

Proximal Humerus Fracture in the Elderly

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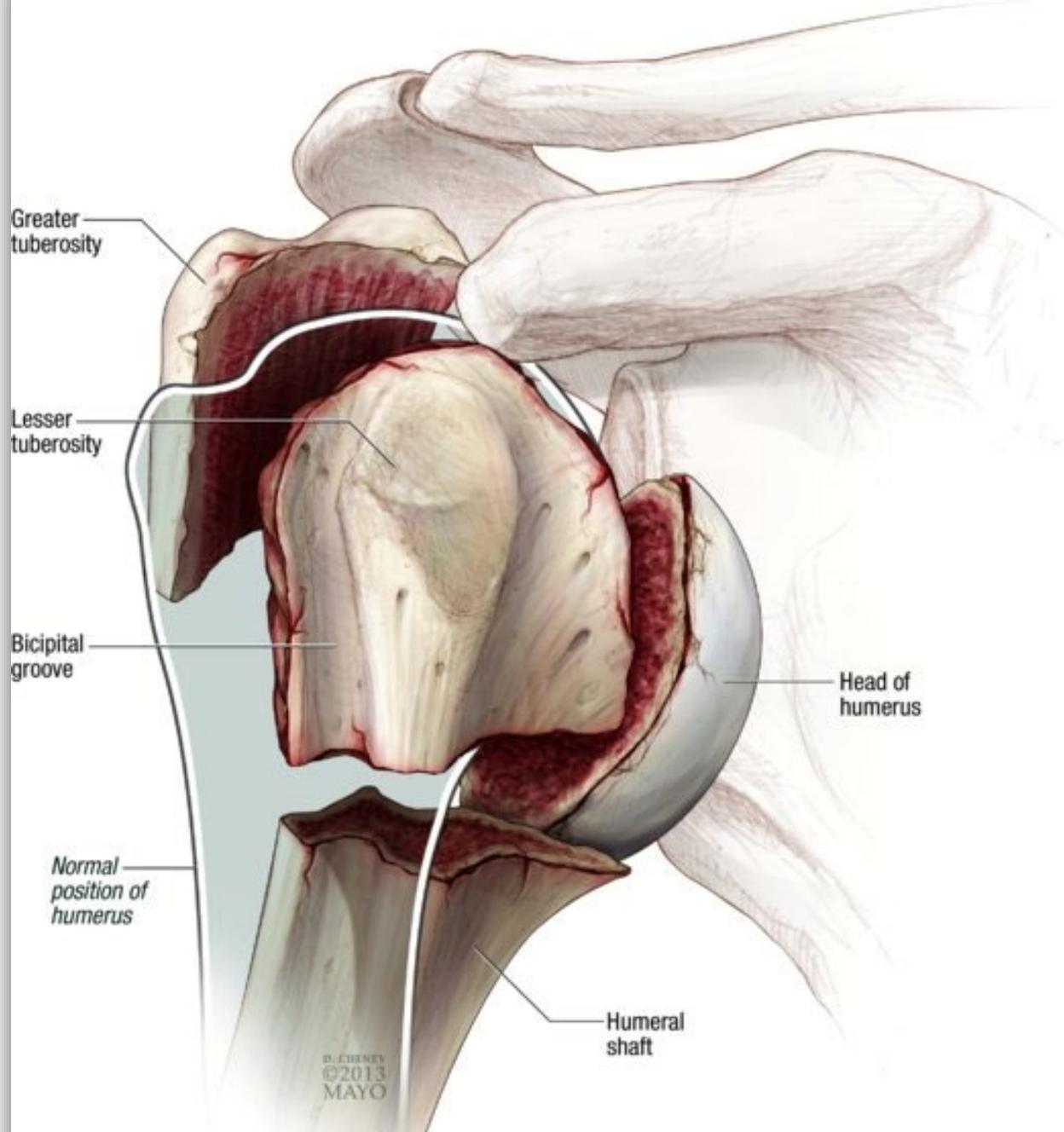
Objectives

- To review updated concepts for the management of proximal humerus fractures based on publications from the last 5 years
- To understand the differences in the diagnostic and therapeutic approach of a proximal humerus fracture in the elderly

Elderly

- **WHO (World Health Organization)**
 - > 65 y

- **UN (United Nations)**
 - Young old (60 - 74 Y)
 - Old old (75 - 84 Y)
 - Oldest old (>85 Y)



Antonio M. Foruria, Joaquin Sanchez-Sotelo. Proximal Humeral Fractures. In: In: Tornetta P, Ricci WM, eds. Rockwood and Green's Fractures in Adults, 9e. Philadelphia, PA. Wolters Kluwer Health, Inc; 2019.

Assesment

- **Images (X Ray and CT)**
 - Pattern of fracture
 - Displacement

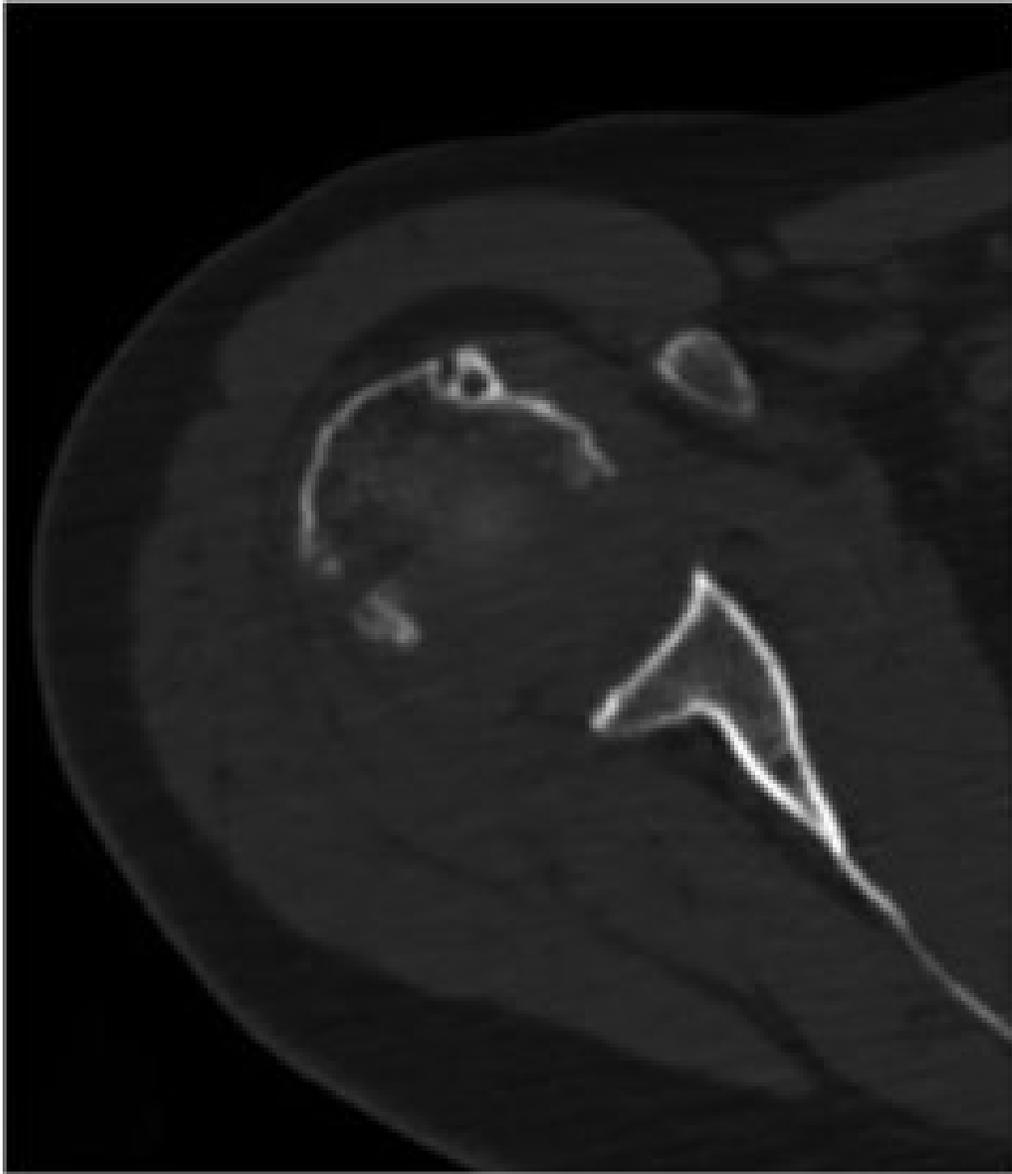
- **Treatment**
 - Images
 - Age
 - Co-morbidities

Imaging to improve agreement for proximal humeral fracture classification in adult patient: A systematic review of quantitative studies

Hannah Bougher^{*}, Archana Nagendiram, Jennifer Banks, Leanne Marie Hall, Clare Heal

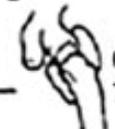
Mackay Clinical School, James Cook University, Mackay Base Hospital, 475 Bridge Road, Mackay, Queensland, 4740, Australia

2D and 3D CT may improve inter-observer agreement, in order to provide a greater extent in the less experienced observers and in more complex fractures

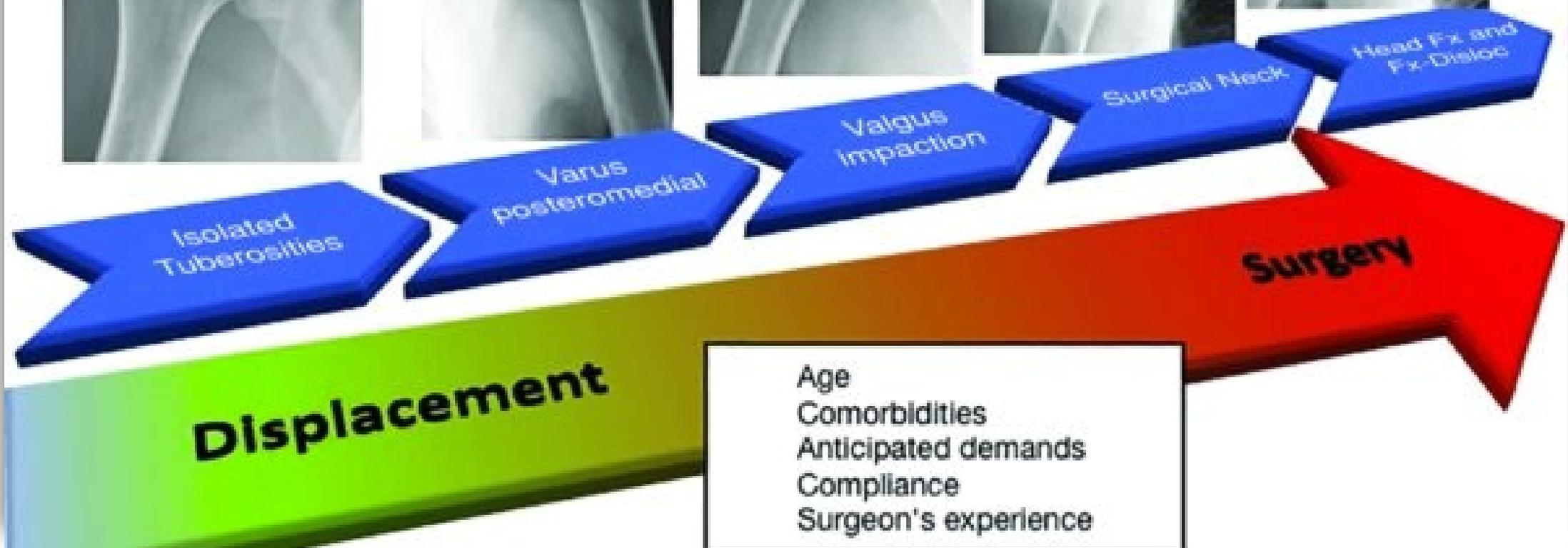




Neer classification

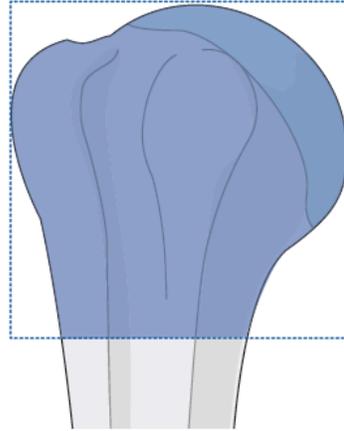
	2 Part	3 Part	4 Part	
Anatomical Neck	2  0.3% 50 yrs			Minimal Displacement 1  49% 63 yrs
Surgical Neck	3  28% 70 yrs			
Greater Tuberosity	4  4% 67 yrs	8  9% 73 yrs	12  2% 72 yrs	
Lesser Tuberosity	5  0%	9  0.3% 65 yrs		
Fracture-Dislocation	6  5% 59 yrs	10  0.1% 77 yrs	13  1% 73 yrs	Articular Surface 15  0.7% 75 yrs
Anterior				
Posterior	7  0.2% 54 yrs	11  0.1% 51 yrs	14  0.1% 68 yrs	

Mayo/FJD



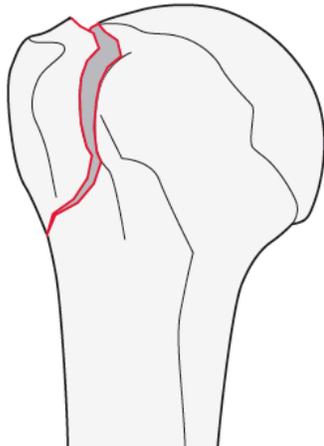
11

Location: Humerus, proximal end segment 11

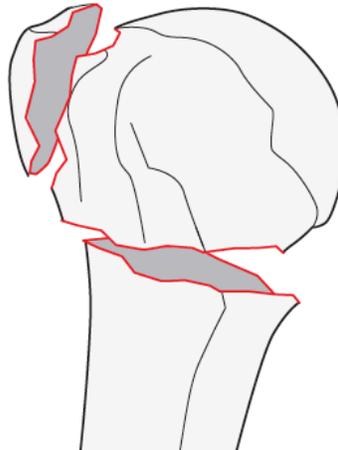


Types:

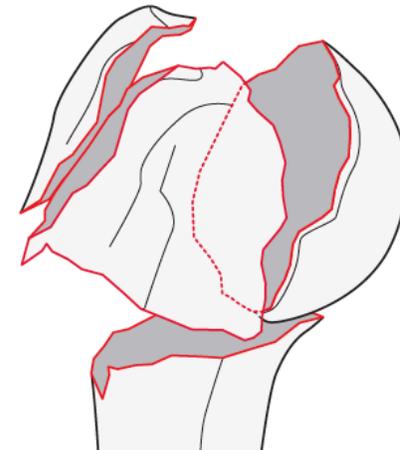
Humerus, proximal end segment,
extraarticular, unifocal, 2-part fracture
11A



Humerus, proximal end segment,
extraarticular, bifocal, 3-part fracture
11B

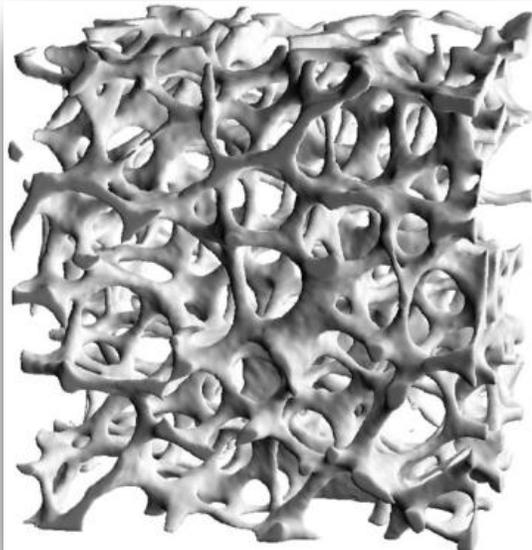
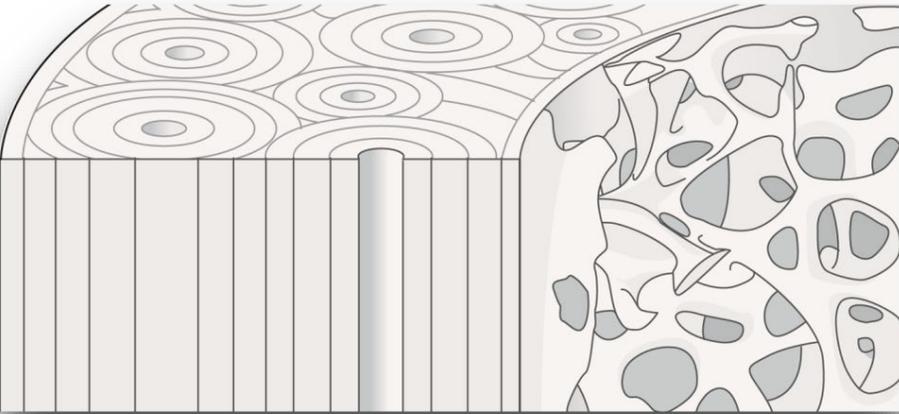


Humerus, proximal end segment,
articular or 4-part fracture
11C

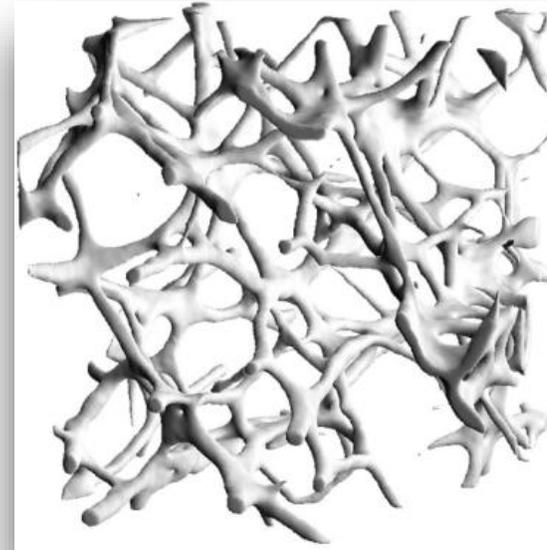


Why are they different ?

Normal bone



Osteoporotic bone



Differences

- Epidemiology
- Fracture pattern
- Mechanism of trauma
- Surgery indications
- Fixation strategies
- Follow up

Epidemiology

Epidemiology

- 185,000 Emergency Department visits yearly in USA
- > 65 y/o: Second most frequent upper extremity fracture, and third most common non-vertebral osteoporotic fracture, after proximal femur and distal radius
- Females > males
- Surgical treatment 10-40%

Risk factors

- Impaired vision
- Use of hearing aids
- Diabetes Mellitus
- Depression
- Alcohol consumption
- Use of anti-convulsive medication
- Maternal history of hip fracture

Fragility fractures in the upper limb: proximal and distal humerus

10 – 24% of the elderly population depend on walking aids.

Trauma mechanism

Mechanism

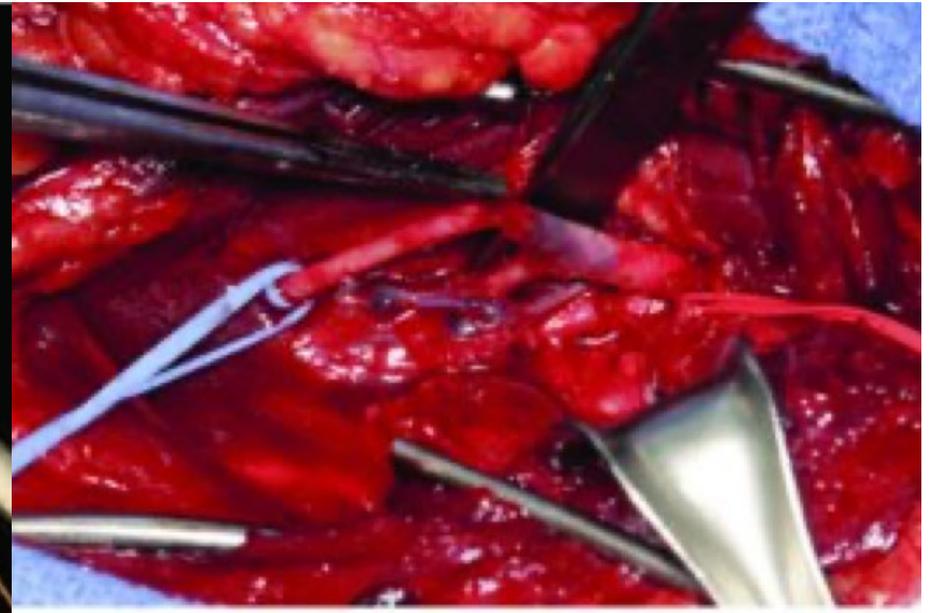
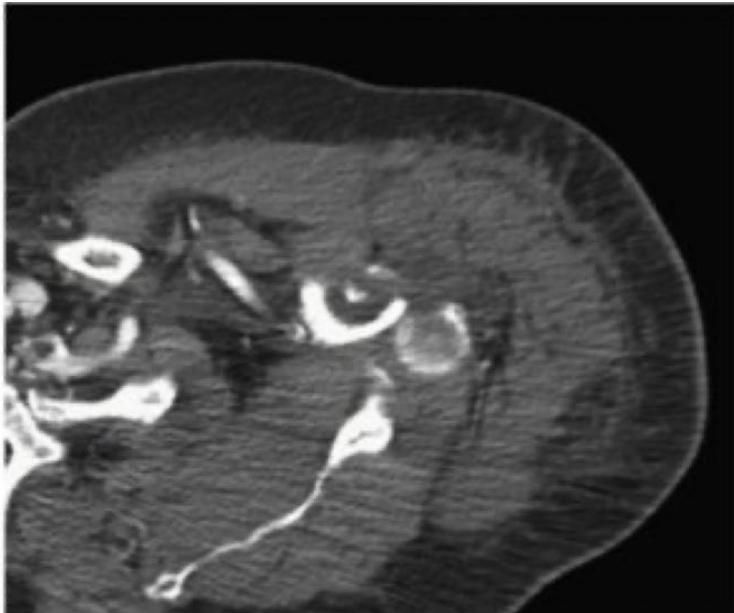
- > 60 y/o
- 90% fall from standing height

Associated Injuries

- 17% another fracture
- 7% proximal femur fracture
- 2% Distal radius
- 2% pelvic
- <1% contralateral
- Neurologic 2/3 EMG
- Vascular lesión (Isolated case reports)
- 30% Rotator Cuff tears (Full thickness tear)

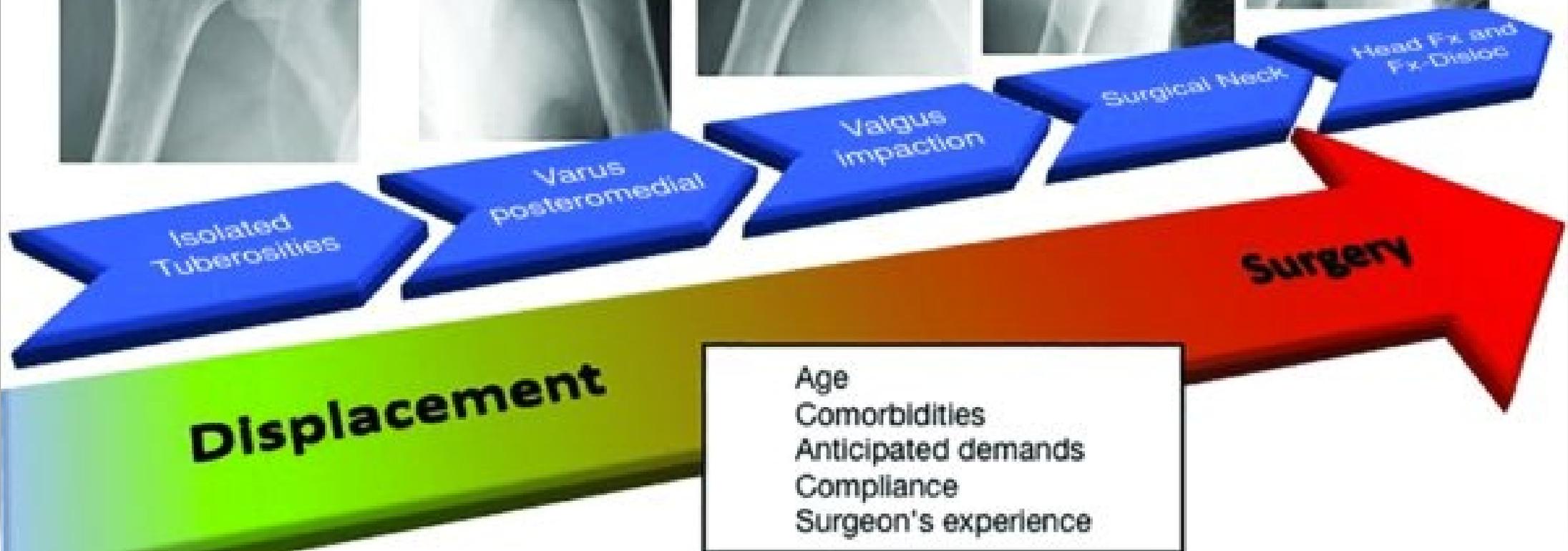


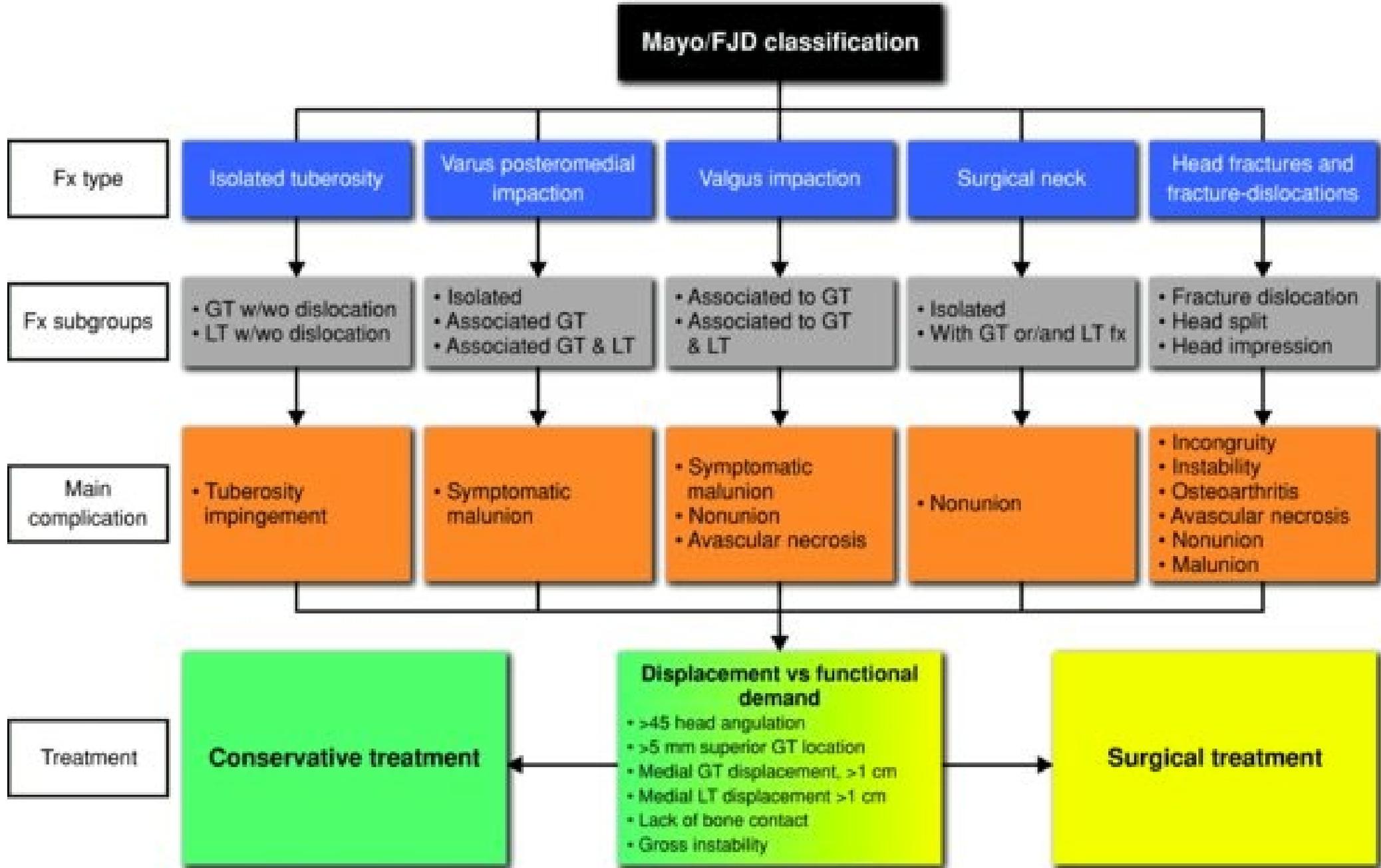
Axillary artery contusion and thrombosis.



Fracture pattern

Mayo/FJD





“The trend has been to move away from fracture classification schemes and to concentrate more on the patient’s characteristics and expectations”

Treatment goals

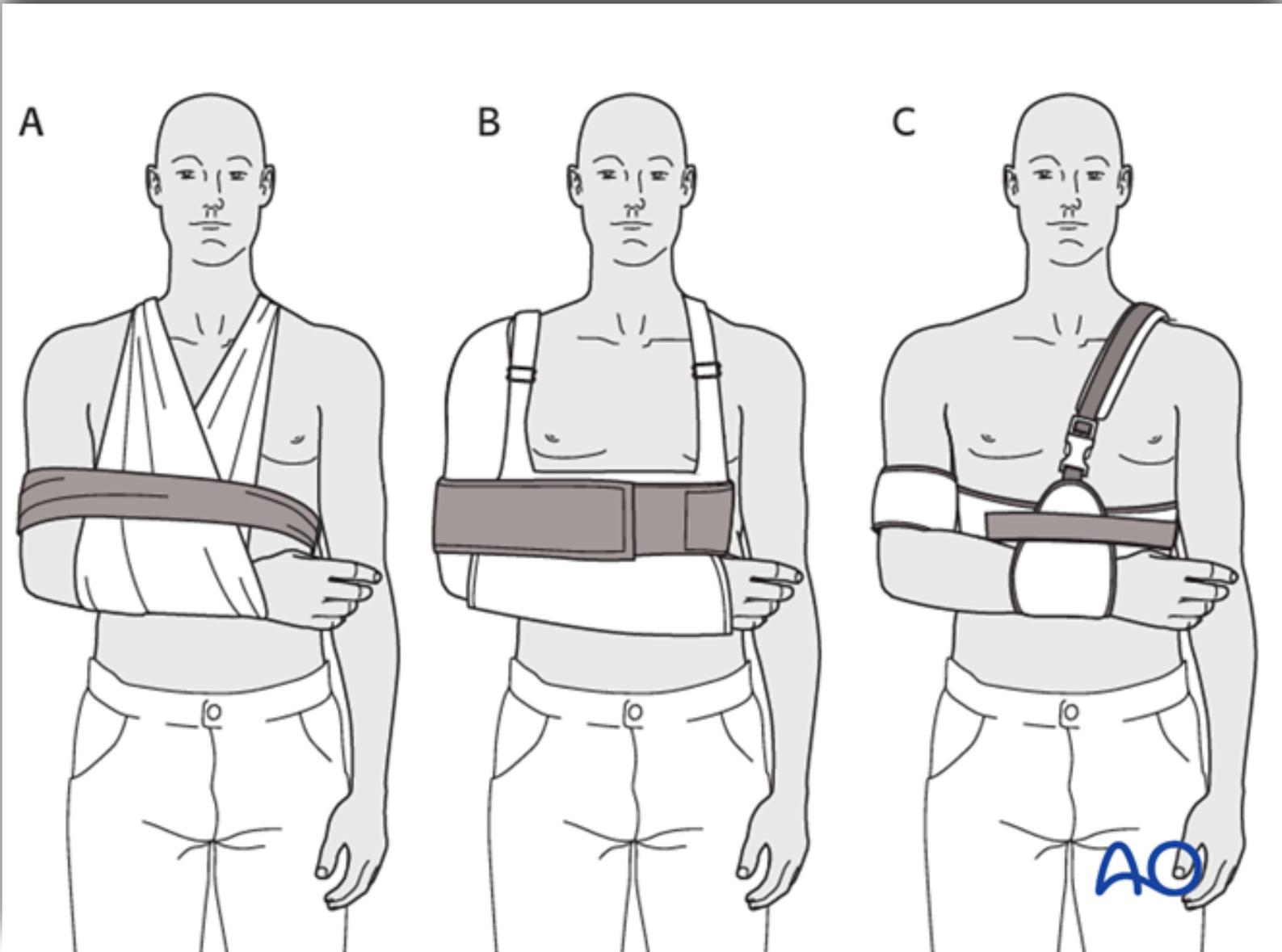
Young patient: Restore function

Elderly patient: Improve pain

Treatment options

Displaced or non displaced

- Age
- Co-morbidities
- Surgeon experience
- Anticipated demand/function



Non operative treatment - Indications

- Surgical neck fractures with contact and no gross instability
- Greater and lesser tuberosity fractures
 - Displacement < 1 cm
 - Overlap with the head < 20%
- Frail, elderly patient with contraindications for anesthesia

Non operative treatment - Indications

- Varus posteromedial fractures
 - Varus < 45 degrees
 - Lesser tuberosity displacement
- Valgus fractures
 - Head not pointing superior or lateral
 - Lesser tuberosity displacement

Non operative treatment - Contraindications

- Fracture-dislocations
- Head splitting fractures
- Head depression fractures involving over 20% of the humeral head surface

Non operative treatment - Relative contraindications

- Open fracture
- Associated vascular injury
- Polytrauma
- Associated disruption of Shoulder's suspensory complex
- Pathologic fracture

Non operative treatment - Relative contraindications

- Head dislocation
- Severe Head Impaction or Head Splitting
- > 1 cm tuberosity displacement
- Excessive varus (>45 degrees) or valgus displacement

Non operative treatment - How to do it?

- Sling
- Slight external rotation
- Active range of motion exercises of the wrist and hand

Non operative treatment - How to do it?

- Codman pendulum exercises (Start at 2 week)
 - Allow passive range of motion exercises of the shoulder
 - To be performed four to six times per day with the help of an assistant
 - During the first 2 to 3 weeks, passive range of motion exercises are best tolerated in the supine position.
 - As the patient better adapts to these exercises, they can be continued in the sitting or standing position

Non operative treatment - How to do it?

- Additional Codman pendulum exercises (3 to 6 week)
 - Lean forward while standing
 - The upper extremity is then allowed to freely dangle from the shoulder assisted by gravity
 - As much as 90 degrees of forward shoulder elevation can thereby be achieved

Non operative treatment - How to do it?

- Active assisted range of motion exercises 6 weeks
- Strengthening starting 3 months after the injury



Antonio M. Foruria, Joaquin Sanchez-Sotelo. Proximal Humeral Fractures. In: In: Tornetta P, Ricci WM, eds. Rockwood and Green's Fractures in Adults, 9e. Philadelphia, PA. Wolters Kluwer Health, Inc; 2019.

Conservative treatment of 3-part and 4-part proximal humeral fractures: a systematic review

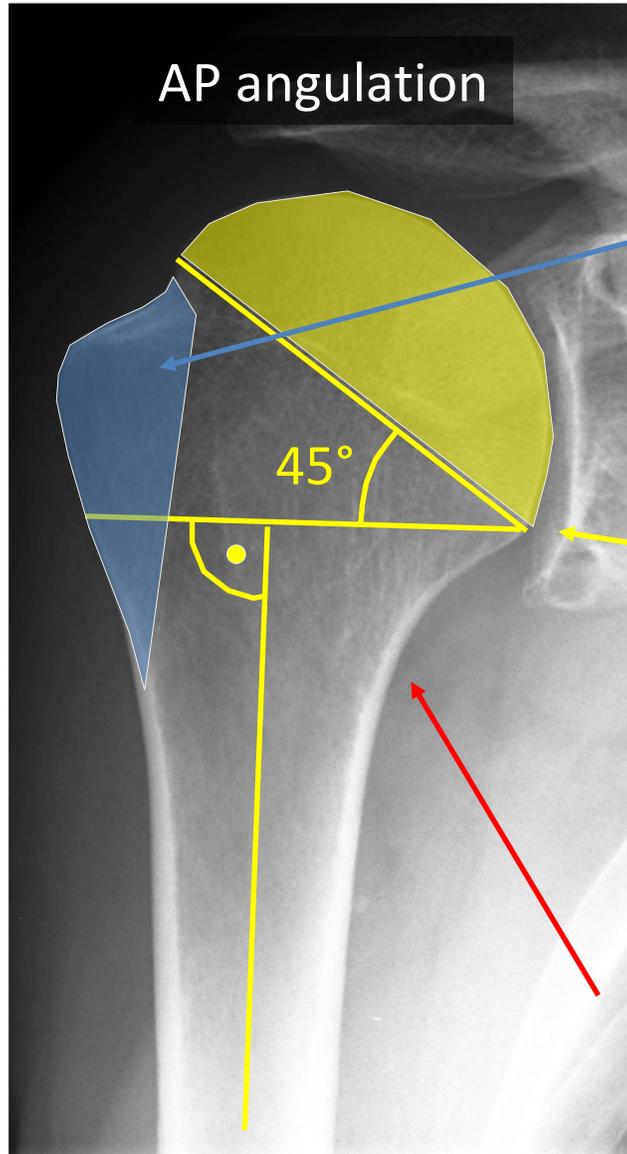


Manuel Soler-Peiro^{1*} , Lorena García-Martínez¹, Luis Aguilera¹ and Marcelino Perez-Bermejo²

- Most three-part PHFs treated conservatively, achieve fracture healing, even a negligible rate of malunion got fair–good functional results with few complications
- Four-part PHF treatment presents high rate of healing with less rate of malunion than the three-part PHF but achieve poorer functional results with few complications

Operative treatment - Indications

AP



AP angulation

greater tuberosity
5-10mm ↑

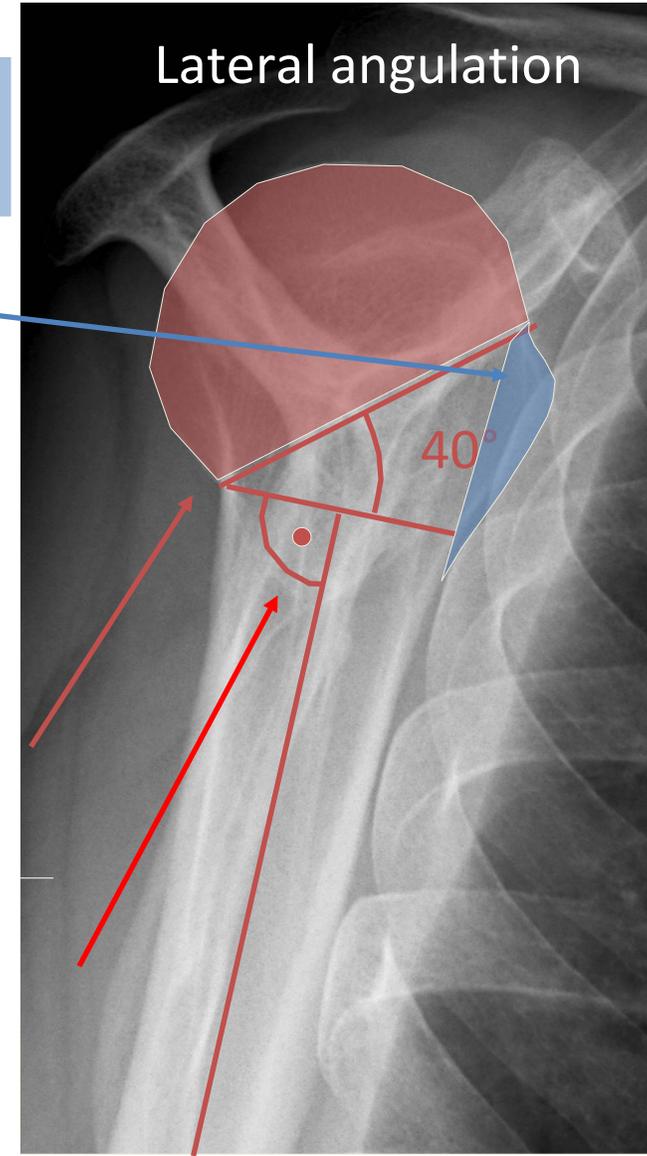
greater tuberosity
> 5-10mm ↑

Varus > 20°
Valgus > 40°

lateral angulation
> 30-45°

Lateral Displacement
> ½ shaft diameter

LAT



Lateral angulation

40°

Operative vs Non operative



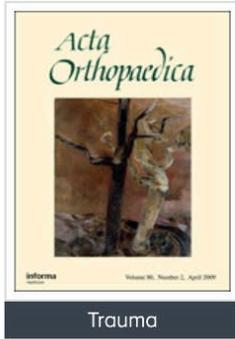
**Cochrane
Library**

Cochrane Database of Systematic Reviews

Interventions for treating proximal humeral fractures in adults (Review)

Handoll HHG, Brorson S

- There is high to moderate quality evidence that, compared with non-surgical treatment, surgery does not result in a better outcome at one to two years after injury for people with displaced proximal humeral fractures involving the humeral neck and is likely to result in a greater need for subsequent surgery.
- There is insufficient evidence from RCTs to inform the choices between different non-surgical, surgical, or rehabilitation interventions for these fractures.



Comparison between operative and nonoperative treatment for proximal humerus fractures

Study Type: Systematic review

OE Level Evidence: 2

Journal Level of Evidence: N/A

Treatment of proximal humerus fractures in the elderly A systematic review of 409 patients

Acta Orthop. 2015 Jun;86(3):280-5.

- Many of the studies found no significant difference between the functional outcomes for operative and nonoperative treatment of proximal humerus fractures in patients above the age of 60.
- Many studies reported high complication rates in the operative group. Both tension band and locking plate systems did not provide significant benefits over nonoperative treatment.
- Treatment of 4-part fractures with hemiarthroplasty found that HRQoL and EQ-5D were significantly better than nonoperative treatment, but the complication rates were high.

REVIEW ARTICLE

**Comparison of Surgical versus Non-Surgical Treatment
of Displaced 3- and 4-Part Fractures of the Proximal
Humerus: A Meta-Analysis**

Feng Mao, MS,¹ De-Hua Zhang, MS,¹ Xiao-Chun Peng, MD,² Yi Liao, MD³

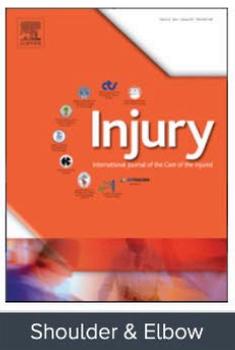
- No difference in functional outcome was observed between the surgical and non-surgical group. Patient reported a quality of life significantly higher in the surgical group.

The ProFHER (PROximal Fracture of the Humerus: Evaluation by Randomisation) trial – a pragmatic multicentre randomised controlled trial evaluating the clinical effectiveness and cost-effectiveness of surgical compared with non-surgical treatment for proximal fracture of the humerus in adults

Helen Handoll,^{1*} Stephen Brealey,² Amar Rangan,³
Ada Keding,² Belen Corbacho,² Laura Jefferson,²
Ling-Hsiang Chuang,⁴ Lorna Goodchild,⁵
Catherine Hewitt² and David Torgerson²

- There were no clinically relevant or statistically significant differences between nonsurgical or surgical treatment at 2 and 5 years of follow-up.
- It is extremely important to understand that the range of fractures included in this study does not represent the whole universe of proximal humeral fractures

Joint preserving vs Arthroplasty



Displaced proximal humerus fracture: Joint-preserving techniques vs. Arthroplasty

Study Type: Meta-analysis/Systematic Review

OE Level Evidence: 2

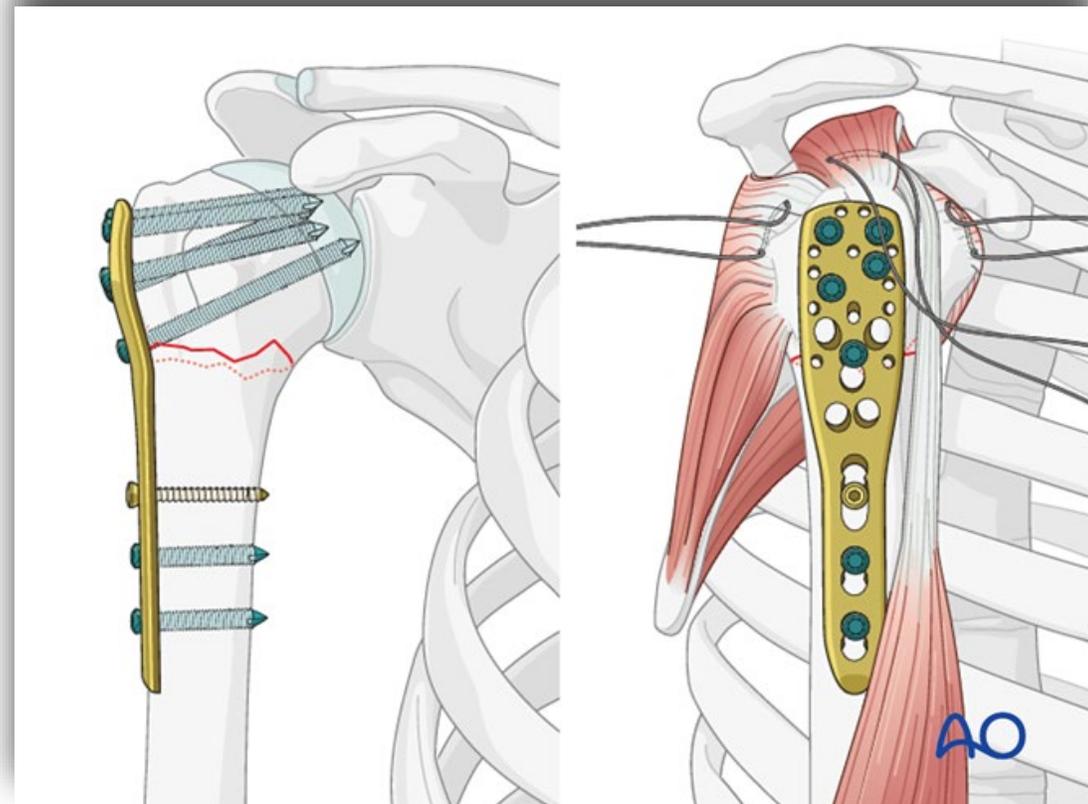
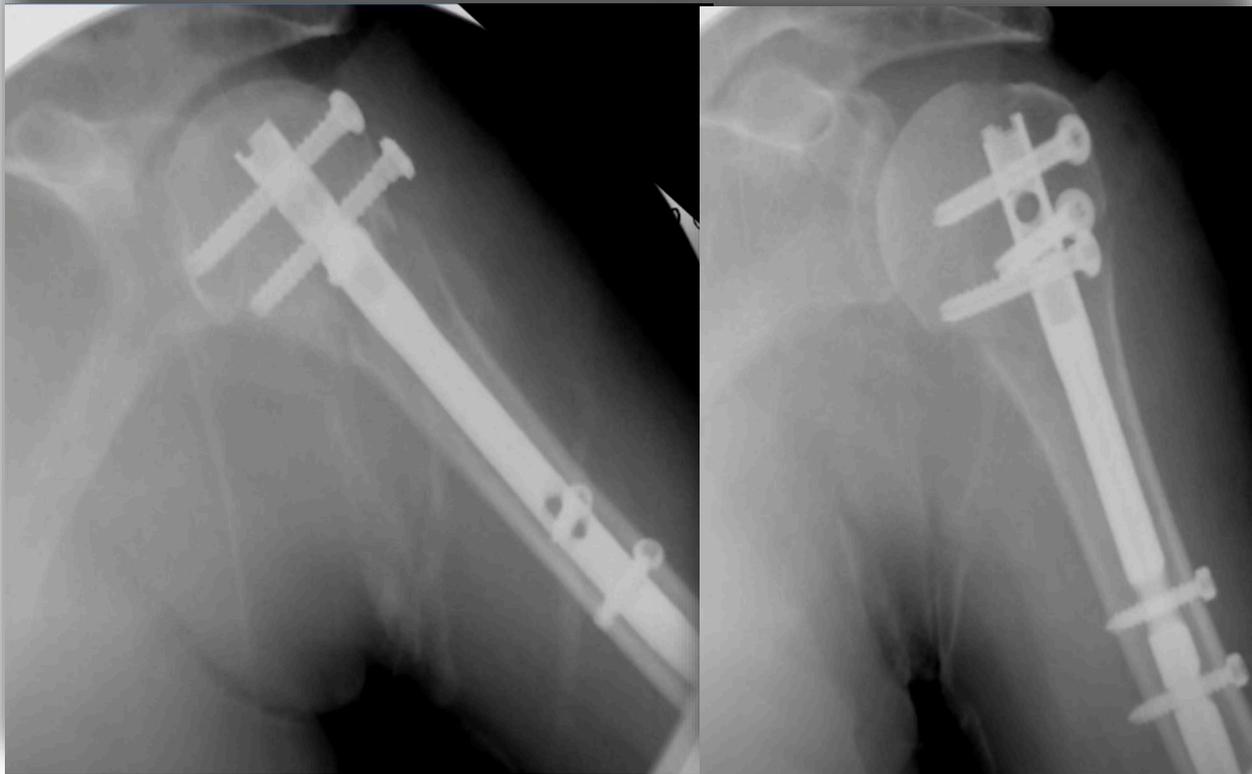
Journal Level of Evidence: N/A

Meta-analysis of joint preservation versus arthroplasty for the treatment of displaced 3- and 4-part fractures of the proximal humerus

[Injury. 2013 Nov;44\(11\):1532-9](#)

- Joint-preserving treatments demonstrated higher Constant scores than arthroplasty. Important: studies exhibited significant heterogeneity.
- Constant scores decrease significantly with increasing age, severity of fracture, and rate of osteonecrosis.

Nail vs plate



Intramedullary nailing of the proximal humerus: evolution, technique, and results



Matthew F. Dilisio, MD^{a,*}, Robert J. Nowinski, DO^b, Armodios M. Hatzidakis, MD^c,
Edward V. Fehringer, MD^d

- Compared with other fixation strategies, such as locking plate fixation, no compelling evidence exists to suggest one technique over another.

Intramedullary nail versus locking plate for treatment of proximal humeral fractures: A meta-analysis based on 1384 individuals

**Ming Li^{1,2,*}, Yanhua Wang^{2,*}, Yupeng Zhang³,
Ming Yang², Peixun Zhang² and Baoguo Jiang^{1,2}**

Journal of International Medical Research
0(0) 1–14

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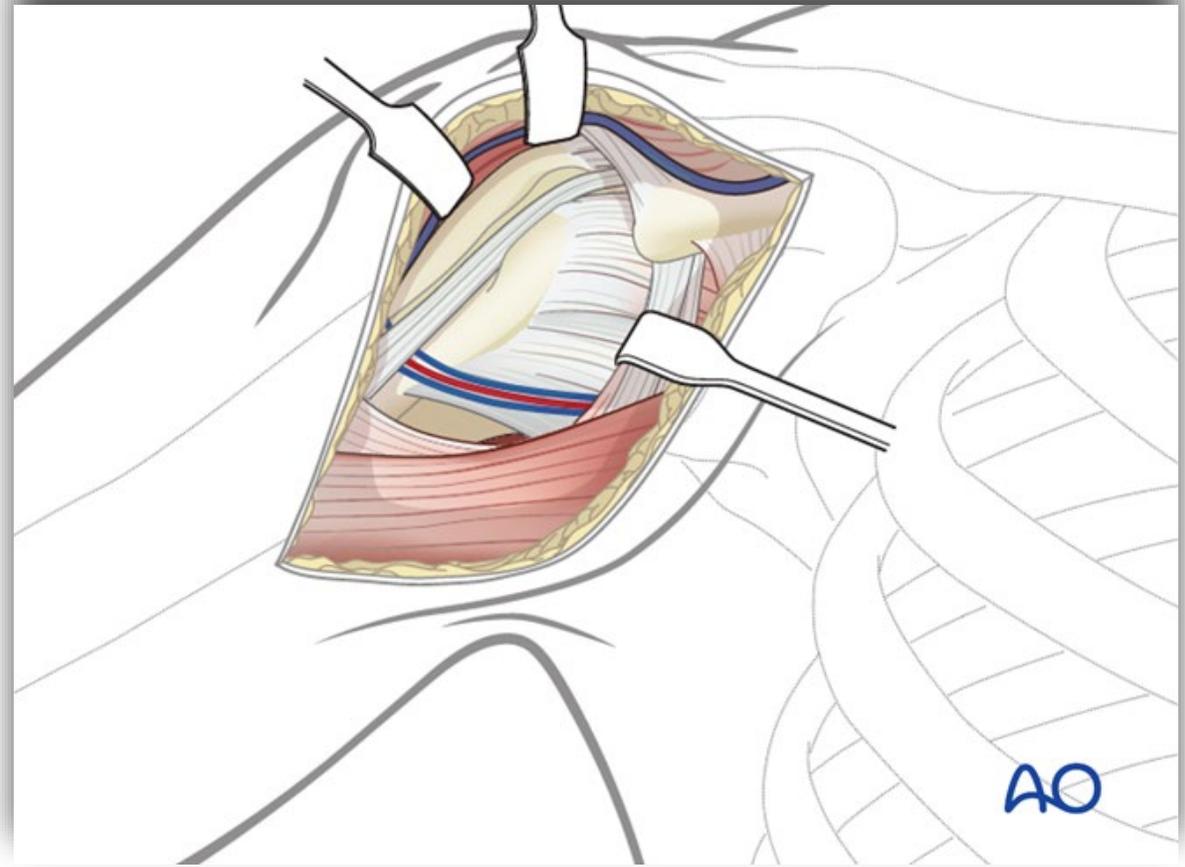
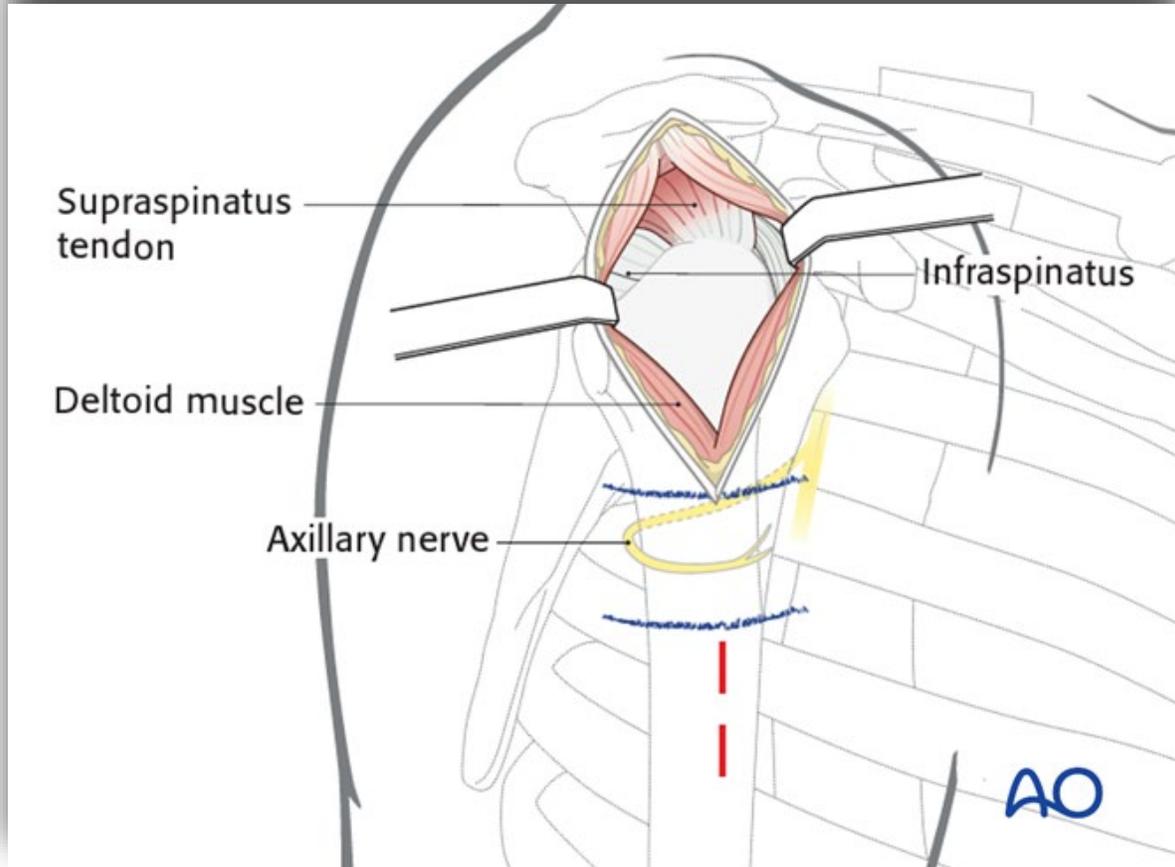
- Although the evidence quality was poor, the results suggest that compared with locking plates, intra-medullary nails may be a better choice for the repair of PHFs

Locking nail versus locking plate for proximal humeral fracture fixation in an elderly population: a prospective randomised controlled trial

Johannes E. Plath^{1*}, Christian Kerschbaum¹, Tobias Seebauer¹, Rainer Holz¹, Daniel J. H. Henderson², Stefan Förch¹ and Edgar Mayr¹

- There was no significant difference in functional scores, pain, range of motion, or overall complication rate over the first year after surgery between patients treated with an antegrade locking intra-medullary nail and patients treated with a locking plate
- There was a lower rate of loss of reduction with screw cut out observed among patients treated with the intra-medullary nail.

MIO vs Open reduction



Review Article

Comparison of Minimally Invasive Percutaneous Plate Osteosynthesis and Open Reduction Internal Fixation on Proximal Humeral Fracture in Elder Patients: A Systematic Review and Meta-Analysis

- The MIPO was more suitable than ORIF for treating proximal humeral fracture in elder patients.



COA/ICORS2019: Deltopectoral superior to deltoid split for function, QoL, pain in PHF fixation

Study Type: Randomized Trial

OE Level Evidence: N/A

Journal Level of Evidence: N/A

Deltopectoral vs Deltoid Split Approach for Proximal Humerus Fracture Fixation With Locking Plate: A Prospective Randomized Study (HURA Study)

Contributing Authors:

Michel Malo

GY Laflamme

B Benoit

D Rouleau

F Balg

S Leduc

- Deltopectoral approach was associated with significantly better function and quality of life scores, when compared to the deltoid split group, as well as a lower incidence of complications
- Skeletally mature patients, with an isolated proximal humerus fracture of Neer Classification II/III



Trauma

OTA 2019: Deltopectoral approach better than deltoid split for proximal humerus fracture fixation

Study Type: Therapy

OE Level Evidence: N/A

Journal Level of Evidence: N/A

Deltopectoral versus Deltoid Split Approach for Proximal HUmerus Fracture Fixation with Locking Plate: A Prospective RANdomized Study (HURA Study)

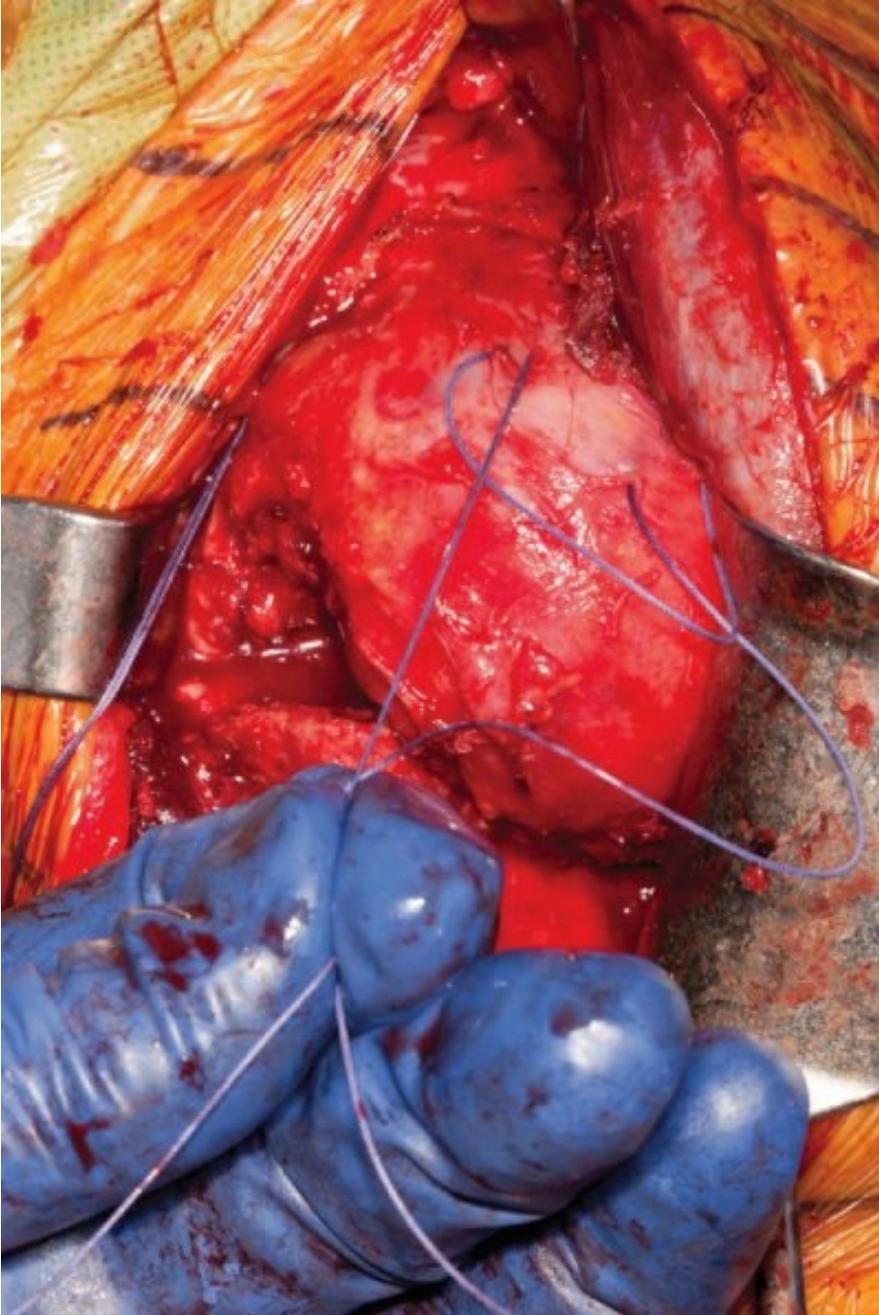
- The deltopectoral approach resulted in significantly better functional and pain scores, and far fewer complications.



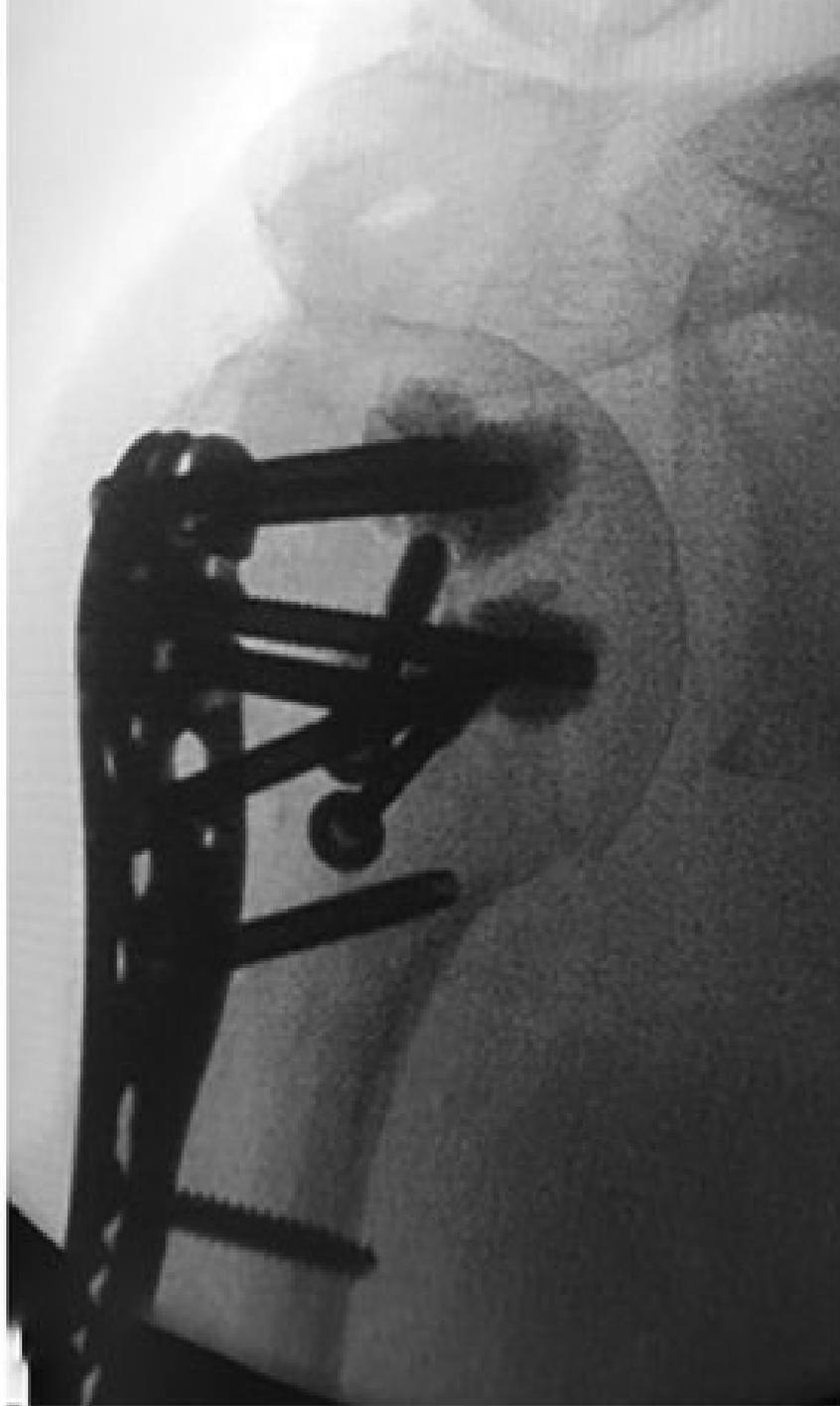
Improving fixation in elderly people

Reduction and fixation

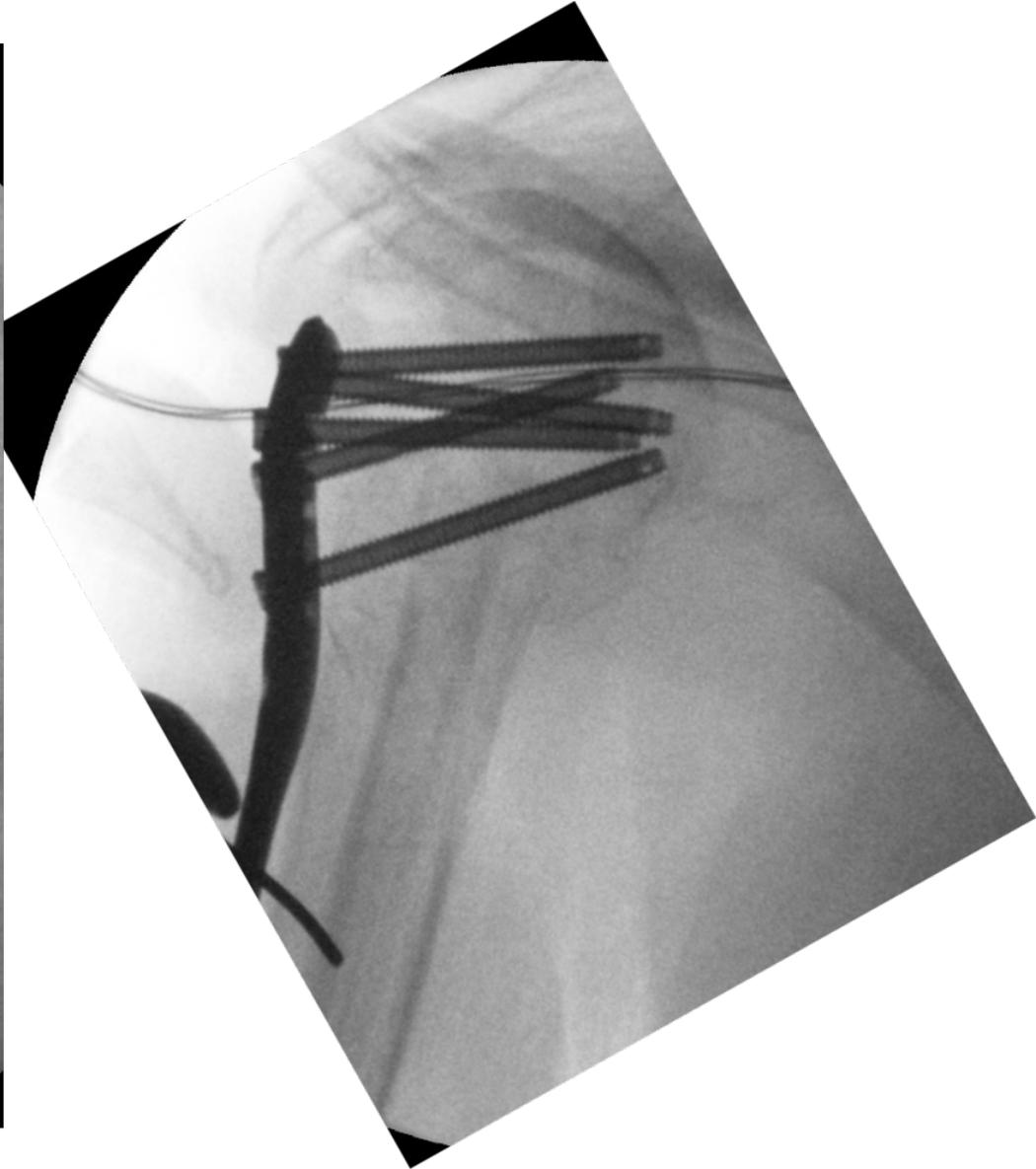
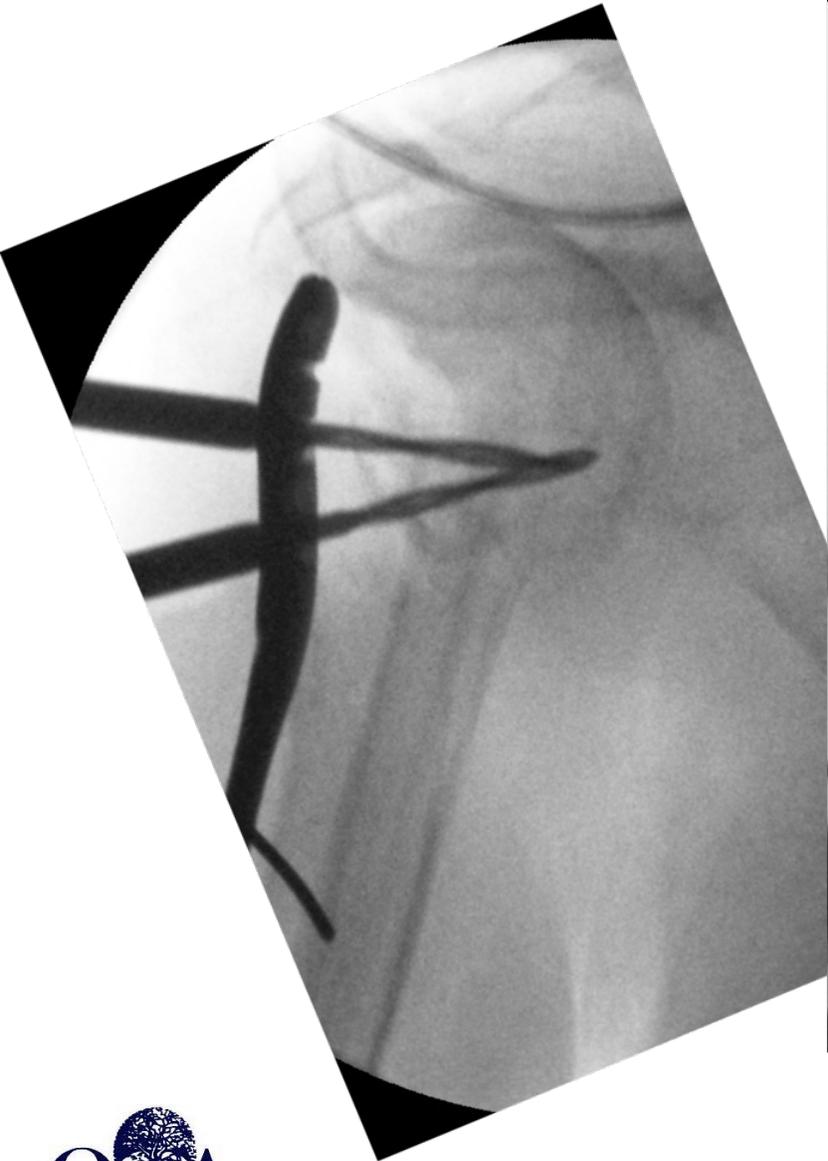




Antonio M. Foruria, Joaquin Sanchez-Sotelo. Proximal Humeral Fractures. In: In: Tornetta P, Ricci WM, eds. Rockwood and Green's Fractures in Adults, 9e. Philadelphia, PA. Wolters Kluwer Health, Inc; 2019.









Osteoporotic Fracture Care: Are We Closer to Gold Standards?

Meir Marmor, MD, Volker Alt, MD,† Loren Latta, PE, PhD,‡ Joseph Lane, MD,§ Brian Rebolledo, MD,§
Kenneth A. Egol, MD,|| and Theodore Miclau, MD**

A comprehensive strategy for the improved treatment of osteoporotic fractures must address both biological and mechanical issues and includes 4 specific approaches:

- (1) removal of inhibitors to bone healing
- (2) introduction of bone healing stimulants
- (3) application of bone augmentation or substitutes**
- (4) modification of fracture fixation constructs

Arthroplasty

Arthroplasty - Indications

- Head depression fractures involving over 40%–50% of the articular surface
- Fracture-dislocations with separation of the head from the shaft and one or both tuberosities
- Valgus impacted fractures with fracture and displacement of both tuberosities

Arthroplasty - Indications

- Very old patient with osteopenia and severe comminution of the greater tuberosity
- Consider it if calcar is less than 8 mm and/or medial hinge disrupted

clear indication for prosthetic replacement

67y



calcar <8mm
medial hinge
mass. disrupted

66y



head split
partial fxdisloc
medial hinge disrupted

85y



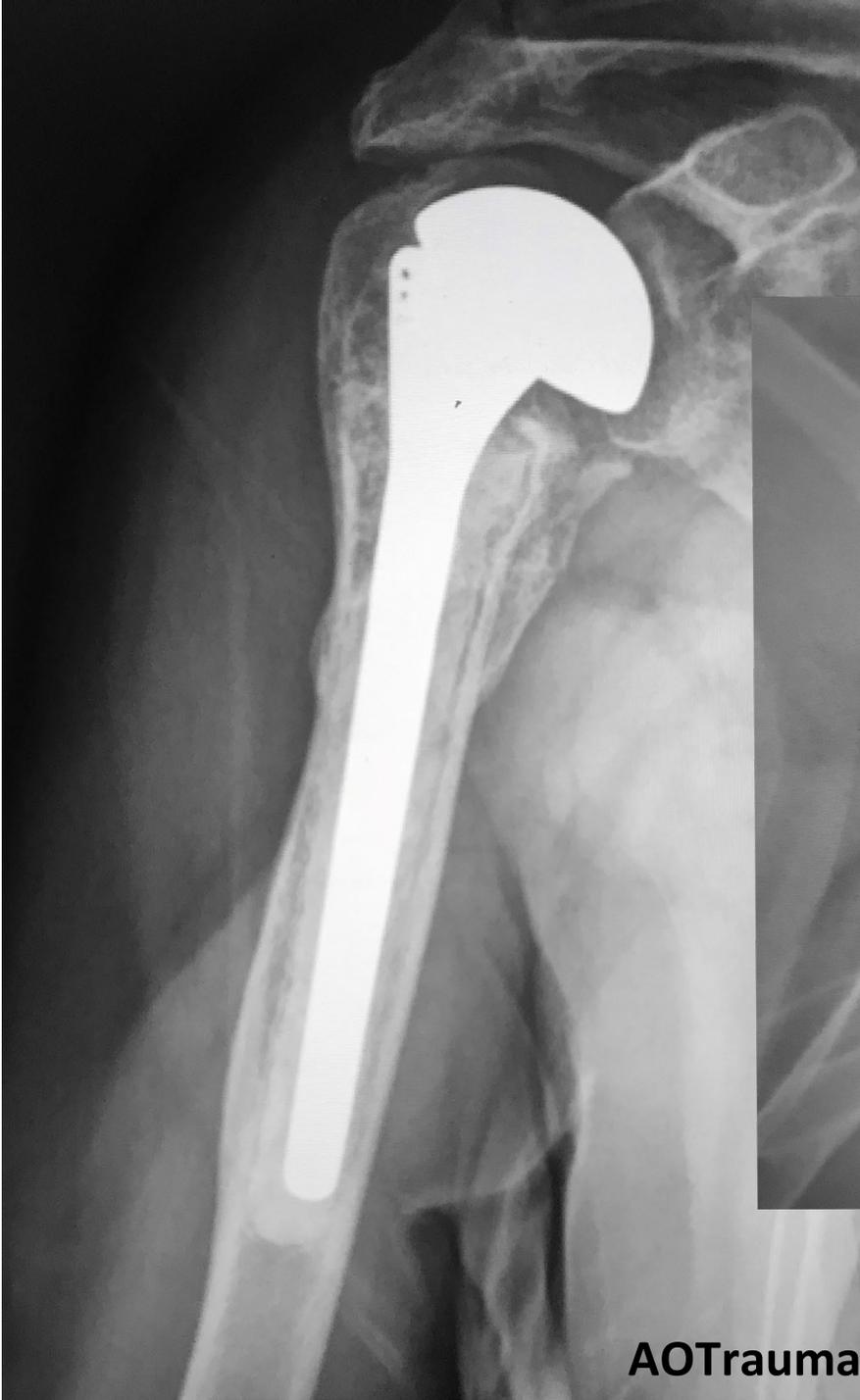
TRIAS
anatomic neck
osteoporosis+++
mass. displaced

75y



partial fxdisloc
calcar <8mm
medial hinge disrupted





Hemiarthroplasty Vs Reverse shoulder arthroplasty

Reverse Shoulder Arthroplasty

- Reverse shoulder arthroplasty was developed for the surgical management of cuff tear arthropathy.
- Since tuberosity/rotator cuff-related complications are the main reason for a poor functional outcome when a humeral head replacement is implanted for management of a proximal humeral fracture,⁷ expanding the indications of reverse arthroplasty to proximal humeral fractures seemed reasonable.

Reverse Shoulder Arthroplasty

- In the treatment of proximal humeral nonunion, not performing a tuberosity repair at the time of reverse arthroplasty has been correlated with a higher rate of dislocation
- Use of a stem with fracture-dedicated features (proximal ingrowth surface, small cross section, holes for suture fixation) may be beneficial.



Arthroplasty

Reverse shoulder arthroplasty superior to HA for acute proximal humeral fractures

How to Cite

OrthoEvidence. Reverse shoulder arthroplasty superior to HA for acute proximal humeral fractures. ACE Report. 2014;3(12):1. Available from: <https://myortho evidene.com/AceReport/Report/7328>

Study Type: Therapy

OE Level Evidence: 2

Journal Level of Evidence: 1

Reverse shoulder arthroplasty versus hemiarthroplasty for acute proximal humeral fractures. A blinded, randomized, controlled, prospective study

J Shoulder Elbow Surg. 2014 Oct;23(10):1419-26.

Contributing Authors:

E Sebastián-Forcada

R Cebrián-Gómez

A Lizaur-Utrilla

V Gil-Guillén

- Patients who were treated with reverse shoulder arthroplasty (RSA) had significantly better University of California–Los Angeles, Constant scores, forward elevation, and abduction compared to those who underwent hemiarthroplasty (HA).
- Failure of tuberosity in the HA group demonstrated significantly worse functional outcomes.

Arthroplasty's outcomes

- Studies reported to date seem to indicate that reverse shoulder arthroplasty provides reliable pain relief and restoration of motion and function, with good subjective shoulder values and overall satisfaction.
- Most but not all studies have reported better outcomes with reverse compared with hemiarthroplasty, internal fixation, or nonoperative treatment.
- The outcome of hemiarthroplasty seems to be directly related to tuberosity healing: anatomic tuberosity healing leads to a very good outcome in terms of pain relief, motion, strength, and function, whereas poor tuberosity healing leads almost universally to limited function (often with “pseudoparalysis”).

Outcomes



AAOS2018: Comparing nonoperative, hemiarthroplasty, ORIF and rTSA for 3- and 4-part humerus fracture

Study Type: Meta analysis OE Level Evidence: N/A Journal Level of Evidence: N/A

Comparison of Surgical and Nonsurgical Treatments for 3 and 4-Part Proximal Humerus Fractures in Elderly Patients: A Network Meta-Analysis

Contributing Authors: J Murphy, A Mohamadi, S Orman, J Serino, P Hanna, MJ Weaver, GS Dyer, A Nazarian, A von Keudell

- In the treatment of 3- and 4-part humeral fractures, nonoperative treatment was favored over ORIF when rates of adverse events and additional surgery were analyzed
- Reverse total shoulder arthroplasty was favored over hemiarthroplasty when functional outcome and rate of adverse events were analyzed



OTA2018: Improved pain and reduced reoperation rate with TSA vs. HA for proximal humerus fractures

Study Type: Meta analysis

OE Level Evidence: N/A

Journal Level of Evidence: N/A

Reverse Total Shoulder Arthroplasty Improves Pain and Outcomes With Reduced Reoperations Compared to Hemiarthroplasty for Acute Geriatric Proximal Humerus Fractures: A Meta-Analysis

- In management of acute, geriatric proximal humerus fractures, reverse shoulder arthroplasty was significantly favored over hemiarthroplasty for outcome related pain, clinical scores, range of forward flexion, and incidence of re-intervention.

RESEARCH ARTICLE

Effectiveness and Safety of Interventions for Treating Adults with Displaced Proximal Humeral Fracture: A Network Meta-Analysis and Systematic Review

Long Chen^{1,2}, Fei Xing¹, Zhou Xiang^{1*}

¹ Department of Orthopedics, West China Hospital, Sichuan University, Chengdu, Sichuan, China,

² Department of Orthopedics, Guizhou Provincial People's Hospital, Guiyang, Guizhou, China

- RSA had the highest probability for improving functional outcome and lowering the total incidence of complications and requiring additional surgery among the five interventions for treating adults with displaced proximal humeral fracture.

Interventions for Treating 3- or 4-part proximal humeral fractures in elderly patient: A network meta-analysis of randomized controlled trials



Shaolong Du ¹, Jiahao Ye ¹, Haolong Chen, Xishan Li, Qiang Lin*

- The statistical result suggested, that RSA has become a beneficial choice to treat displaced 3- or 4-part fracture in elderly patients, that **might** result in more favorable clinical outcomes and reduction of re-intervention rates than other methods performed for the same indication. But the ORIF is the worst

Underlying Mental Illness and Psychosocial Factors Are Predictors of Poor Outcomes After Proximal Humerus Repair

Rebekah Belayneh, MD, Jack Haglin, BS,* Ariana Lott, MD,* David Kugelman, MD,*
Sanjit Konda, MD,*† and Kenneth A. Egol, MD*†*

- Psychological and social factors at 3 months postoperatively have a strong correlation with negative long-term (1 year) outcomes after proximal humerus fixation.
- Clinicians may offer psychological support and encourage social support to these patients postoperatively to improve pain and treatment outcomes.



OTA 2020: Reverse Shoulder Arthroplasty Improves Function vs Plate Fixation for PHF in the Elderly

Study Type: N/A

OE Level Evidence: N/A

Journal Level of Evidence: N/A

Reverse Shoulder Arthroplasty Superior at 2 Years Compared with Plate Fixation for Displaced Proximal Humeral Fractures in the Elderly: A Multicenter Randomized Controlled Trial

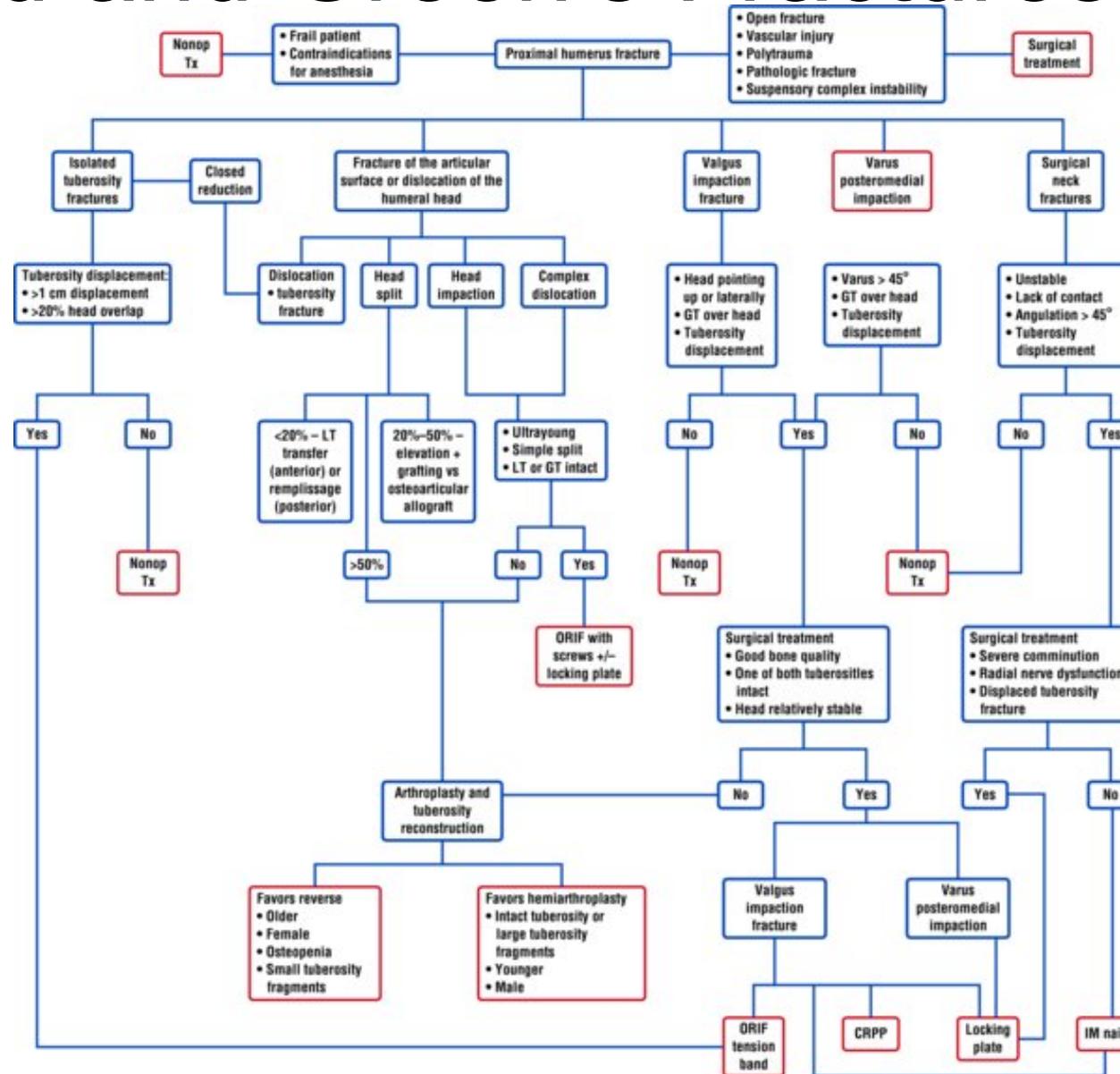
- The findings suggest that reverse shoulder arthroplasty may result in superior shoulder function compared to plate fixation, particularly in type OTA/AO classified type C2 proximal humeral fractures.

Summary

Proximal humerus fractures in the elderly present several challenges that should be addressed when planning treatment (patient, bone quality, co-morbidities, functionality) and there are differences in technique and strategies to improve the follow up

Long-term follow-ups are required to validate recommendations and findings of studies comparing the results of surgery with those of orthopedic treatment in the elderly

Rockwood and Green's Fractures algorithm



Antonio M. Foruria, Joaquin Sanchez-Sotelo. Proximal Humeral Fractures. In: In: Tornetta P, Ricci WM, eds. Rockwood and Green's Fractures in Adults, 9e. Philadelphia, PA. Wolters Kluwer Health, Inc; 2019.



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Underlying Mental Illness and Psychosocial Factors Are Predictors of Poor Outcomes After Proximal Humerus Repair. *Journal of Orthopaedic Trauma* 2019

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