SUBTROCHANTERIC FEMUR FRACTURES

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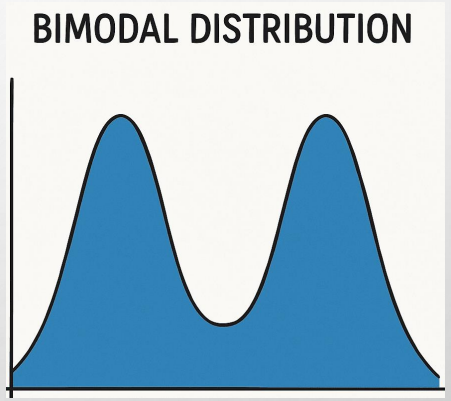
OBJECTIVES

- EPIDEMIOLOGY
- ANATOMY
- EVALUATION & DECISION MAKING
- SURGICAL TECHNIQUES
- OUTCOMES

INTRODUCTION

- DEFINED AS FRACTURES THAT OCCUR WITHIN 5 CM DISTAL OF THE LESSER TROCHANTER
- TYPICAL BIMODAL DISTRIBUTION
  - HIGH-ENERGY TRAUMA IN YOUNGER PATIENTS
  - LOW-ENERGY FALLS IN ELDERLY



- BIOMECHANICALLY CHALLENGING AREA WITH HIGH STRESS AND SLOW HEALING

BONY ANATOMY – PROXIMAL FEMUR

- REGION OF MAXIMAL COMPRESSIVE FORCES (MEDIALLY) AND TENSILE FORCES (LATERALLY)
  - LARGEST ASYMMETRIC DIFFERENCE IN LOAD OF A SINGLE LONG BONE IN THE BODY

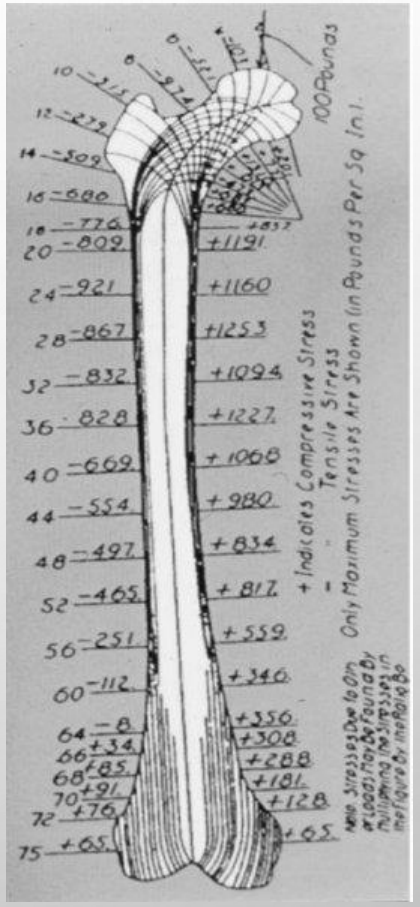
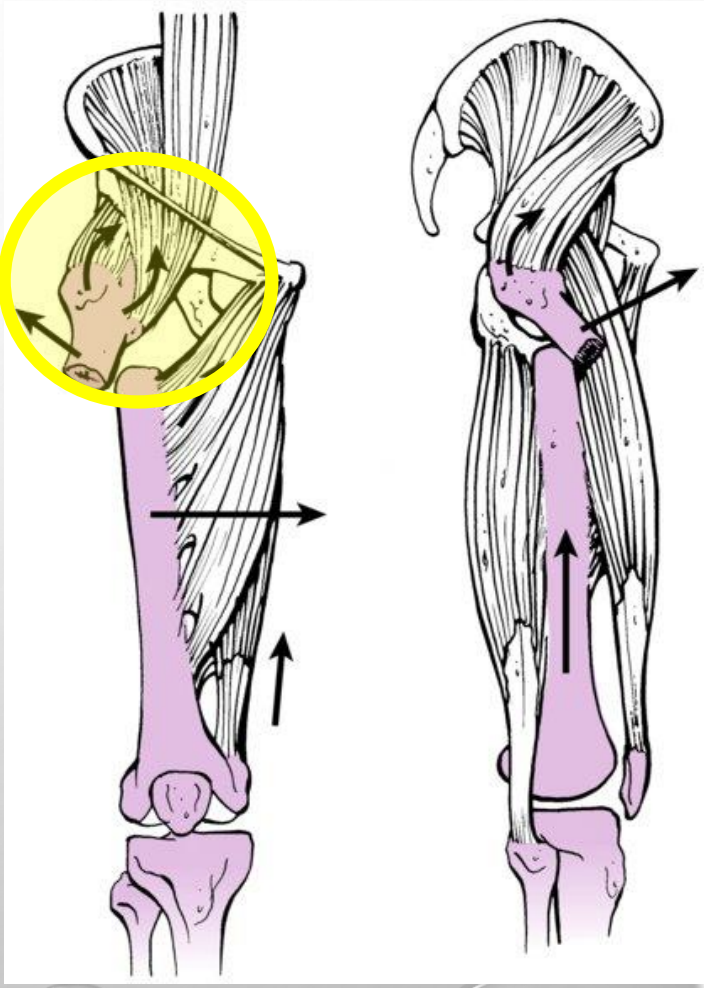


Image: Yoon RS and Haidukewych GJ, Subtrochanteric Fractures, Chapter 54, Figure 54-2. Rockwood and Green's Fractures in Adults, editors Tornetta, Paul; Ricci, William. Wolters Kluwer, 2019

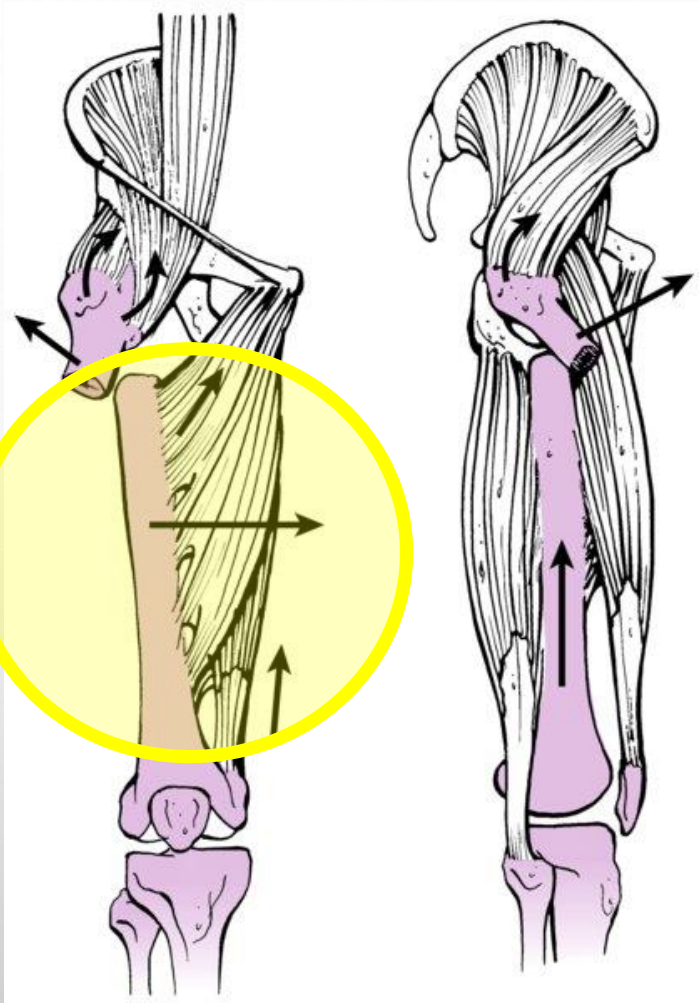
SOFT TISSUE ANATOMY – PROXIMAL FEMUR

- MULTIPLE MUSCLES ACT PROXIMALLY
- EXTERNAL ROTATION
  - SHORT EXTERNAL ROTATORS
- FLEXION
  - ILIOPSOAS AND ABDUCTORS
- ABDUCTION (OR VARUS)
  - ABDUCTORS



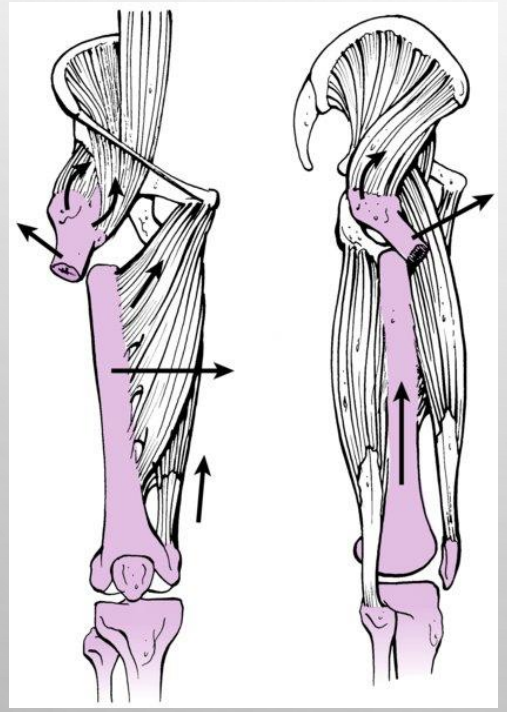
SOFT TISSUE ANATOMY – DISTAL FEMUR

- AND DISTAL SEGMENT!
  - ADDUCTORS: SHORTENING AND MEDIAL TRANSLATION



SOFT TISSUE ANATOMY – PROXIMAL FEMUR

- MULTIPLE LARGE MUSCLES ACT ON PROXIMAL (AND DISTAL) SEGMENT



- CLINICAL APPLICATION →
  - MUST OVERCOME THESE FORCES TO OBTAIN & MAINTAIN A REDUCTION

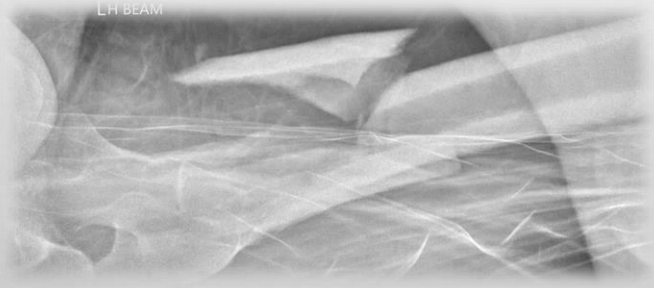
Image: Yoon RS and Haidukewych GJ, Subtrochanteric Fractures, Chapter 54, Figure 54-4 and 54-9. Rockwood and Green's Fractures in Adults, editors Tornetta, Paul; Ricci, William. Wolters Kluwer, 2019

INITIAL ASSESSMENT

- HISTORY
  - MECHANISM OF INJURY,
  - COMORBIDITIES/ADDITIONAL INJURIES
  - MEDICATIONS (DOAC, GLP-1)
  - ILLICIT DRUG USE
- PHYSICAL EXAM
  - SHORTENED, EXTERNALLY ROTATED LEG
  - PAIN
  - NV STATUS

RADIOGRAPHIC EVALUATION

- AP PELVIS AND AP/LATERAL FEMUR X-RAYS (HIP TO KNEE)
  - TRACTION VIEWS CAN BE HELPFUL
- CT: USEFUL IN COMPLEX OR PERIPROSTHETIC FRACTURES
- MRI/BONE SCAN FOR SUSPECTED STRESS FRACTURES, ATYPICAL FF, MALIGNANCY

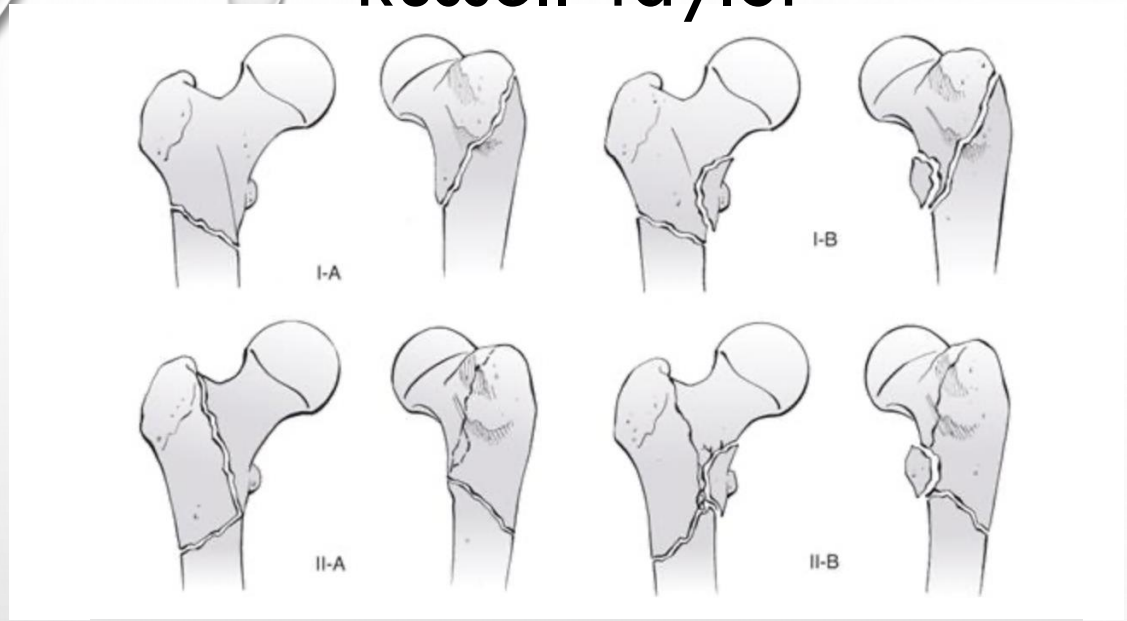


CLASSIFICATION

- RUSSELL-TAYLOR
- AO/OTA: 31 AND 32
- CONSIDER ATYPICAL FRACTURES: TRANSVERSE, NONCOMMINUTED, BILATERAL

Type	Description
1	Fracture does NOT involve the piriformis fossa
1A	Fracture extends below the lesser trochanter
1B	Fracture involves the lesser trochanter
2	Fracture DOES involve the piriformis fossa
2A	Fracture has stable medial buttress
2B	Fracture has unstable medial buttress

Russell-Taylor



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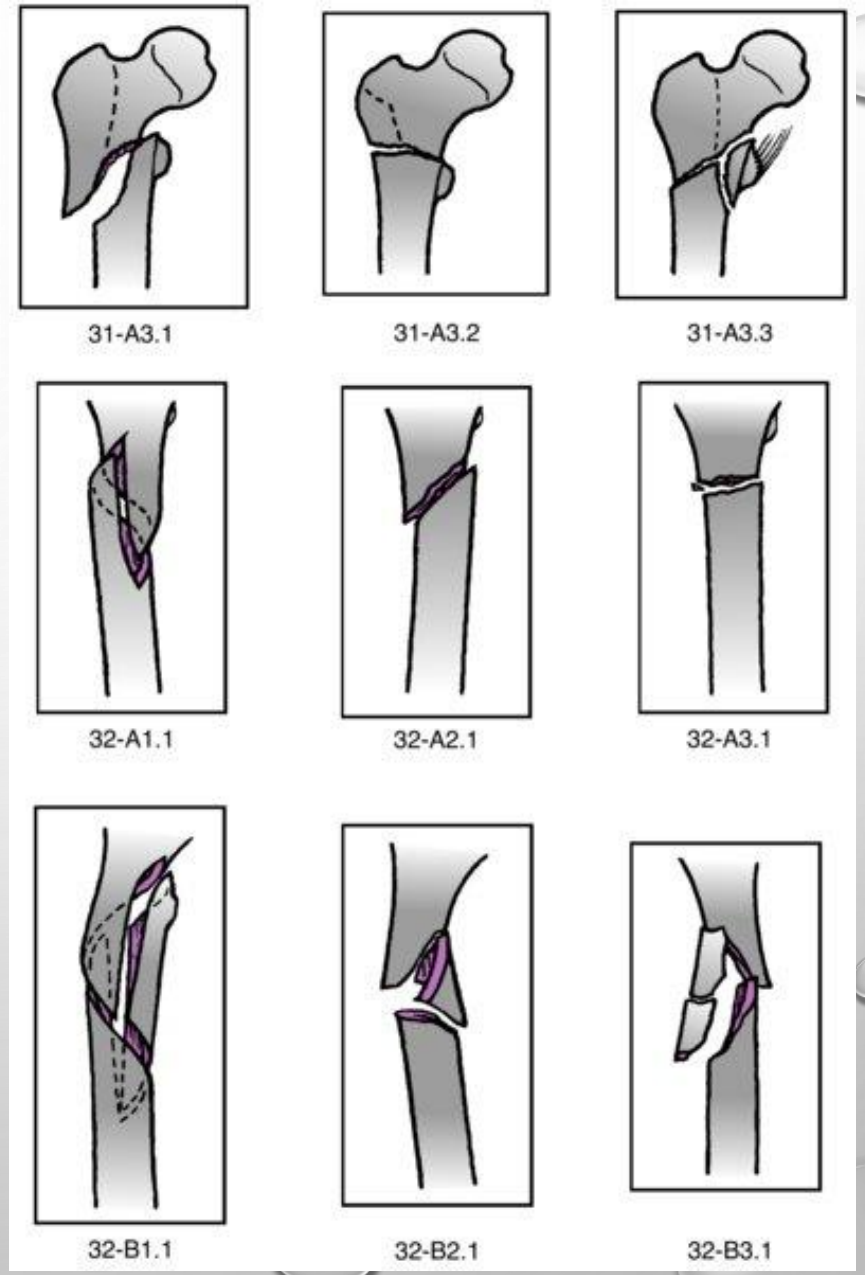
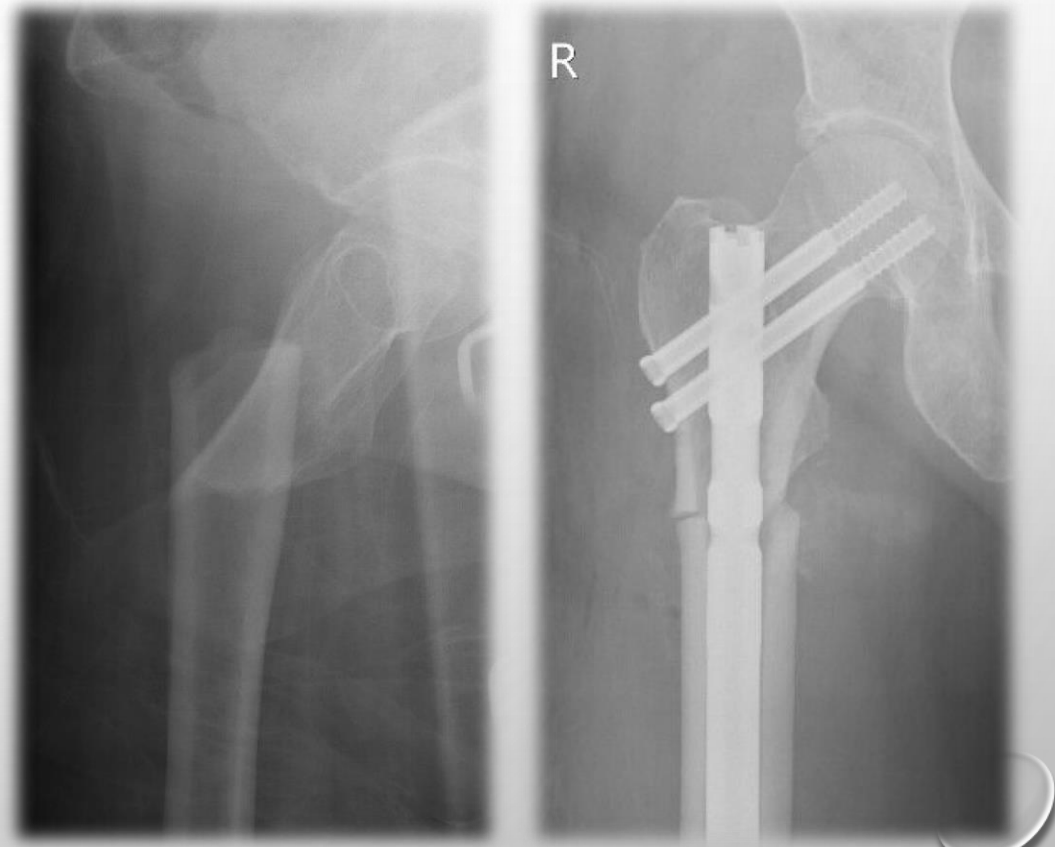
AO/OTA: 31 AND 32



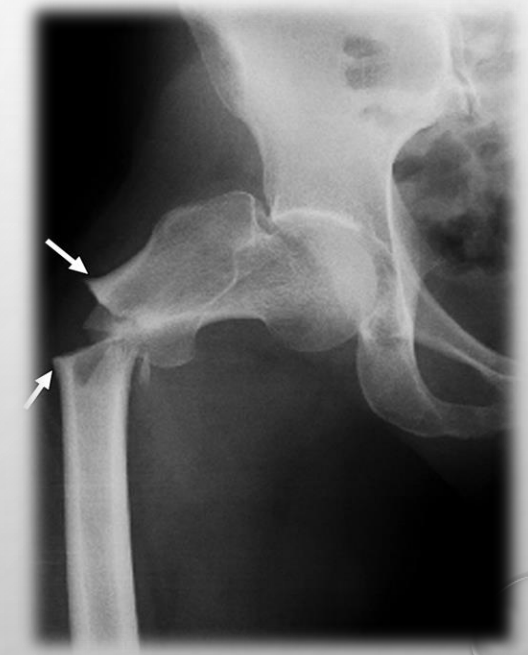
EPIDEMIOLOGY

- SUBTROCHANTERIC FEMUR FRACTURES
  - 10–30% OF PROXIMAL FEMUR FRACTURES
- BIMODAL AGE DISTRIBUTION: ELDERLY VS. YOUNG ADULTS
- RISK FACTORS: OSTEOPOROSIS, BISPHOSPHONATES, METASTASES
- 1-YEAR MORTALITY UP TO 20–30% IN ELDERLY PATIENTS (HIP FXS)



ATYPICAL/BISPHOSPHONATES

- LOOK FOR THE “BEAK”
- VARUS ALIGNMENT TYPICALLY
- THE DREADED BLACK LINE INDICATIVE OF INCOMPLETE FRACTURE - MRI
- MRI CAN BE USEFUL – PRE-OP, SYMPTOMATIC
- TEND TO BE WILDLY DISPLACED



ASBMR MAJOR CRITERIA (SHOULD HAVE 4/5)

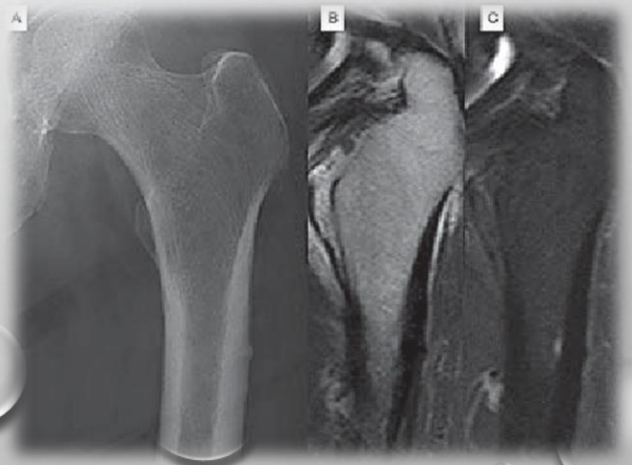
- LOCATION: FRACTURE LINE IN SUBTROCHANTERIC OF SHAFT OF FEMUR
- TRAUMA: MINIMAL OR NO TRAUMA, PRODROMAL THIGH PAIN/DISCOMFORT
- FRACTURE LINE: ORIGINATING IN THE LATERAL CORTEX AND BEING SUBSTANTIALLY TRANSVERSE
- COMMINUTION: UNCOMMINUTED OR MINIMALLY COMMINUTED FRACTURE
- CORTICAL THICKENING: LOCALIZED ENDOSTEAL OR PERIOSTEAL THICKENING AT THE FRACTURE SITE

ATYPICAL/BISPHOSPHONATES

- BIOLOGIC COMPROMISED: IMPEDED BONE TURNOVER
- MEDICAL TREATMENT RECOMMENDED—ANABOLIC AGENTS (IE TERIPARATIDE)
- CONTRALATERAL IMAGING: DON'T MISS AN IMPENDING FRACTURE ON THE OTHER SIDE!!

WHEN TO STABILIZE PROPHYLACTICALLY

- IF NO BLACK LINE AND NO PAIN, CAN OBSERVE — GET STARTED WITH MEDICAL TREATMENT
- IF PAINFUL, SHOULD BE PROPHYLACTICALLY STABILIZED
- BLACK LINE (I.E. INCOMPLETE FRACTURE) SHOULD BE STABILIZED

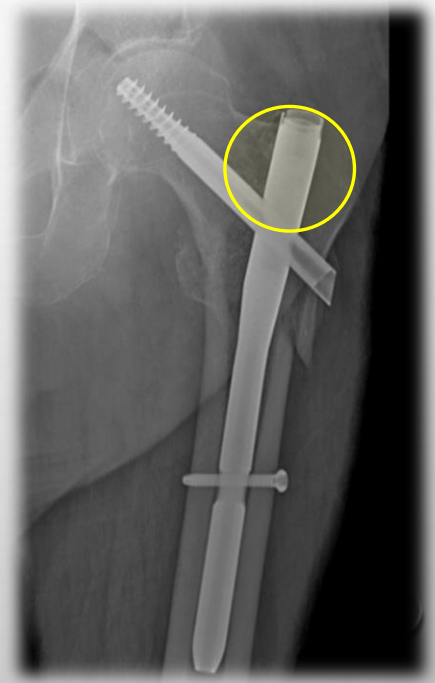


SURGICAL DECISION MAKING

- IMPLANT OPTIONS
  - ANTEGRADE INTRAMEDULLARY NAIL
    - RECON VS CEPHALOMEDULLARY NAIL
    - PIRIFORMIS VS TROCHANTERIC START POINT
  - BLADE PLATE
  - PROXIMAL FEMUR LOCKING PLATE
- POSITIONING
  - FREE LEG VS FRACTURE TABLE
  - SUPINE VS LATERAL
- CLOSED VS PERCUTANEOUS VS OPEN REDUCTION

CEPHALOMEDULLARY NAIL

- LARGE PROXIMAL BODY
- ONE CHOICE FOR PROXIMAL LOCKING
  - VARIATIONS BETWEEN COMPANIES
- SET SCREW TO PREVENT LAG SCREW BACK OUT



INTRAMEDULLARY NAIL: NAIL DESIGN

RECONSTRUCTION NAIL: SMALLER PROXIMAL BODY, MULTIPLE PROXIMAL INTERLOCKING OPTIONS

BLADE PLATE

- ALSO CONSIDER FOR CASES NEEDING REVISION FIXATION
  - DIFFICULT TO NAIL WITH PATH FROM PRIOR NAIL
  - POOR STARTING POINT

Courtesy of Dr Brandon Yuan

PROXIMAL FEMUR LOCKING PLATE

- A PLATE IS STILL A VIABLE OPTION

PATIENT POSITIONING

SUPINE – FREE LEG

- SKELETAL TRACTION
- ADVANTAGES
  - ABLE TO MANIPULATE LIMB POSITIONING
- DISADVANTAGES
  - POTENTIAL NEED FOR ASSISTANT
  - POSITIONING/DRAPING REQUIRES EXPERIENCED PERSONNEL

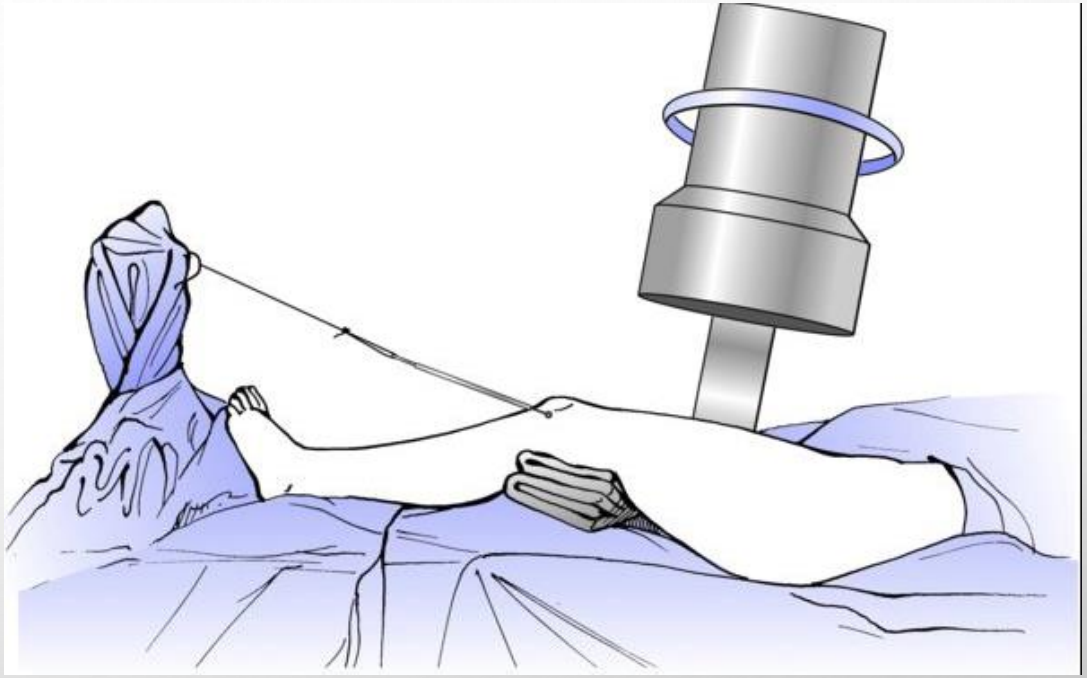


Image: Adams JD and Jeray KJ, Femoral Shaft Fractures, Chapter 56, Figure 56-13. Rockwood and Green's Fractures in Adults, 9th edition. Editors Tornetta, Paul; Ricci, William. Wolters Kluwer, 2019

PATIENT POSITIONING

SUPINE – TRACTION TABLE

- ADVANTAGES
  - LESS TECHNICAL POSITIONING/DRAPING
  - TRACTION/REDUCTION HELD WITHOUT ASSISTANT
- DISADVANTAGES
  - POTENTIAL COMPLICATIONS OF SUSTAINED TRACTION: NERVE PALSY, SKIN INJURY
  - MORE CHALLENGING ACCESS FOR OPEN REDUCTION
  - MORE DIFFICULT TO CHANGE LEG POSITIONING INTRAOPERATIVELY
  - BE AWARE OF WLCS!!!

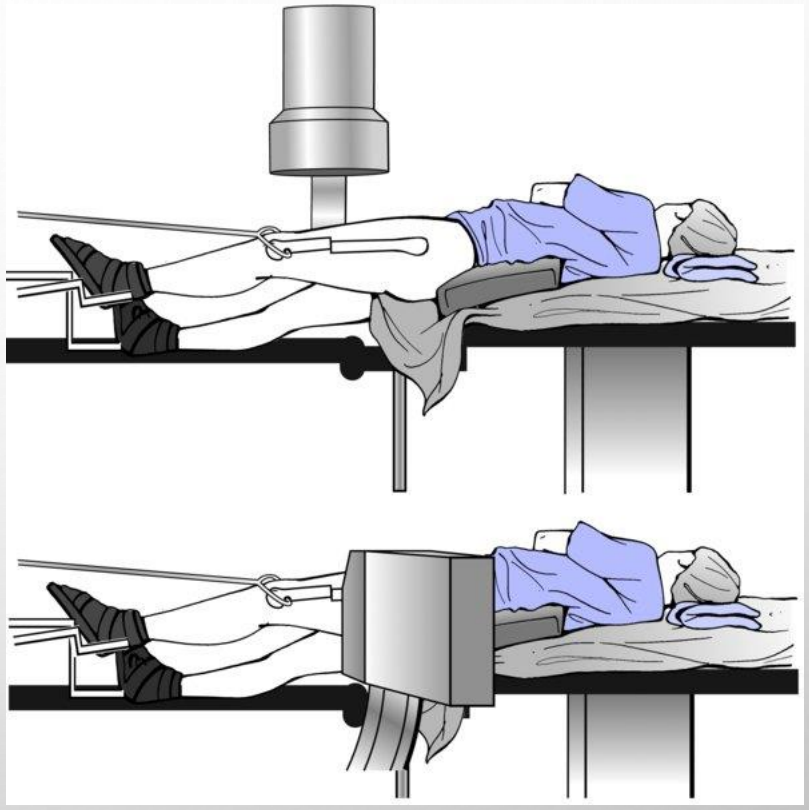


Image: Adams JD and Jeray KJ, Femoral Shaft Fractures, Chapter 56, Figure 56-14. Rockwood and Green's Fractures in Adults, 9th edition. Editors Tornetta, Paul; Ricci, William. Wolters Kluwer, 2019

PATIENT POSITIONING

LATERAL – FREE LEG

- ADVANTAGES
  - EASIER ACCESS TO STARTING POINT
  - ABLE TO MOVE DISTAL SEGMENT TO MATCH FLEXION AND ABDUCTION OF PROXIMAL FRAGMENT
  - ASSISTANT PROVIDES INTERMITTENT TRACTION
- DISADVANTAGES
  - DIFFICULT IMAGING IF UNFAMILIAR
  - DIFFICULTY ACCESSING CONTRALATERAL LIMB FOR COMPARISON
  - POLYTRAUMA PATIENTS MAY BE UNABLE TO BE POSITIONED LATERALLY

SURGICAL TACTICS

- CLOSED REDUCTION
    - TRACTION, LEG-POSITIONING, CRUTCH/LEG HOLDER, F-TOOL, INTRAMEDULLARY FINGER TOOL

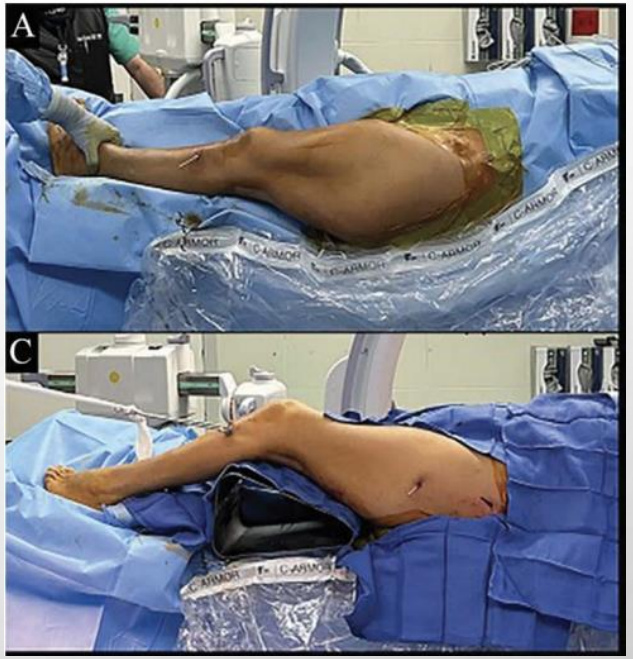
LEG POSITIONING

- FRACTURE TABLE
    - ELEVATE DISTAL SEGMENT TO MATCH FLEXION OF PROXIMAL SEGMENT
    - MAY NEED NEUTRAL OR EVEN ABDUCTION RATHER THAN ADDUCTION IN THIS PATTERN
    - CRUTCH OR LEG HOLDER ATTACHMENT UNDER DISTAL SEGMENT

SURGICAL TACTICS

LEG POSITIONING

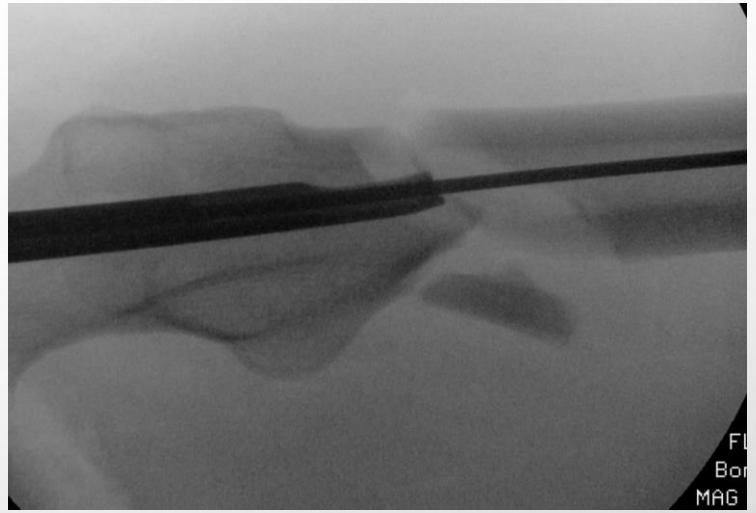
- SUPINE, FREE LEG
  - BUMP OR TRIANGLE UNDER DISTAL SEGMENT TO MATCH FLEXION OF PROXIMAL SEGMENT
  - SKELETAL TRACTION (DISTAL FEMUR, PROXIMAL TIBIA)



Brewer J, Fuster F, Mosle S, Heng M. Principles of Minimally Invasive Reduction and Nail Fixation for Subtrochanteric Femur Fractures. J Am Acad Orthop Surg. 2024 Jun 1;32(11):e514-e522. doi: 10.5435/JAAOS-D-23-00904. Epub 2024 Apr 9. PMID: 38626351.

SURGICAL TACTICS: CLOSED REDUCTION

- INTRAMEDULLARY FINGER TOOL



SURGICAL TACTICS

- OPEN REDUCTION
  - BALL-SPIKE PUSHER, COBB/HOHMANN
  - SCHANZ PIN, BLOCKING WIRE, COLINEAR CLAMP, POINTED TENACULUM
  - CABLE, UNICORTICAL PLATE

A well-aligned fracture, achieved by open reduction, is always preferable to malreduction via closed reduction

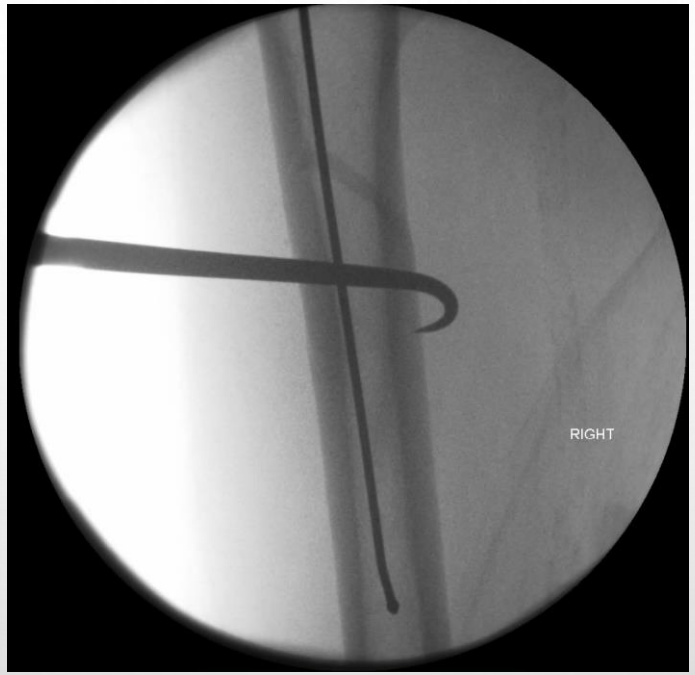
Be soft-tissue friendly

Percutaneous manipulation

Subvastus approach if needed

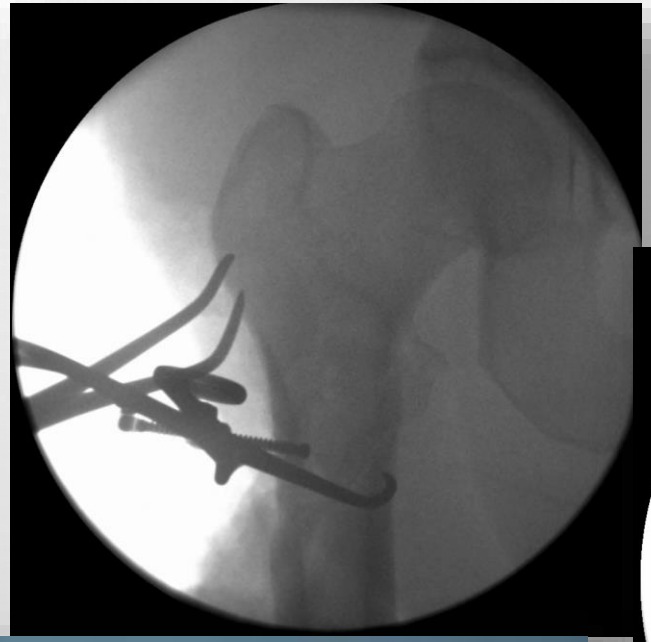
SURGICAL TACTICS: OPEN REDUCTION

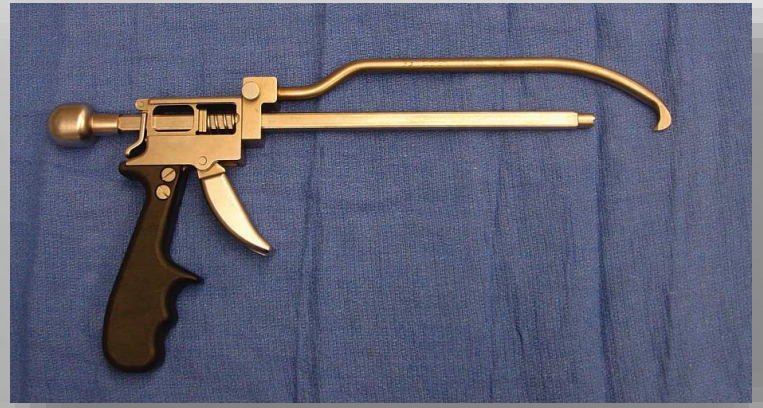
- PERCUTANEOUS
  - PICADOR/BALL-SPIKE
  - BONE HOOK
  - SCHANZ PINS



SURGICAL TACTICS: OPEN REDUCTION

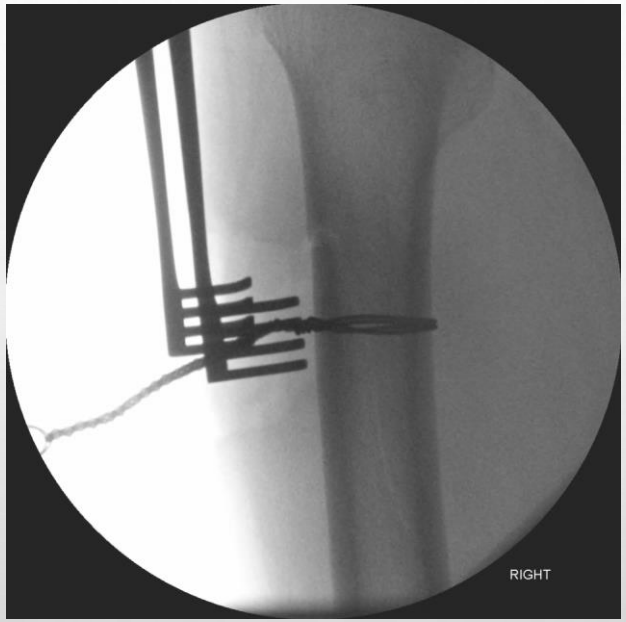
- REDUCTION CLAMP
- VERBRUGGE CLAMP
- COLINEAR CLAMP

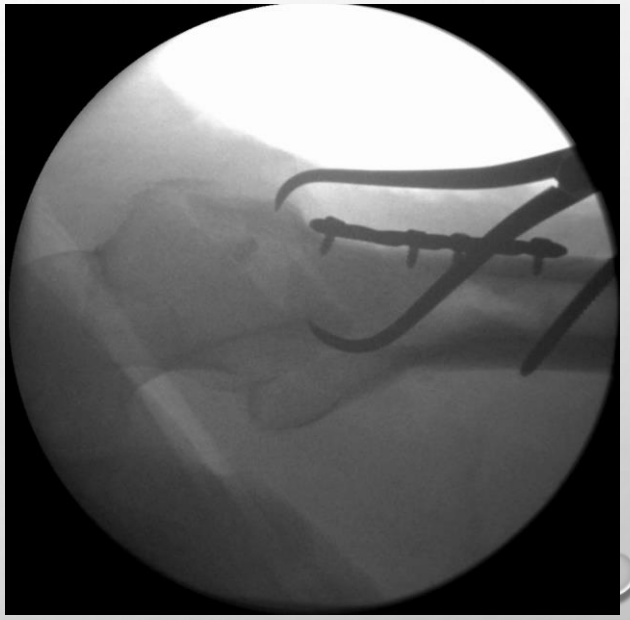




SURGICAL TACTICS: OPEN REDUCTION

- CERCLAGE CABLE
- PLATE ASSISTED REDUCTION

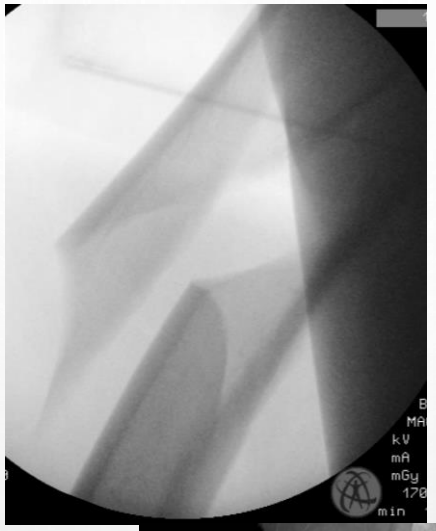




SURGICAL TACTICS: OPEN REDUCTION

OFTEN A PROGRESSIVE REDUCTION

- SCHANZ PIN
- REDUCTION CLAMP
- COLINEAR CLAMP
- REDUCED
  - INTRAMEDULLAR NAIL





OUTCOMES

NAIL TYPE

- NO DATA SHOWING SUPERIORITY OF ONE TYPE OF NAIL OVER THE ANOTHER

  (SUBTROCHANTERIC FRACTURES OF THE FEMUR)

- CONSIDER RECONSTRUCTION STYLE NAIL FOR YOUNG PATIENTS – REMOVE LESS OVERALL BONE FROM THE PROXIMAL FEMUR, WHICH MAY BE BENEFICIAL IF NAIL REMOVAL IS LATER PERFORMED
- CONSIDER CEPHALOMEDULLARY NAIL FOR PROXIMAL EXTENSION OR POOR BONE QUALITY (ABILITY TO “LOCK” LAG SCREW WITH SET SCREW)

OUTCOMES

ATYPICAL FEMUR FRACTURES

- NATURE OF THE AFF LEADS TO LOWER HEALING RATES, AND ABNORMAL LATERAL CORTEX
- ATYPICAL FEMUR FRACTURES ARE INTOLERANT OF VARUS!
  - AS LITTLE AS 5 DEGREES → FAILURE!
    - CHO ET AL, JOT 2017
- BEWARE
  - INTOLERANT TO MALREDUCTION
  - ABNORMAL FEMORAL GEOMETRY
  - CONTRALATERAL FRACTURE
  - PROLONGED HEALING TIME

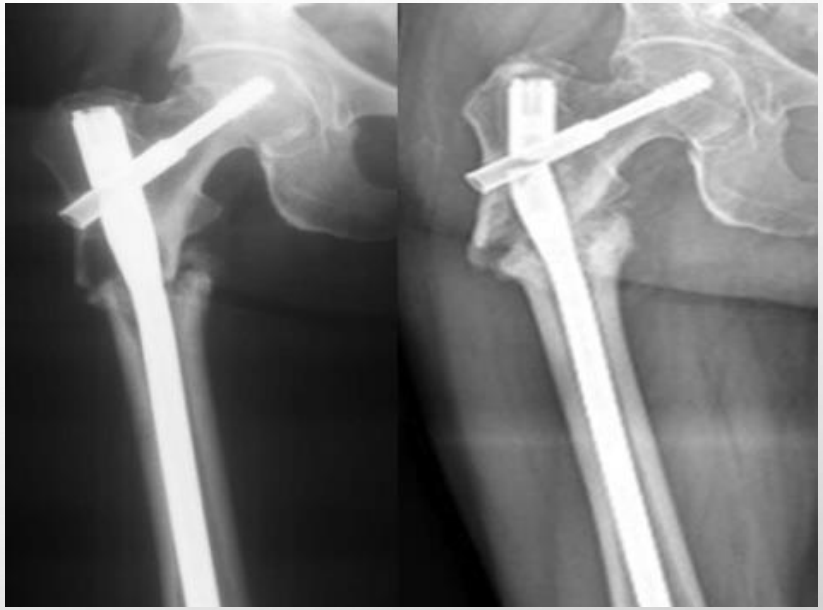


Image: Rollick N et al. *Orthogonal Plating With a 95-Degree Blade Plate for Salvage of Unsuccessful Cephalomedullary Nailing of Atypical Femur Fractures: A Technical Trick*. J Orthop Trauma. 2019;33(6):e246-e250. Figure 1

OUTCOMES

ATYPICAL FEMUR FRACTURES

- ANTICIPATE PROLONGED HEALING TIME
  - 5- 10 MONTHS!
    - BOGDAN Y. ET AL., JOT 2016; 30:177-181
- MEDICAL TREATMENT
  - STOP BISPHOSPHONATES
  - CA AND VIT D SUPPLEMENTATION
  - CONSIDER ANABOLIC AGENTS (EX: TERIPARATIDE, ETC)

SUMMARY

ANATOMY

- MUSCULAR/MECHANICAL FORCES HAVE SIGNIFICANT IMPLICATIONS FOR FRACTURE REDUCTION AND FIXATION

SURGICAL DECISION MAKING

- POSITIONING: LATERAL OR SUPINE
- IMPLANT CHOICE
  - ANTEGRADE INTRAMEDULLARY NAIL MOST COMMONLY
    - CONSIDER NAIL WITH LOCKING OPTION IN GERIATRIC/OSTEOPOROTIC PATIENTS
    - CONSIDER RECON NAIL IN YOUNGER PATIENTS (SMALLER PROXIMAL BODY)
  - BLADE PLATE
  - PROXIMAL FEMORAL LOCKING PLATE