

Femoral Neck Fractures: Internal Fixation vs. Arthroplasty

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Femoral Neck Fracture Epidemiology

- > 300,000 Hip fractures occur annually in the US each year!!
- Hip fractures account for 30% of all hospitalizations
- WHO: expects to surpass 6M annually worldwide by 2050
 - As the world's population ages and people remain active into 8th and 9th decade of life
- Hip fractures have been associated with significant morbidity, mortality, expense
 - ~ \$10-15 billion/year in the US

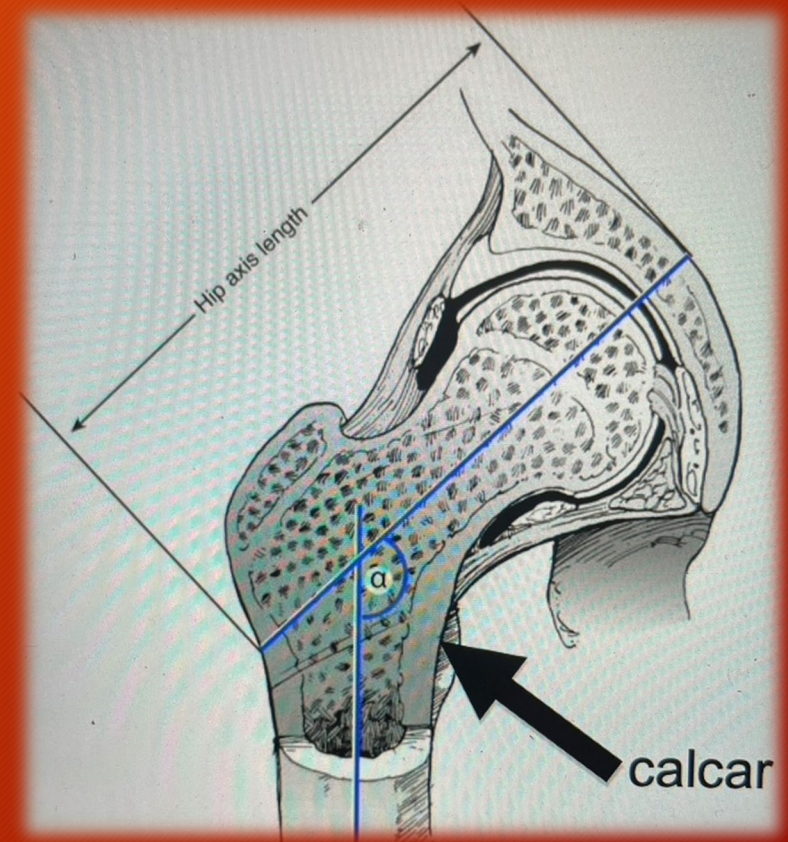
Epidemiology: Bimodal Distribution

- Older Individuals – “lower” energy fractures
 - Incidence doubles each decade beyond age 50
 - increased incidence
 - Women
 - Caucasians
 - Smokers,
 - lower BMI,
 - Excessive caffeine
 - ETOH
- Young – “high” energy trauma
 - Bad Choices

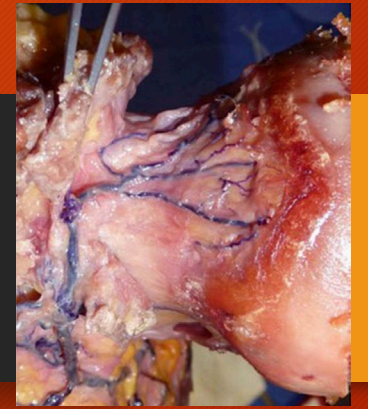


Femoral Neck Anatomy

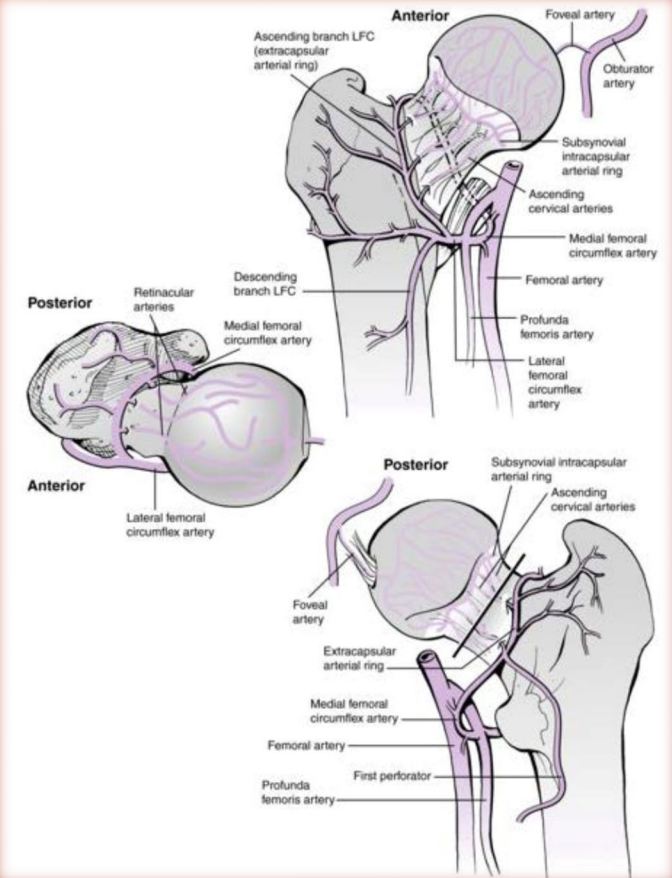
- Physeal closure age 16
- Neck-shaft angle (a)
 $130^{\circ} \pm 7^{\circ}$
- Anteversion
 $10^{\circ} \pm 7^{\circ}$
- General alignment b/w neck and center of head
- Calcar Femorale
Posteromedial dense plate of bone



Femoral Head/Neck Blood Supply

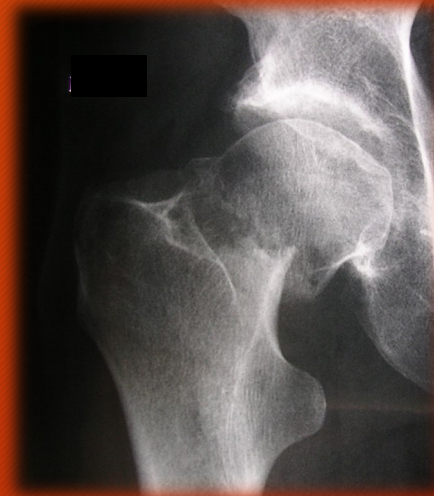


- Lateral epiphyseal artery
 - terminal branch Medial Femoral Circumflex artery
 - predominant blood supply to femoral head
 - Give rise to the ascending branches that pass upward along the femoral neck
- After fracture, blood supply depends on retinacular vessels
- Greater fracture displacement = greater risk of retinacular vessels being disruption
- Tamponade effect of blood in intact capsule
 - Theoretical risk of AVN with increased pressure



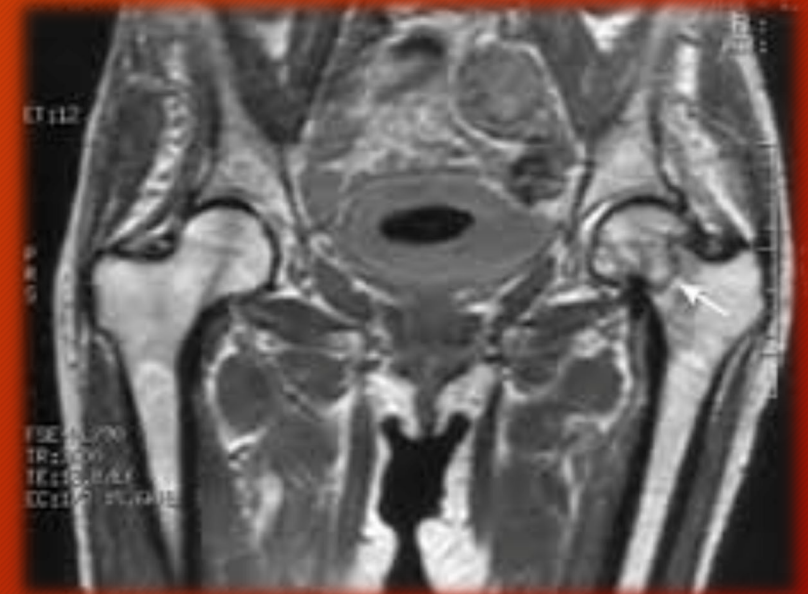
Femoral Neck Fracture: Diagnosis

- Plain Xrays
 - Consider traction-internal rotation view if comminuted
- CT scan
 - Better to assess displacement
 - Better to assess comminution



Femoral Neck Fracture: Diagnosis

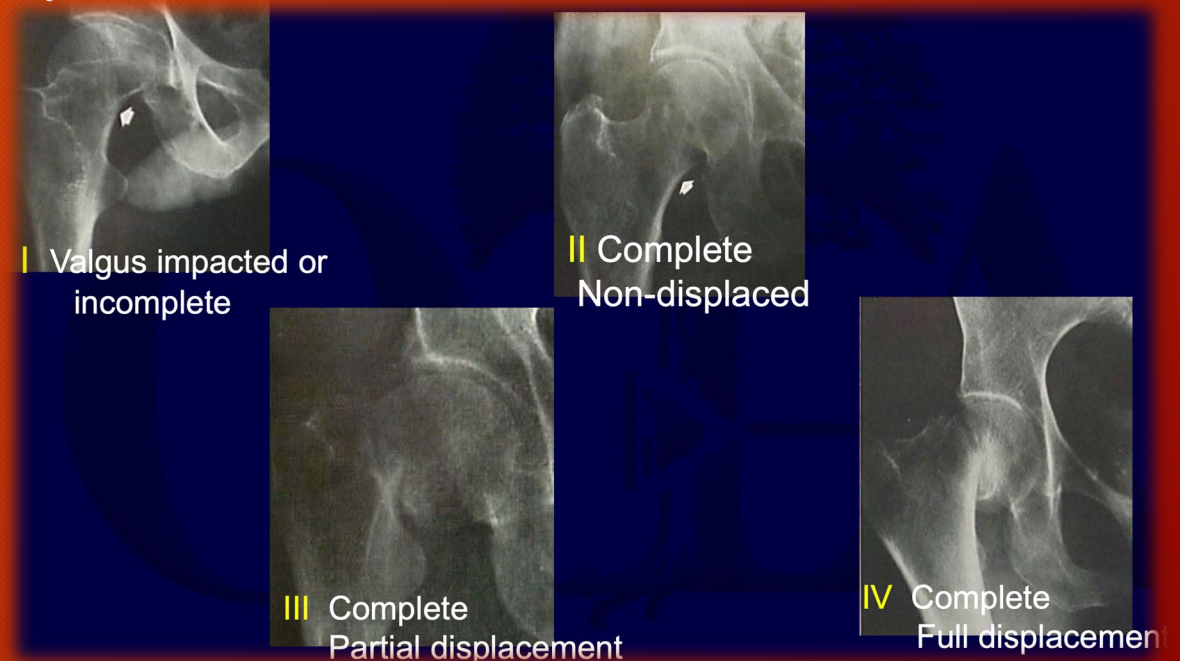
- MRI – Occult femoral neck fracture
- Consider MRI in an elderly patient who:
 - Mechanism unknown
 - “Generalized” Pain
 - Unable to weight bear
 - Physical Exam +/-
 - Xrays/CT: equivocal
- MRI - 100% sensitive and specific
 - may reduce cost by shortening time to diagnosis



Classification: Femoral Neck Fractures

- Garden (1961) - based upon a single AP hip/pelvic X-ray
 - Degree of displacement
 - Relates to risk of vascular disruption
 - Most commonly applied to geriatric/insufficiency fractures

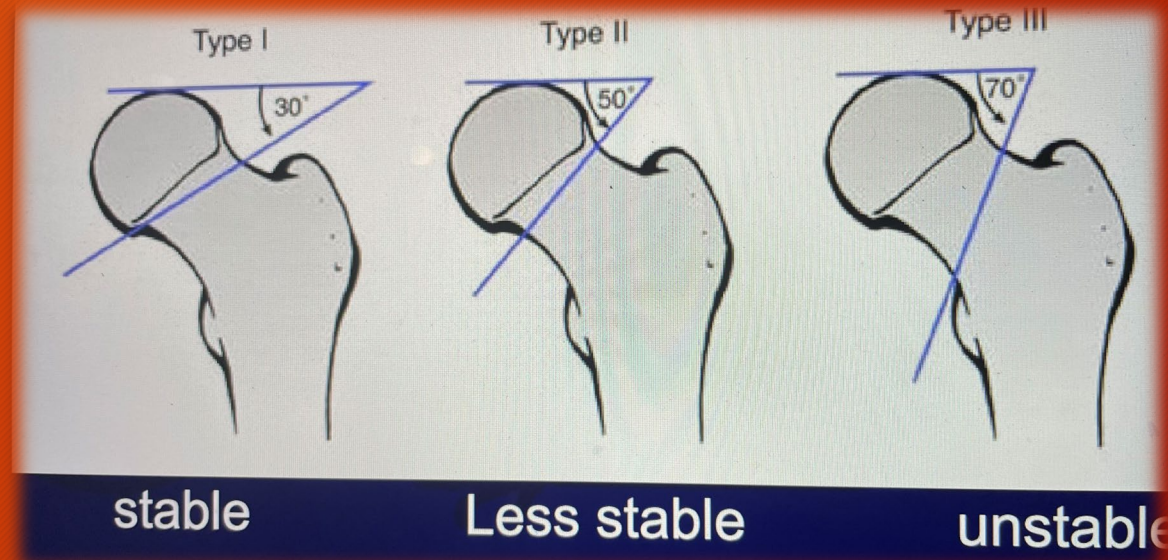
- I - Valgus impacted or incomplete
- II - Complete Non-displaced
- III - Complete Partial displacement
- IV - Complete Full displacement



Classification: Femoral Neck Fractures

- Pauwels (1935)
 - Fracture orientation (relates to biomechanical stability)
 - More vertical fracture has more shear force (i.e. less stable)
 - Commonly applied to the higher energy fractures (younger pts)

- Type I – Stable
- Type II – Less Stable
- Type III - Unstable



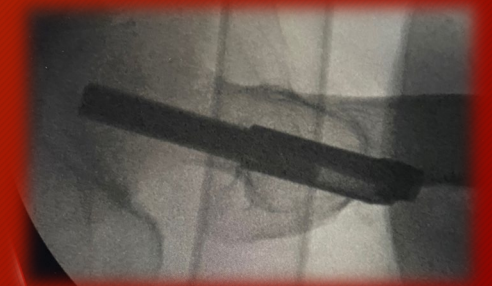
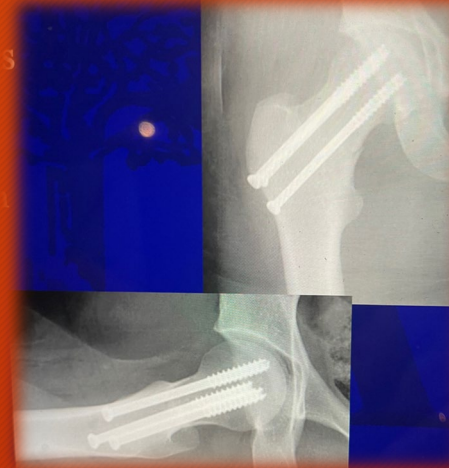
Treatment Goals: Older Patients

- Mobilize (get them OOB!)
 - Weight bearing as tolerated
 - Minimize period of bedrest
- Minimize surgical morbidity
 - Minimize anesthesia time, blood loss and muscle dissection
 - Reduced risk of reoperation



Traditional Treatment of FNF in “Older” Patients

- Garden I and II
 - Closed Reduction and “percutaneous” fixation
 - Cannulated screws
 - Compression hip screw +/- de-rotation screw
 - Femoral neck system
- Garden III and IV
 - Hemi hip arthroplasty
 - Total hip arthroplasty



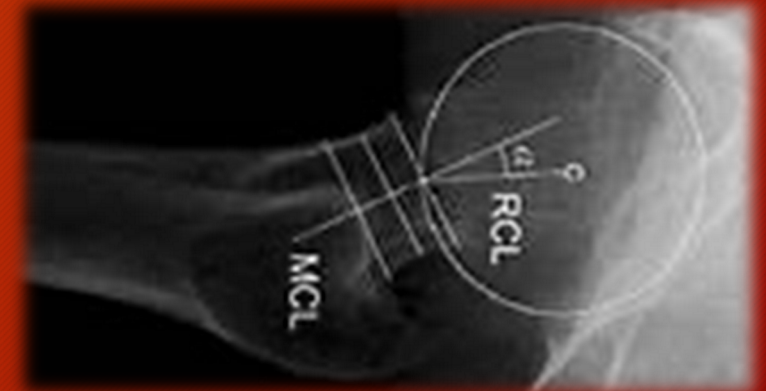
Decision Making Variables: Factors

- Patient Factors
 - Older Patients – Lower energy injury (falls)
 - Comorbidities
 - Bone Quality
 - Functional Demands
 - Pre-existing hip disease



Decision Making Variables: Factors

- Fracture Factors - unraveling of the IF for Garden I/II philosophy
 - AP and Lateral Xray analysis of the FNF
 - Displacement in the sagittal and coronal planes
 - Influences outcome – re-operation rates, nonunion rates, failure
- Posterior Tilt Angle ≥ 20 degrees,
Statistically Significant increase in re-operation rate v arthroplasty
 - Palm et al. Acta Orthop 2009
 - Faith Investigators Lancet 2017 and JOT 2021
 - $>80y/o$, female, PTA $\geq 20 = 42.9\%$ failure rate
 - Olansen et al. Orthopedic Research and Review 2024
 - Keating et al OTA 2002
 - Many others!



Decision Making Variables: Factors

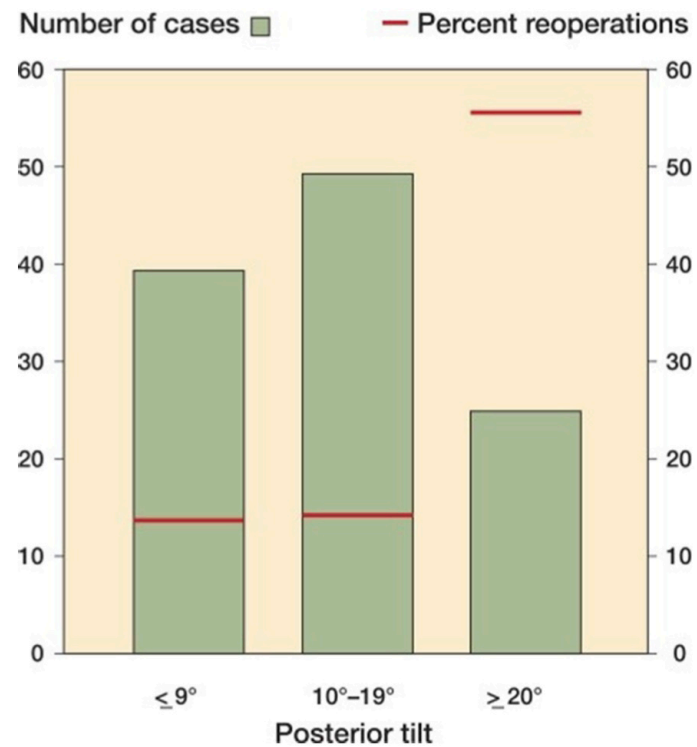
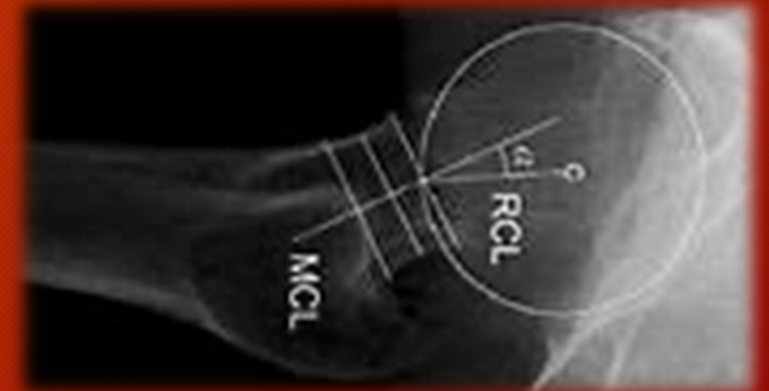


Figure 3 Distribution of posterior tilt and rates of reoperation in the 113 patients who were operated on with internal fixation for a Garden I or II femoral neck fracture. Bar graphs represent the total number of cases and red lines represent the percent of the group that underwent reoperation, shown to be disproportionately greater in patients with a posterior tilt >20°.

Notes: Reproduced with permission from Palm H, Gosvig K, Krasheninnikoff M, Jacobsen S, Gebuhr P. A new measurement for posterior tilt predicts reoperation in undisplaced femoral neck fractures: 113 consecutive patients treated by internal fixation and followed for 1 year. *Acta Orthop.* 2009;80(3):303-307.¹⁸



Decision Making Variables: Factors

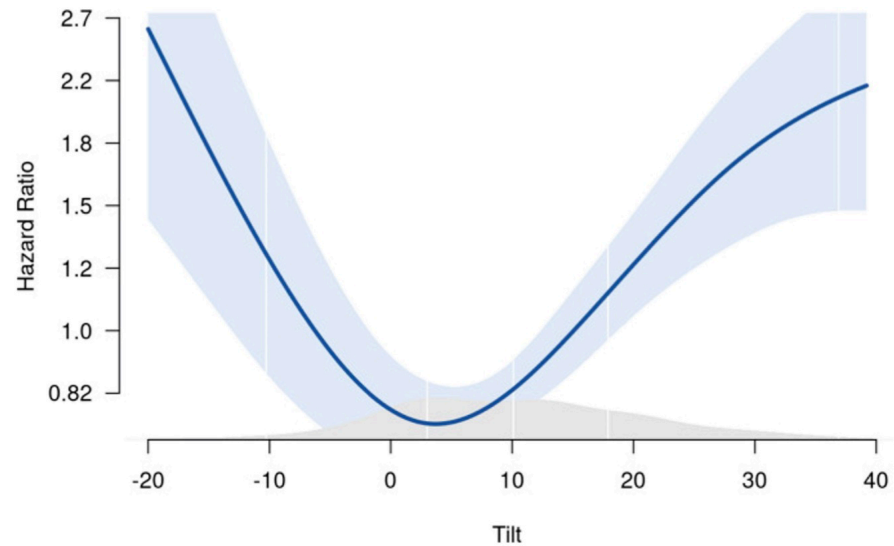
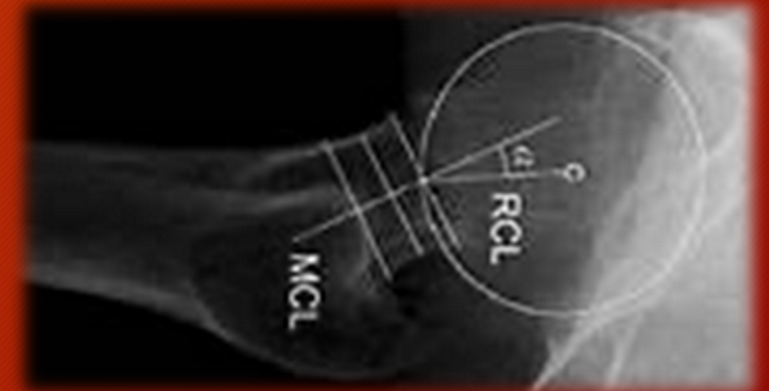


Figure 5 Graph showing the risk of treatment failure (Hazard Ratio) as a function of tilt in degrees. Anterior tilt corresponds with negative values on the x-axis. Posterior tilt corresponds with positive values on the x-axis. Vertical blue lines represent the significant hazard ratios. The values are adjusted for sex, American Society of Anesthesiologists (ASA) classification, sheltered housing, implant inclination, cognitive impairment, and postoperative fracture tilt. The light blue area corresponds to the 95% CI.

Notes: Modified from Sjöholm P, Sundkvist J, Wolf O, Sköldenberg O, Gordon M, Mukka S. Preoperative Anterior and Posterior Tilt of Garden I-II Femoral Neck Fractures Predict Treatment Failure and Need for Reoperation in Patients Over 60 Years. *JB JS Open Access*. 2021;6(4):e21.00045. Creative Commons.²²



Young patients with FNF: Summary

- Femoral neck fractures in < 60 y/o.
 - ORIF to avoid THA
 - Ideally, within 24 hours
 - Fracture reduction is likely more important than:
 - capsulotomy, approach, method of fixation
 - Stable fixation to allow early weight bearing
 - Follow closely for shortening, AVN and nonunion
 - Intervene early

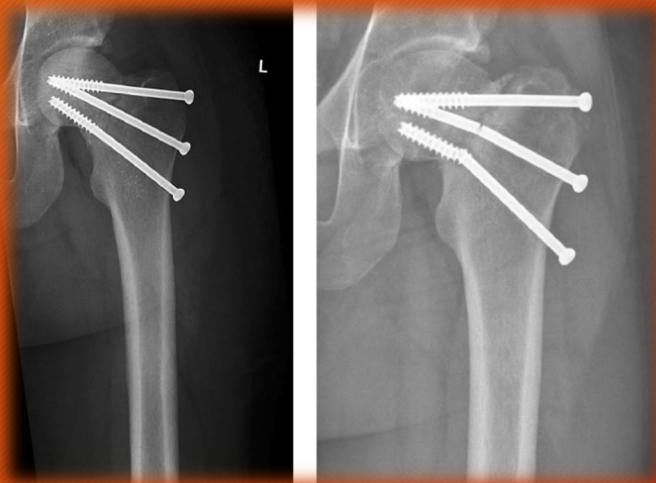


Treatment Issues: Older Patients

- Internal Fixation

- Lower surgical risk
- Higher risk for re-operation

Even for apparent Garden I and II's



- Arthroplasty

- Higher surgical risk (EBL, etc.)
- Fewer reoperations
- Better function

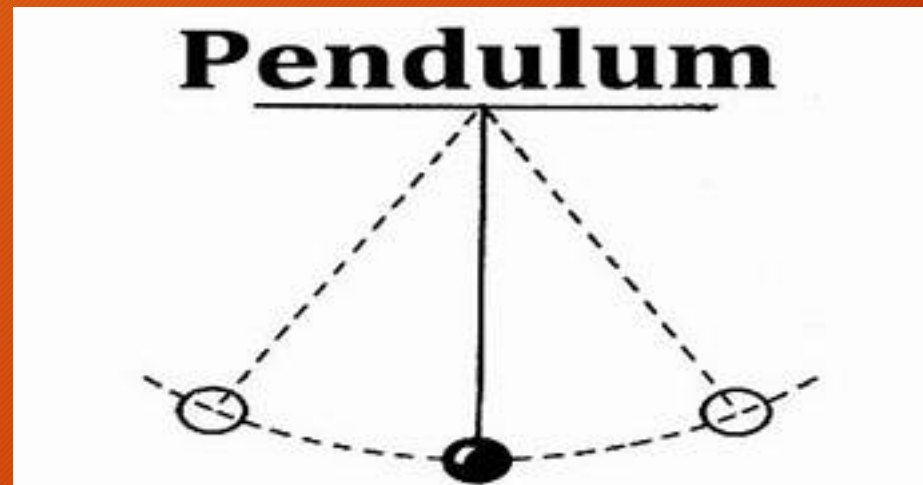


Older Patient Femoral Neck Fracture: Summary

- Multiple Considerations
 - Diagnosis
 - Xrays
 - CT
 - MRI
 - Patient Factors
 - Age
 - Co-morbidities
 - Functional level and demands
 - Fracture Factors
 - Displacement – multi-planar
 - Posterior and Anterior Tilt (PTA)



Older Patient Femoral Neck Fracture: Summary



Closed Reduction and Internal Fixation
for Garden I and II



Arthroplasty
for Garden I and II