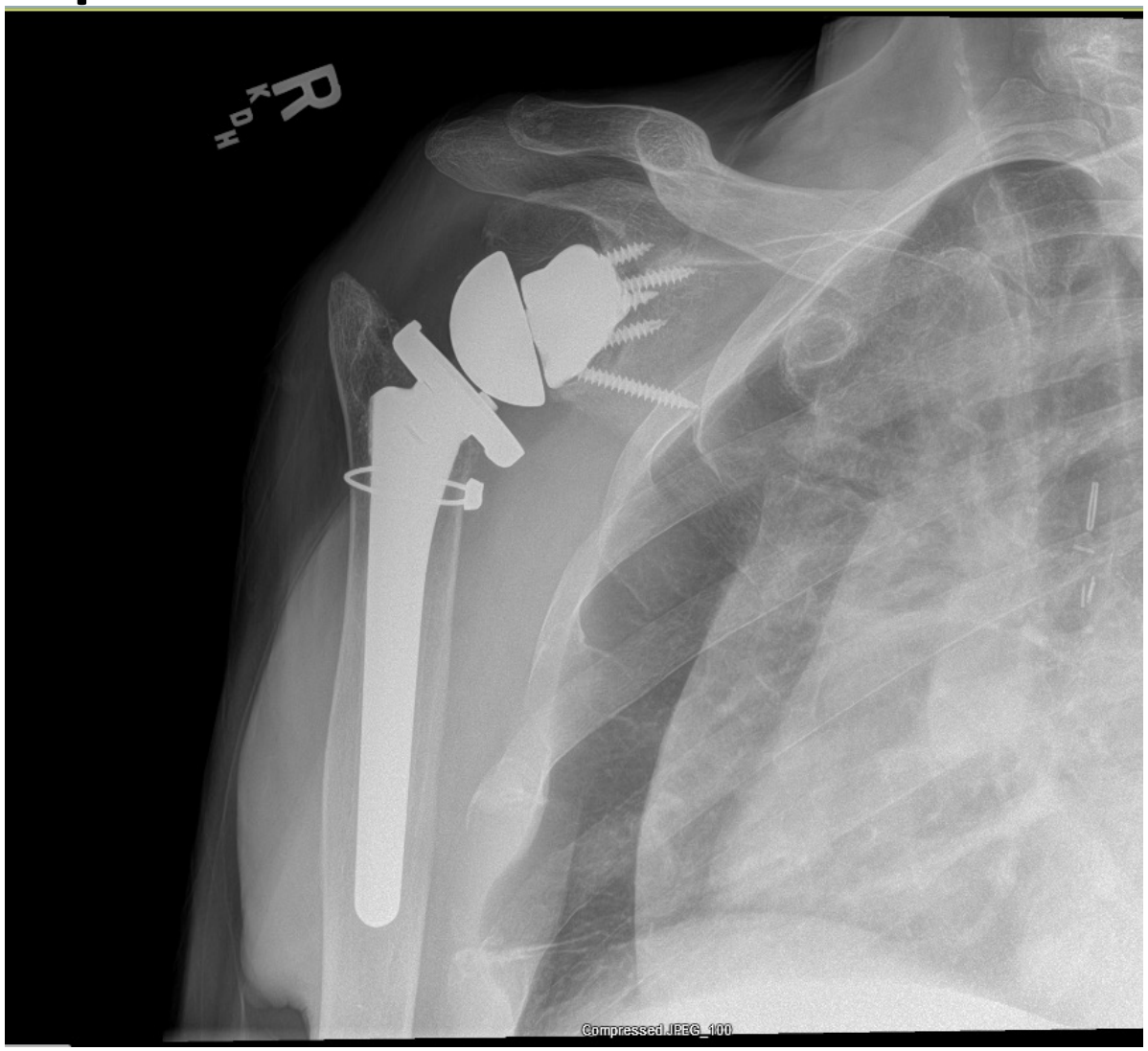

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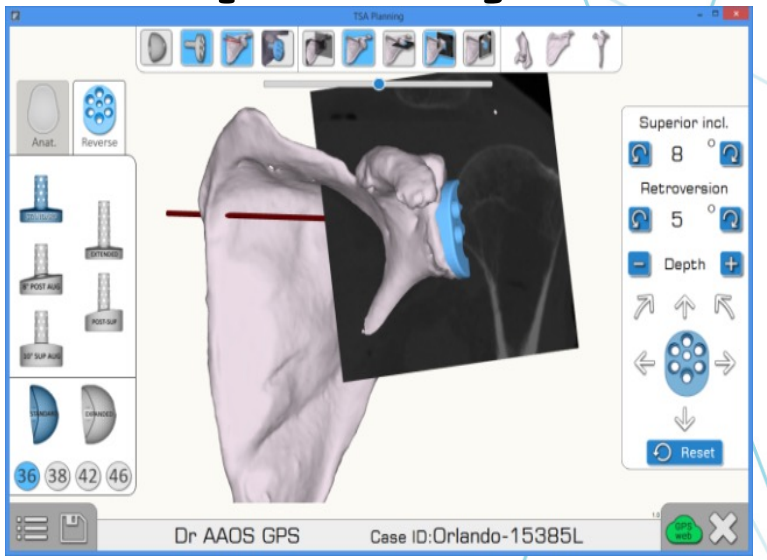
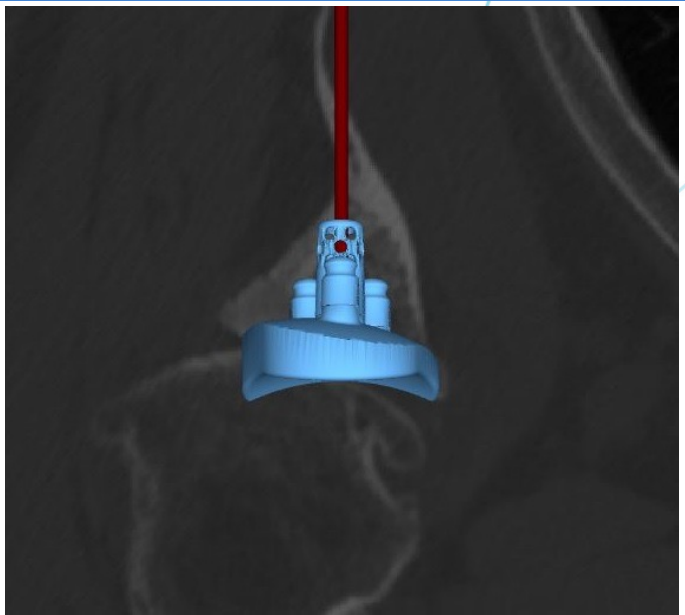
CT Navigation in Shoulder Arthroplasty

- **3D Pre-operative planning from CT reconstructions**
  - Compact touch-screen positioned in the sterile field enables user-controlled execution and (if desired) adjustment of the surgical plan.
  - Small, active trackers with coracoid fixation
  - CT based, real-time view of:
    - Glenoid Version/Inclination
    - Glenoid Position
    - Reaming depth
    - Screw placement





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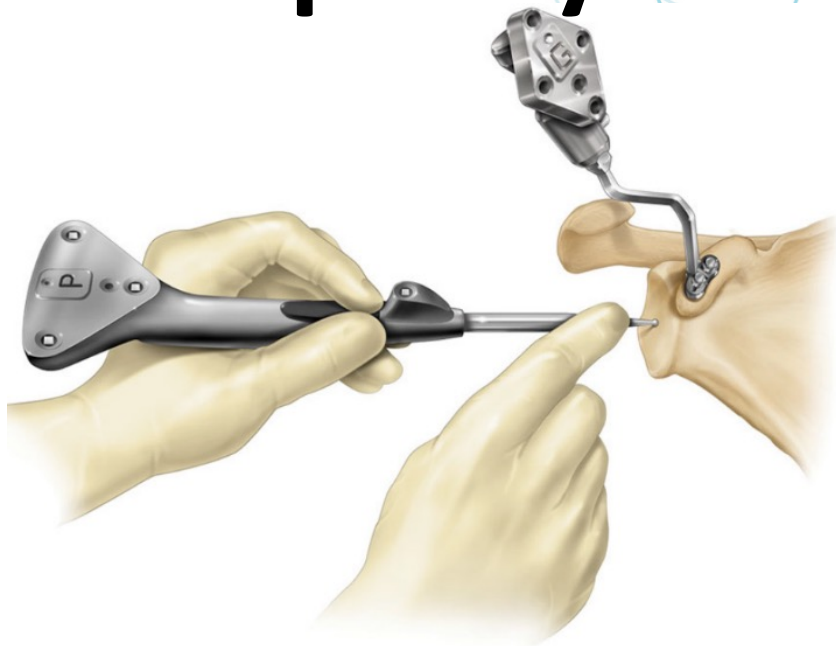

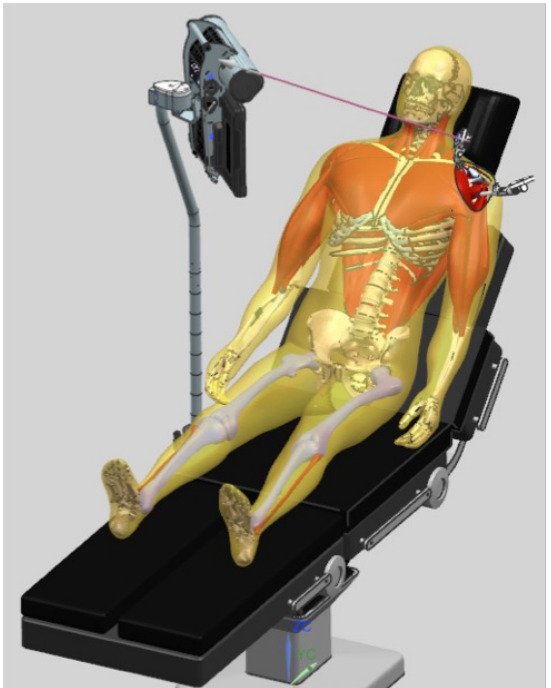

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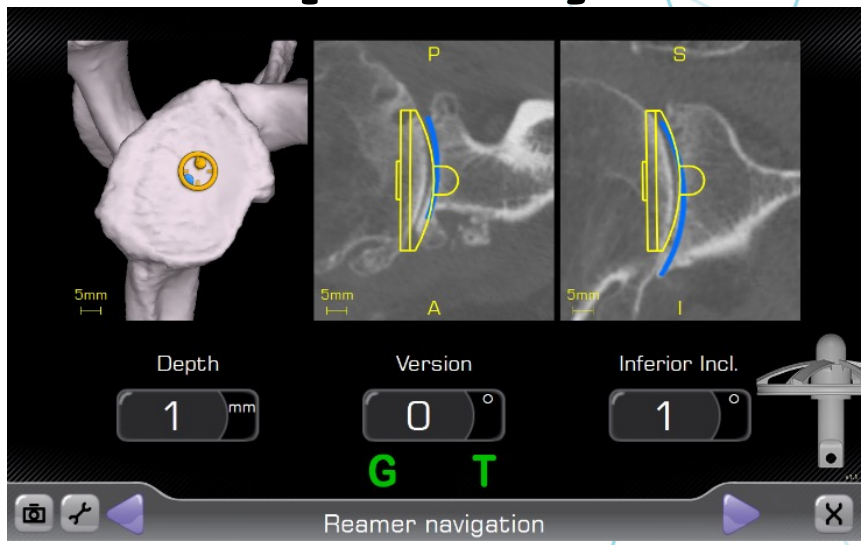
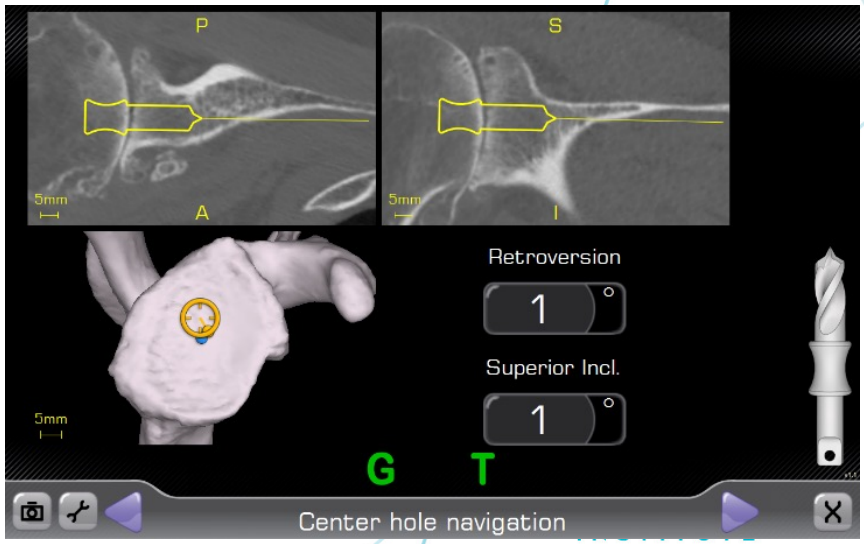
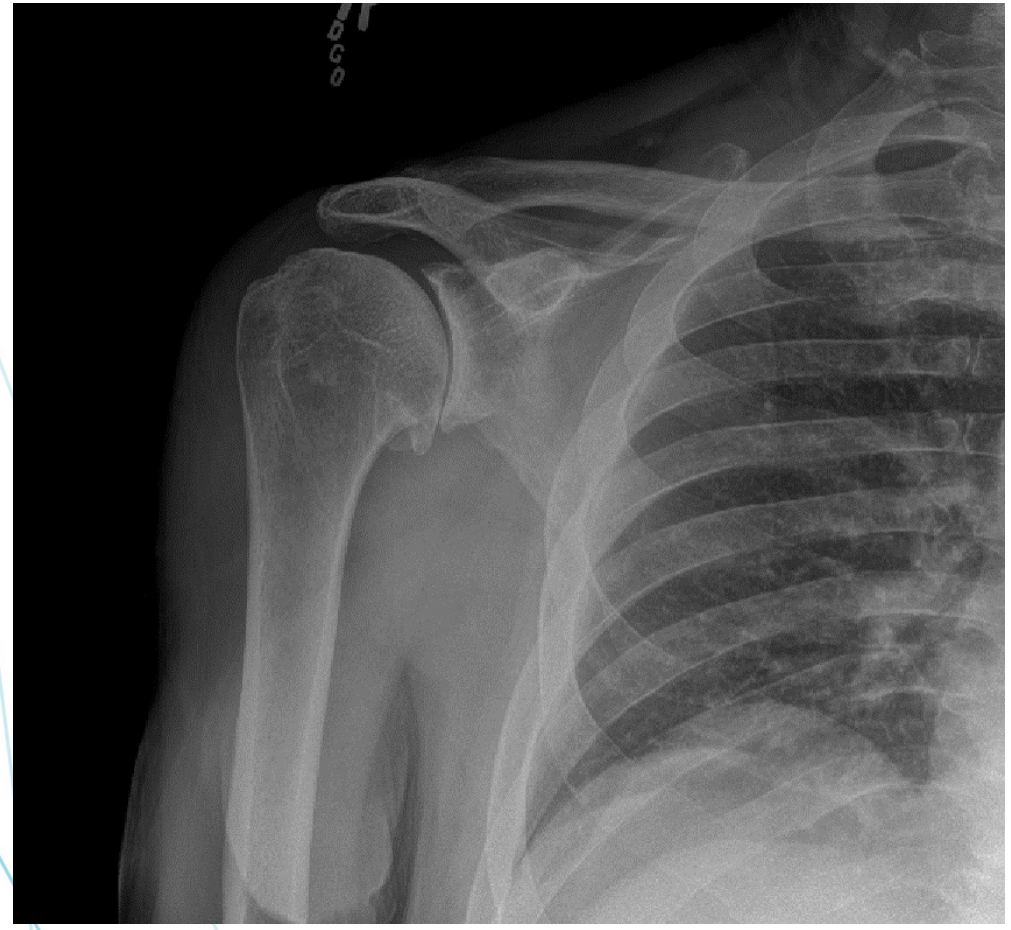
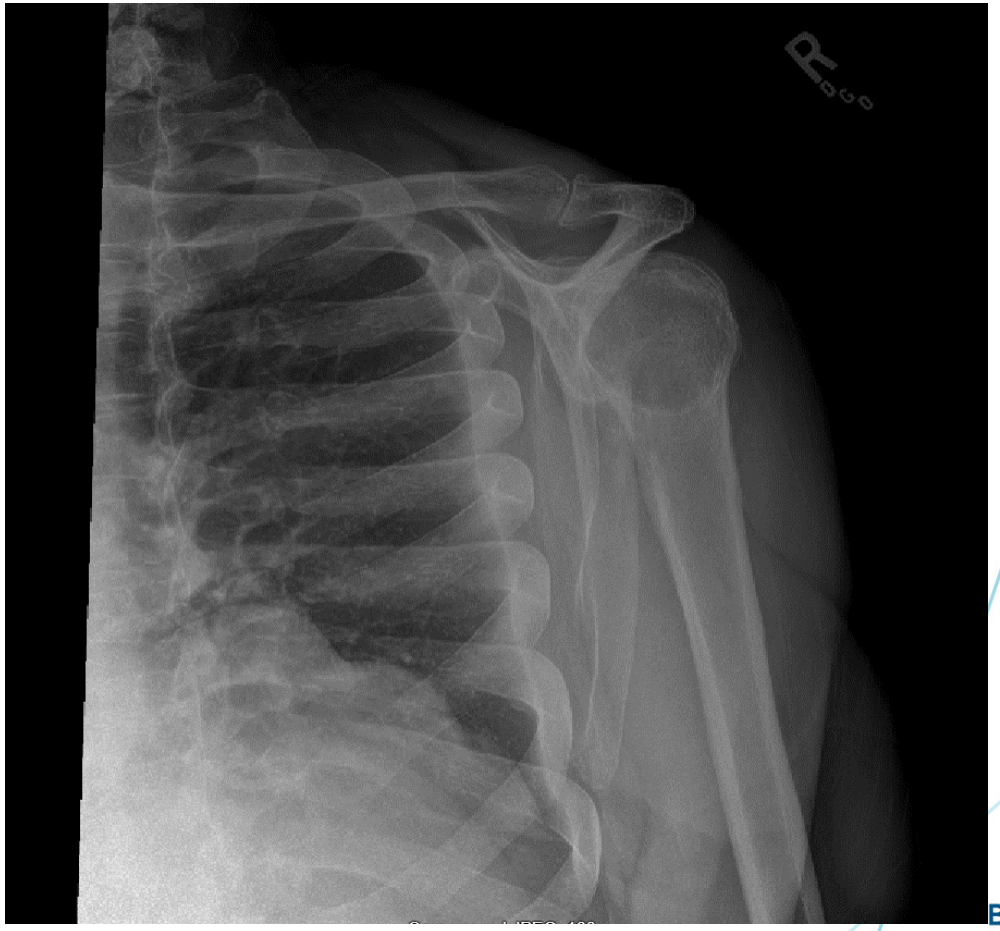
  - **Glenoid Position**
  - **Reaming depth**
  - **Screw placement**





Case example: 73 yo male golfer





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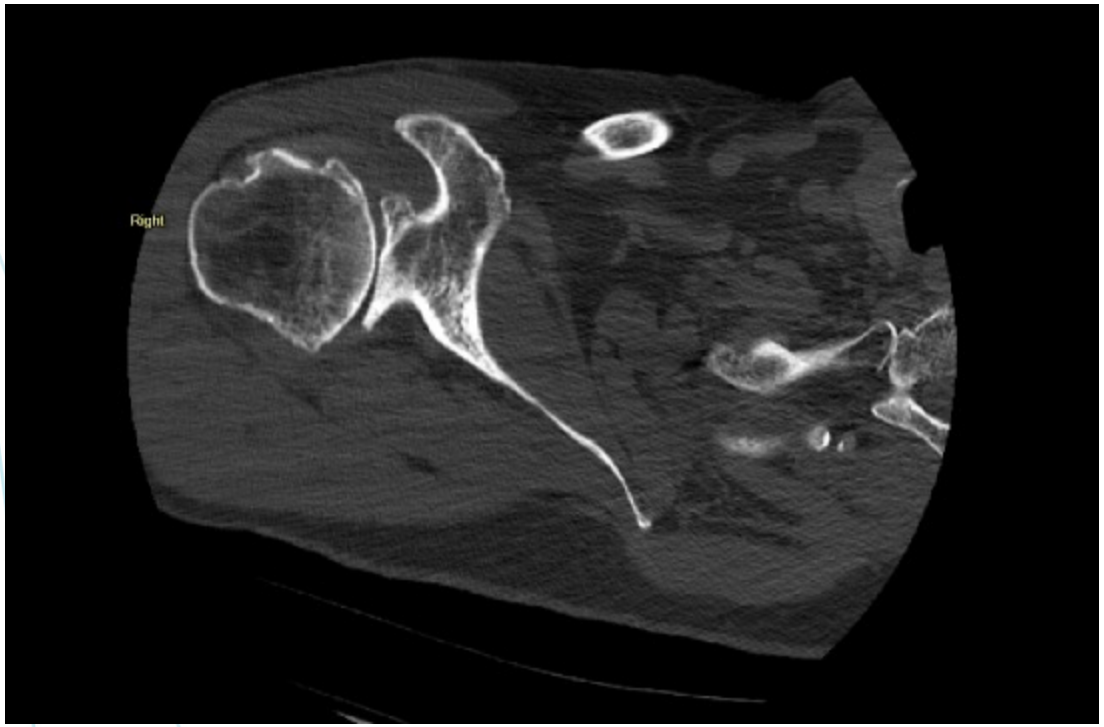

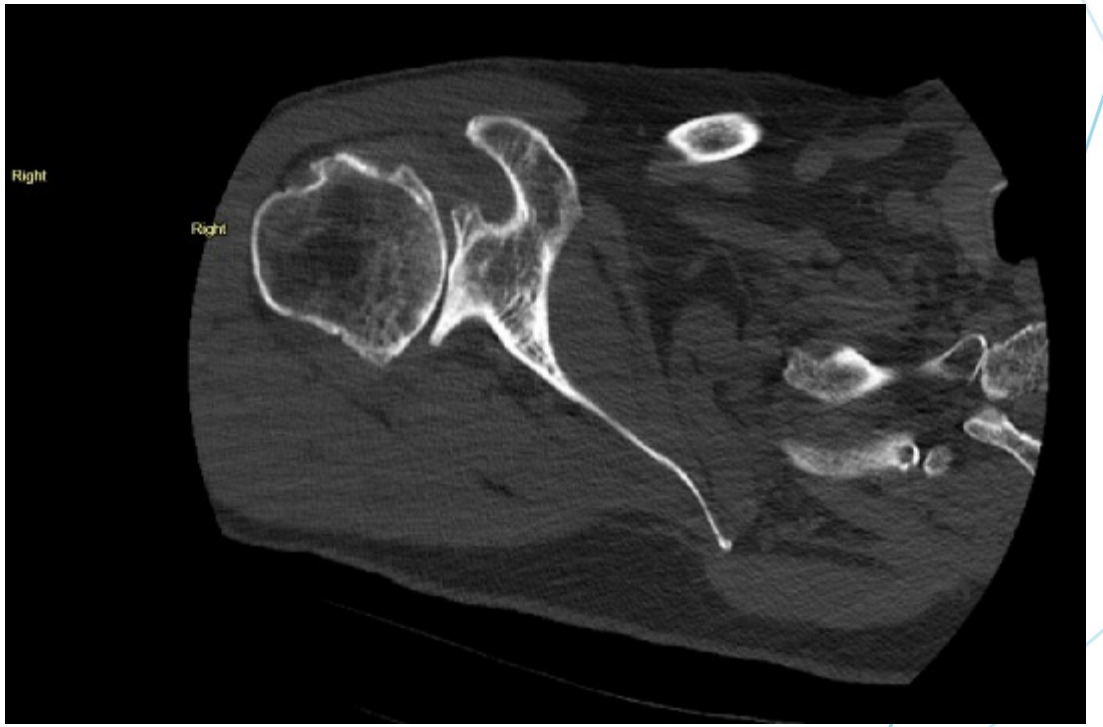

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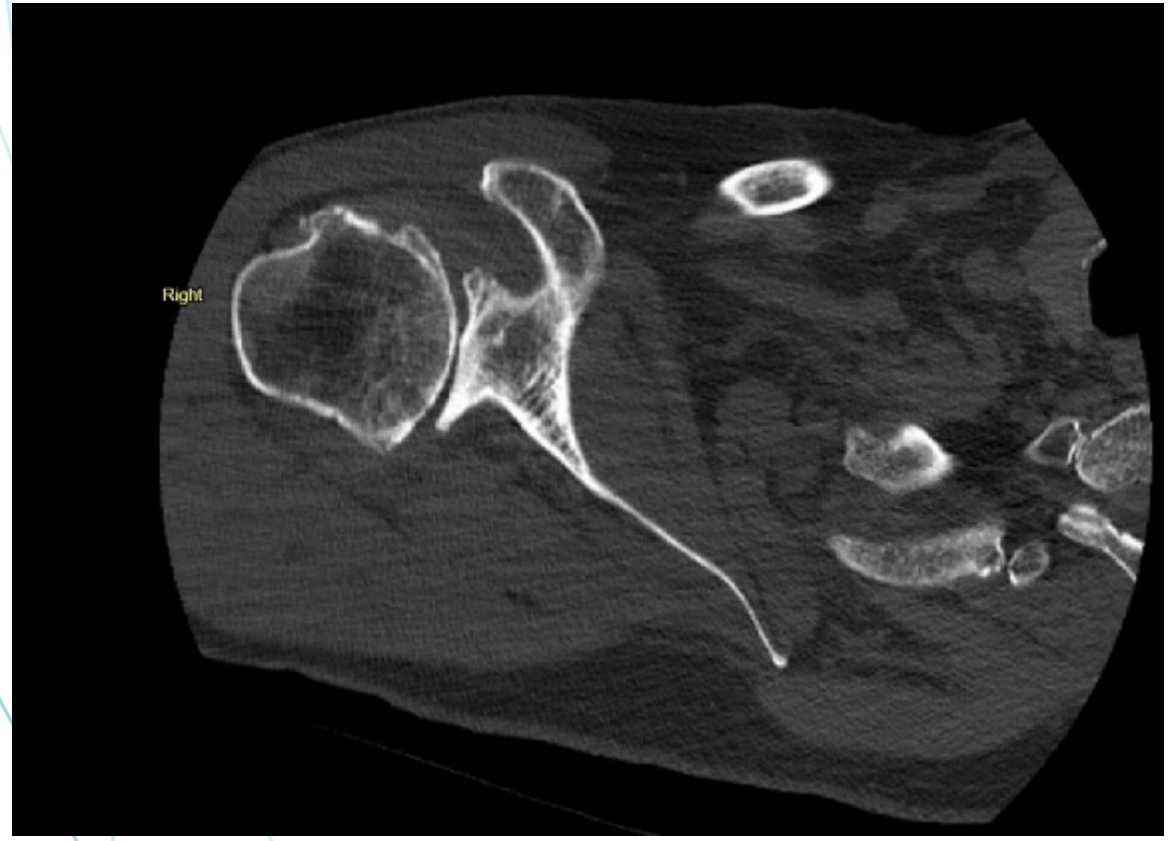

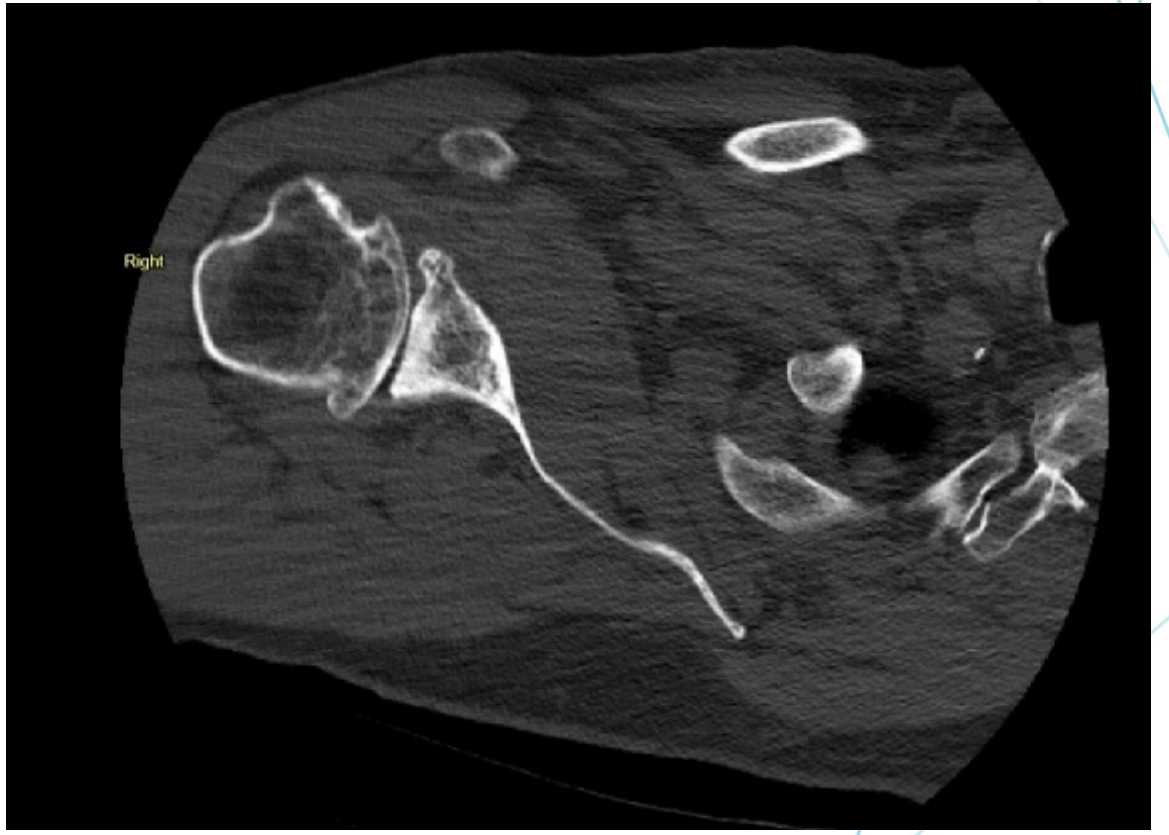

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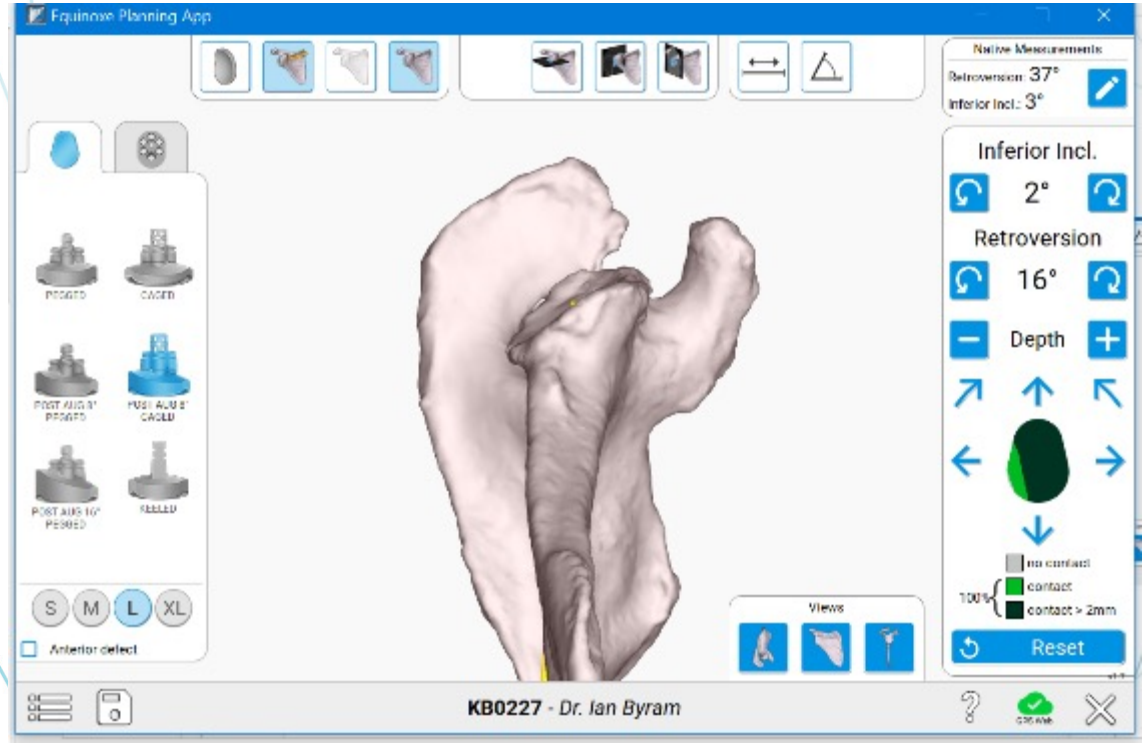
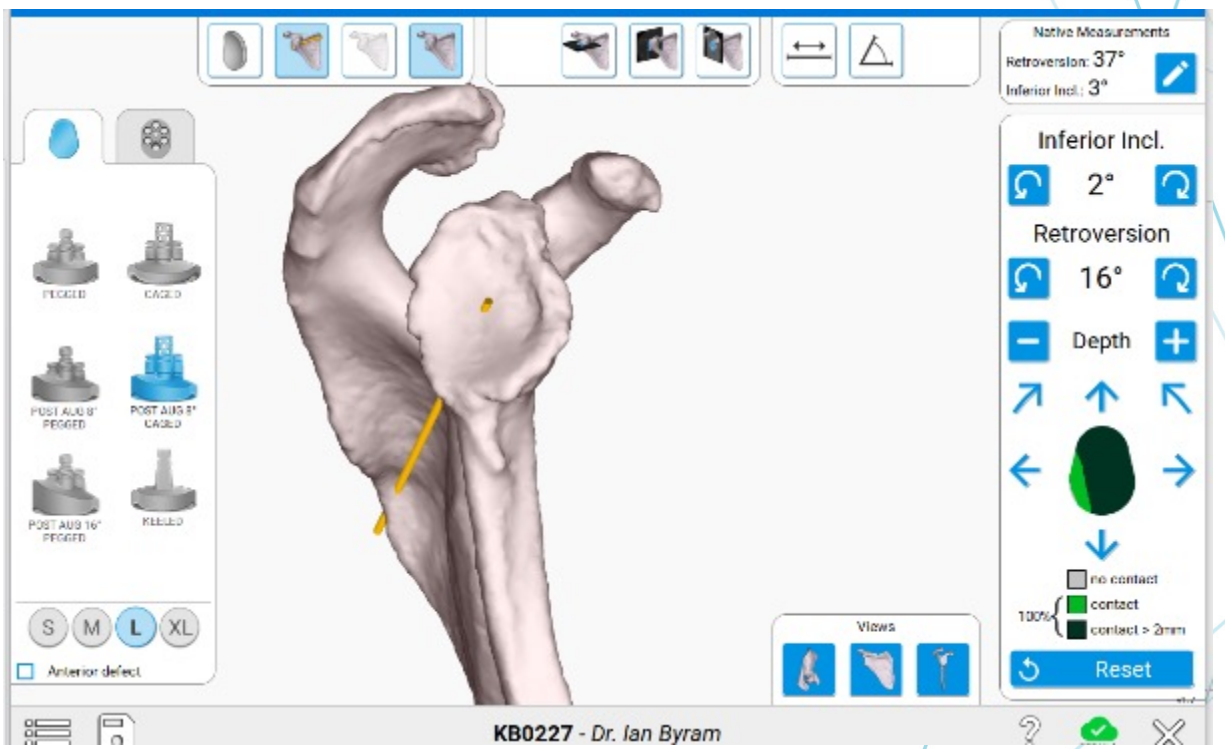
Planning





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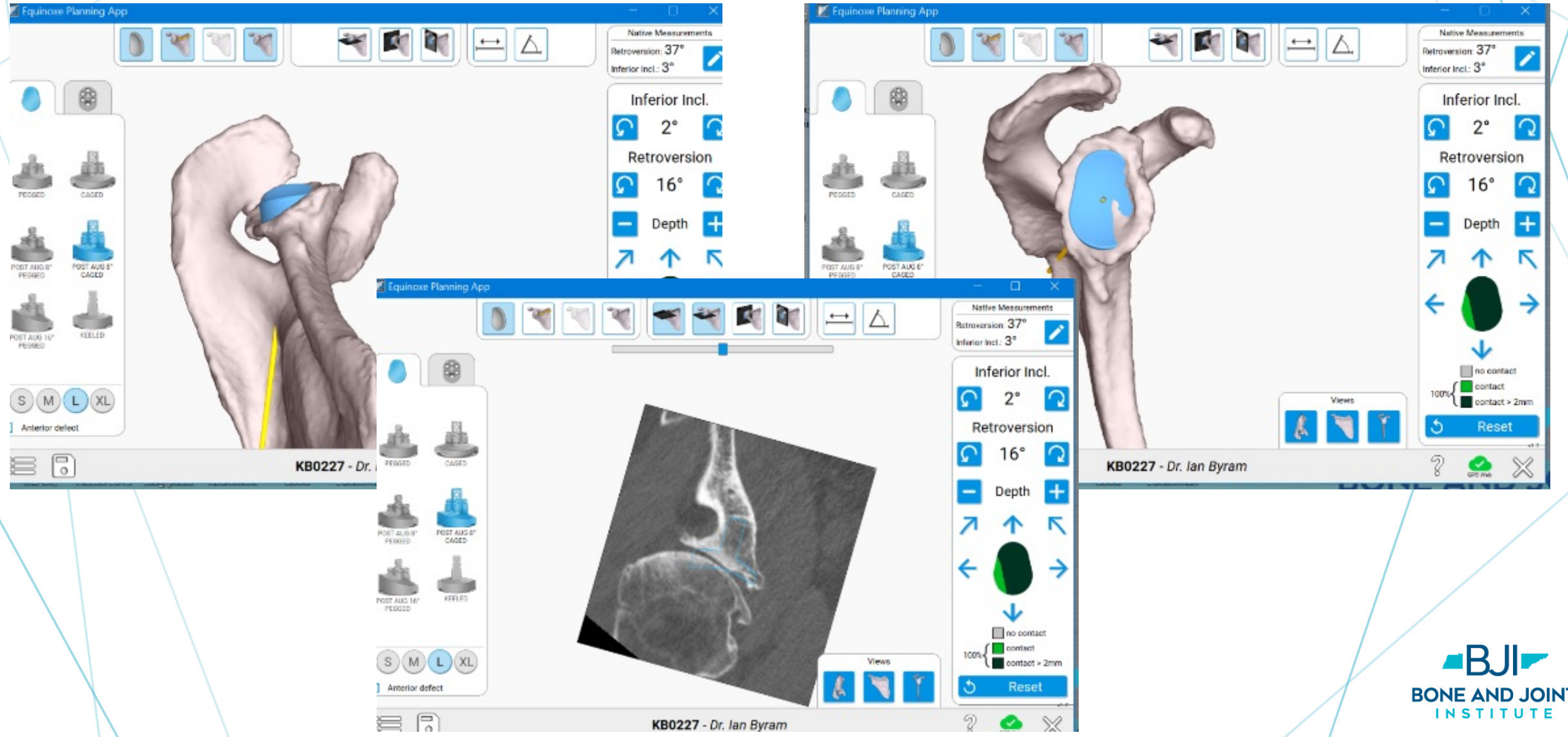

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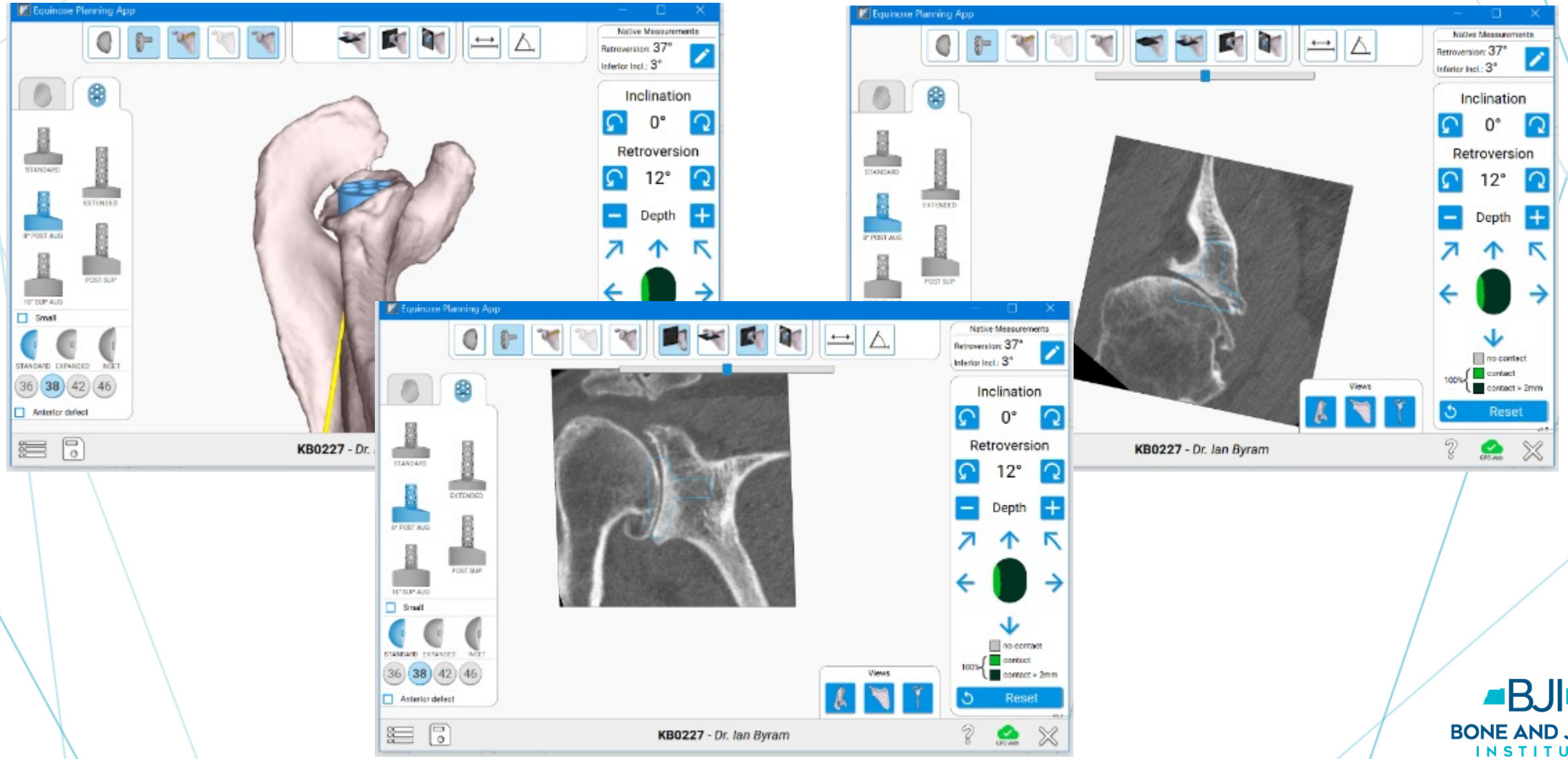

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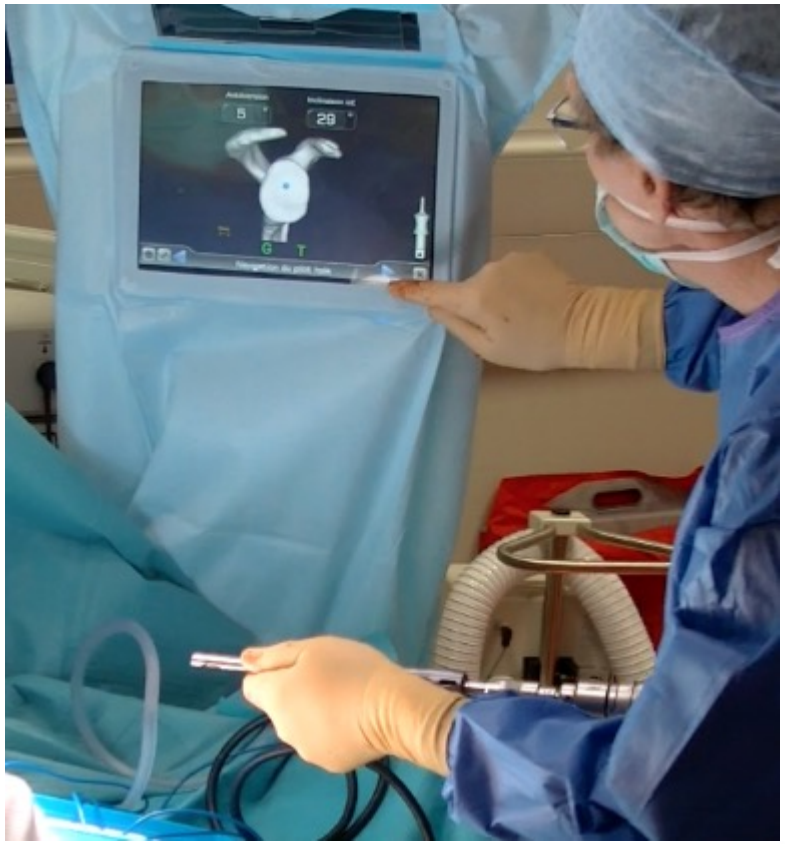
Plan execution: How is navigation different?

- No PSI guide that needs to be produced
- Live feedback regarding version, inclination, depth of reaming
- Live feedback for screw placement
- ***Allows for adjustment*** of the surgical plan



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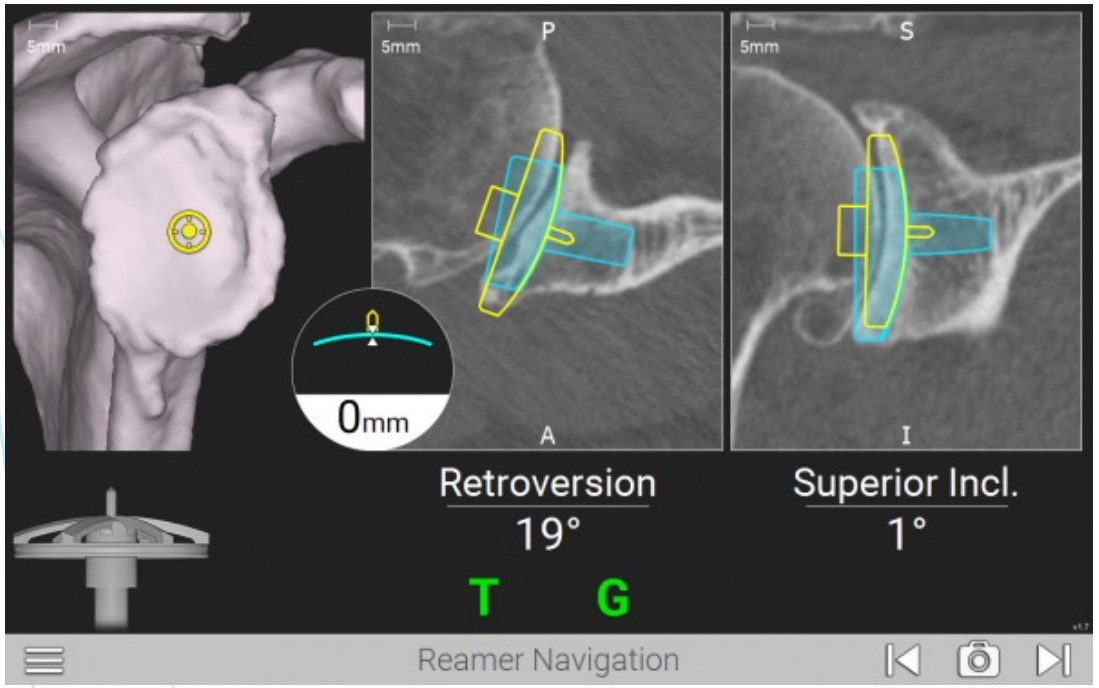
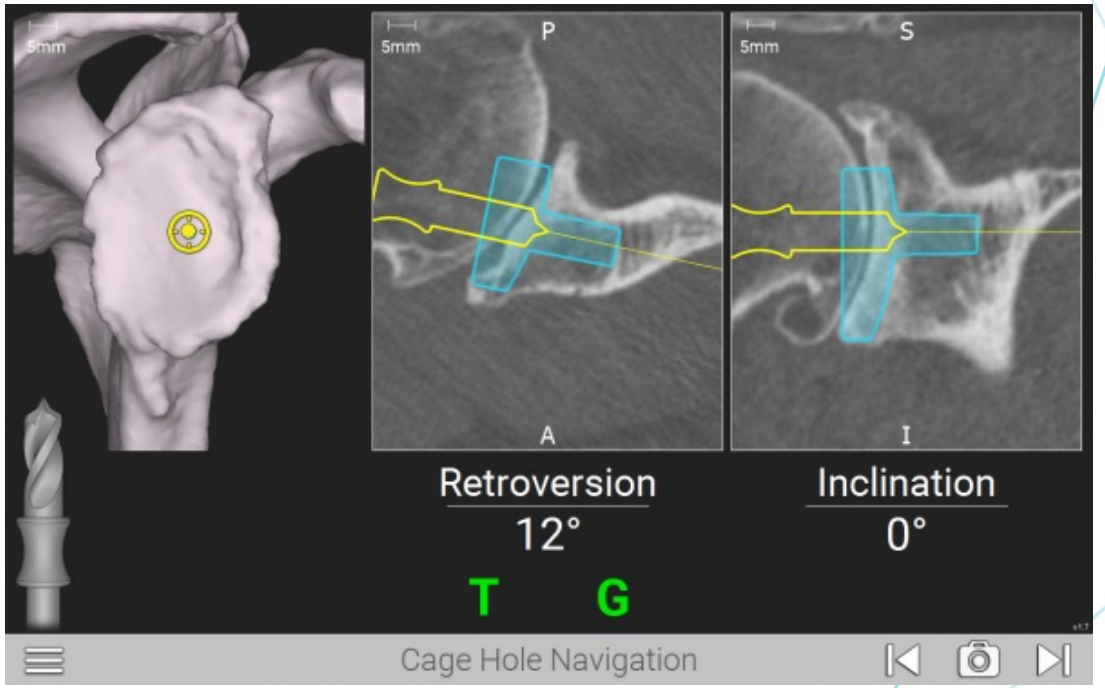
Glenoid prep





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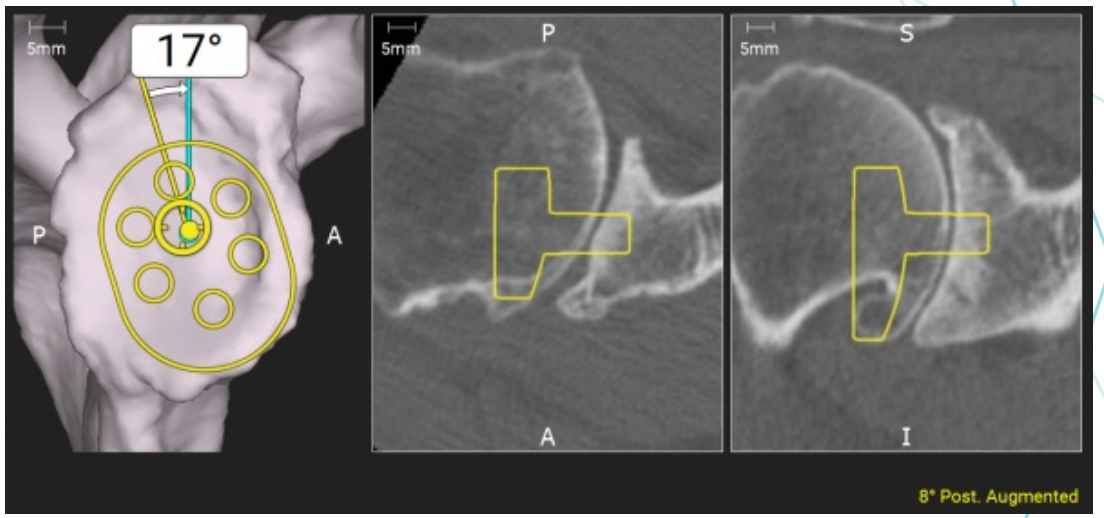
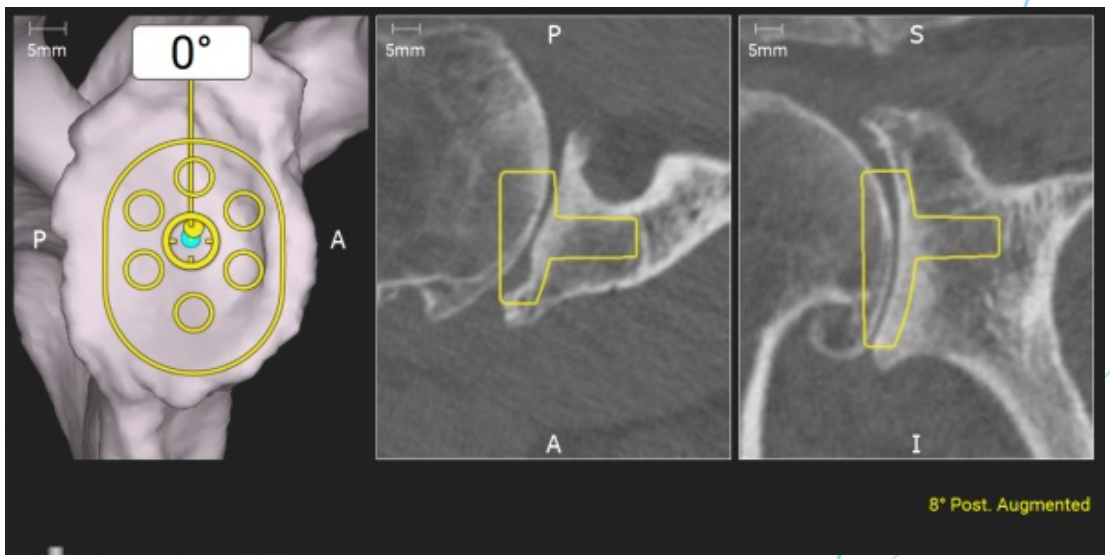
Implantation - verified





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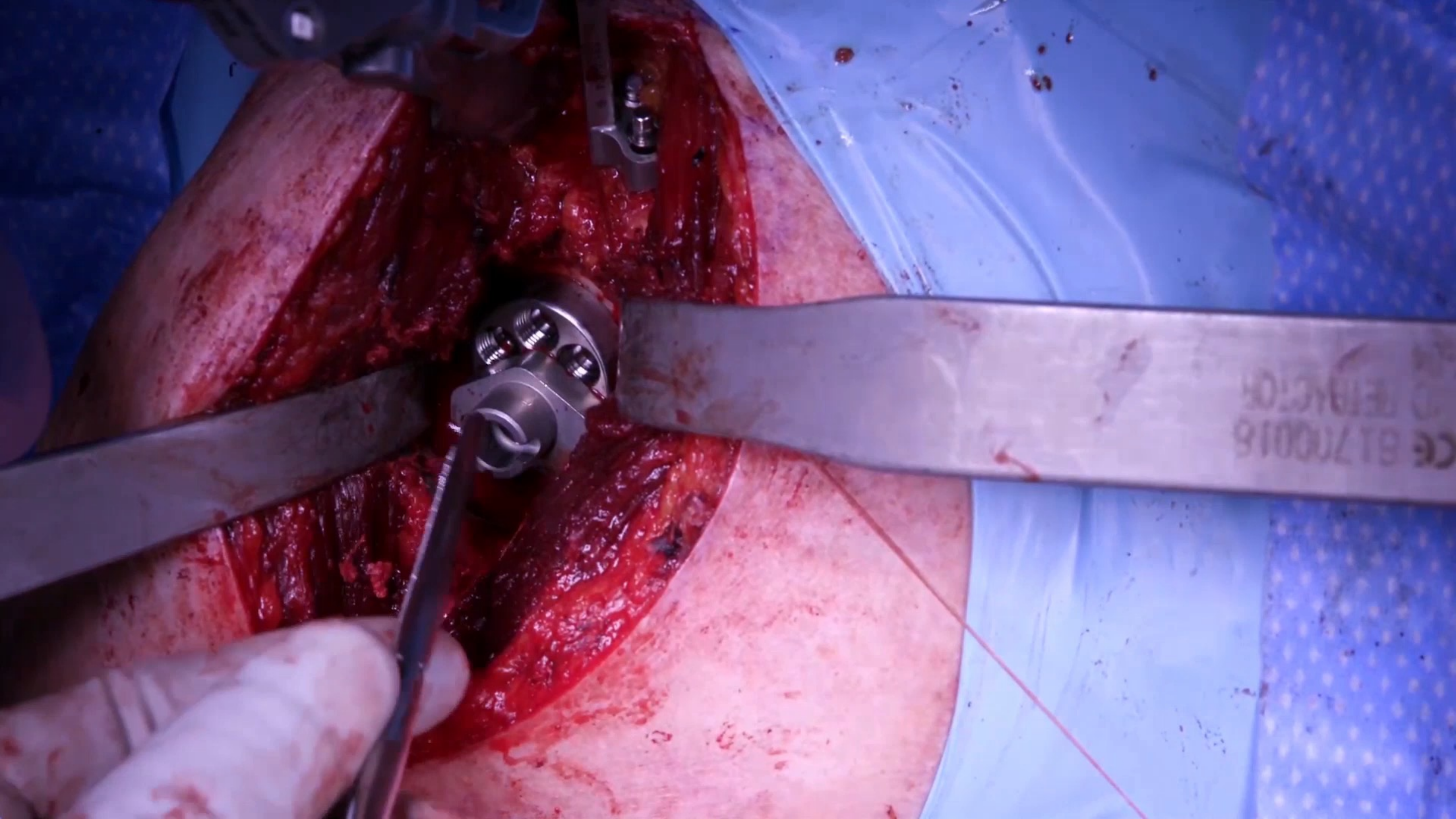
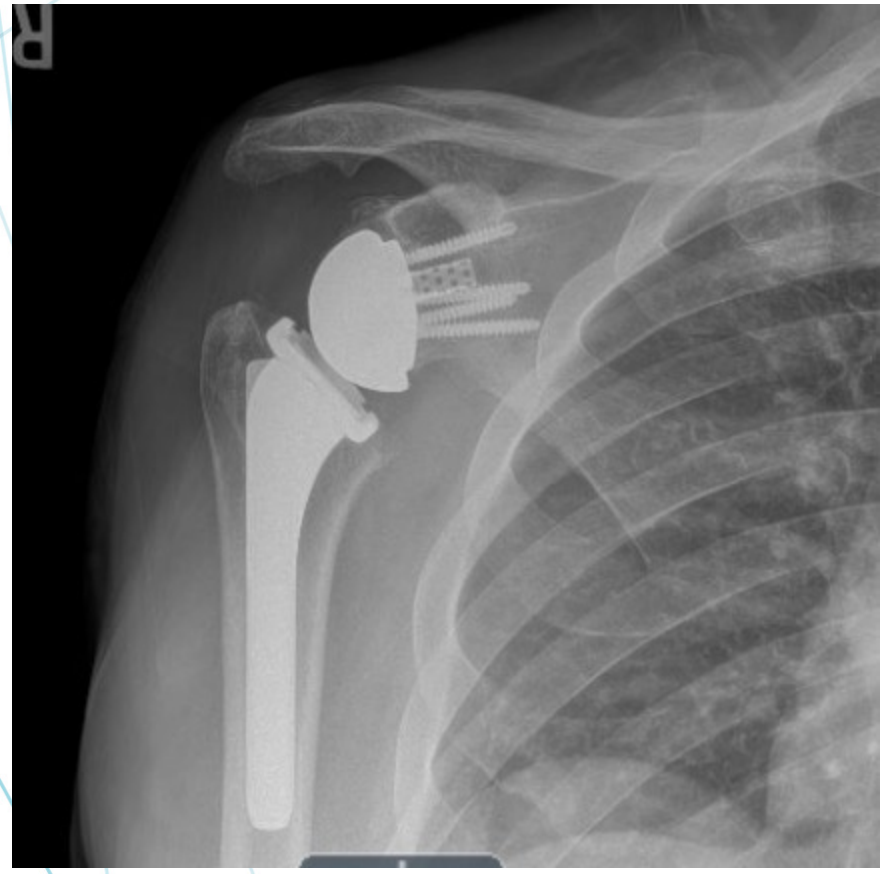
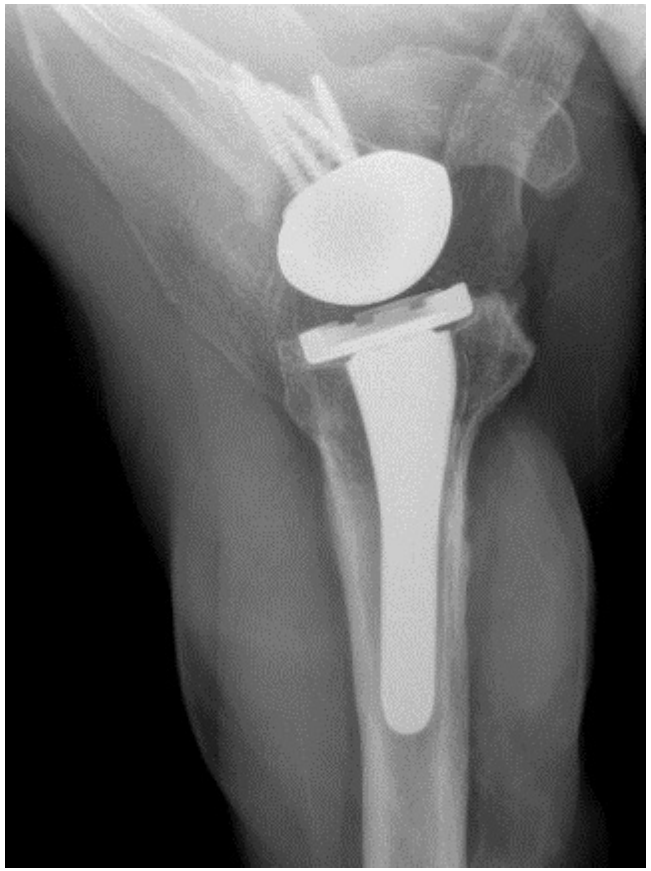
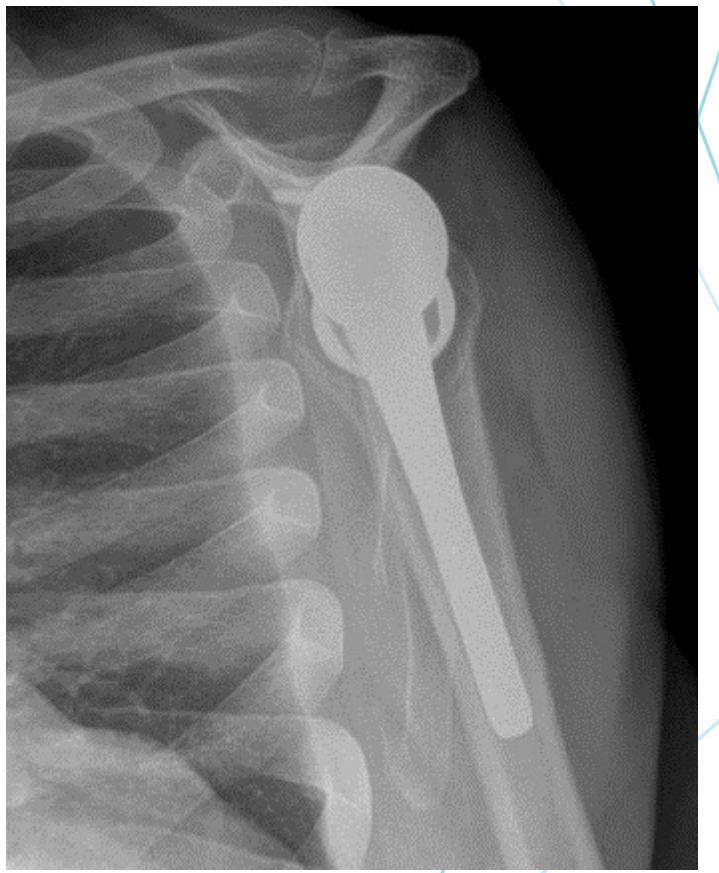


Post operative







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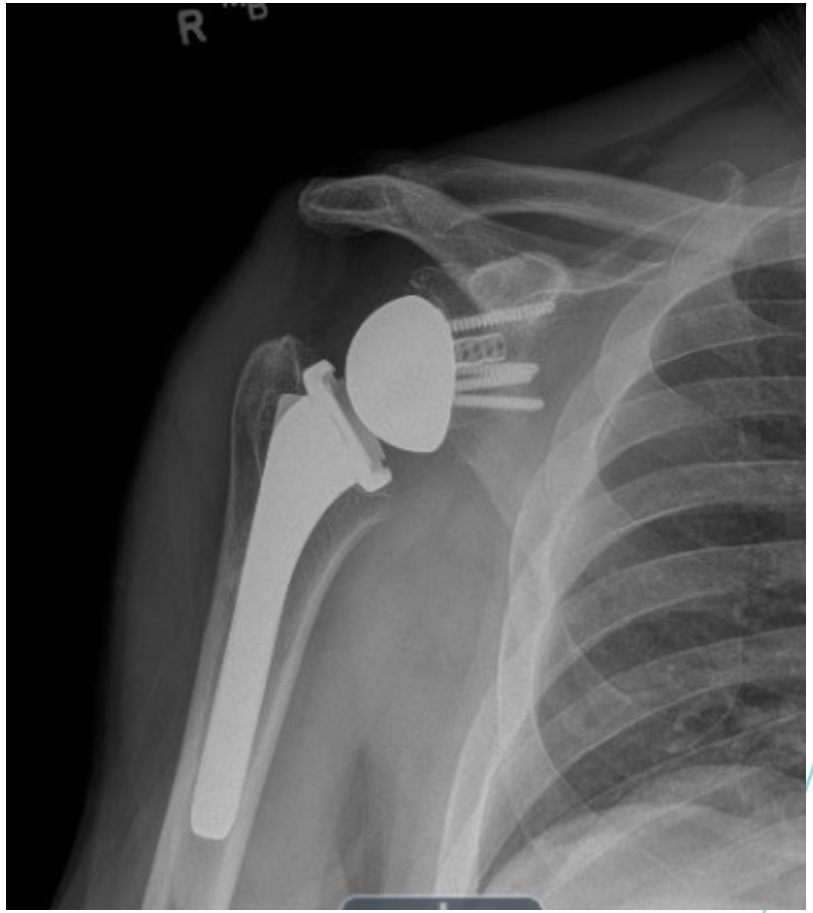
One year post operative

- Active FF 160°
- IR to T10
- Active ER 40°, passive 45°
- Able to touch top/back of head
- Abducts 11 lbs
- Back to playing golf with no limitations



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Thank You!

Ian R. Byram, MD

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