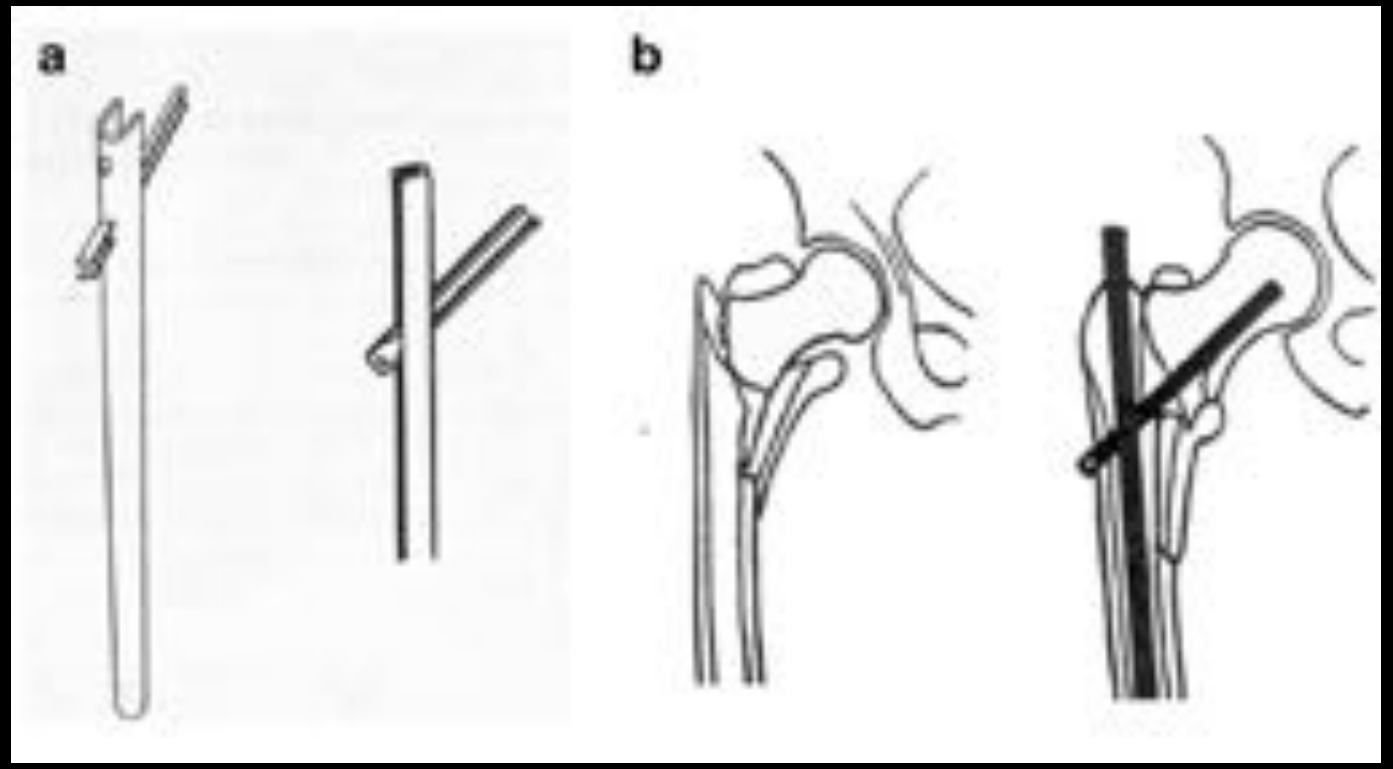
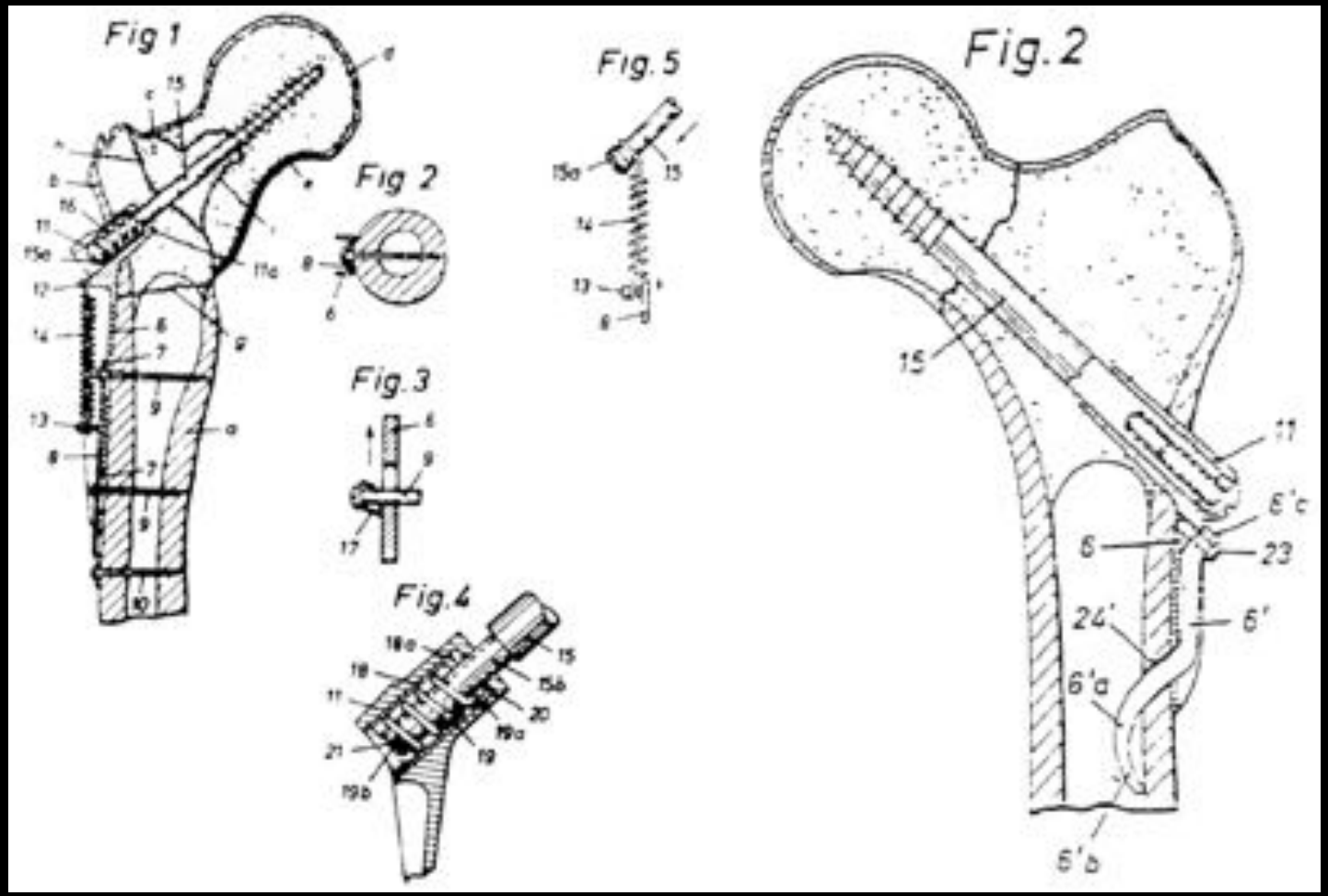
Good evening !!

ERNST POHL (1876-1962)

Y NAIL DESIGN



THE FIRST CLINICALLY SUCCESSFUL SLIDING HIP SCREW WAS PATENTED BY ERNST POHL IN GERMANY IN 1951



INTER TROCHANTERIC FRACTURE

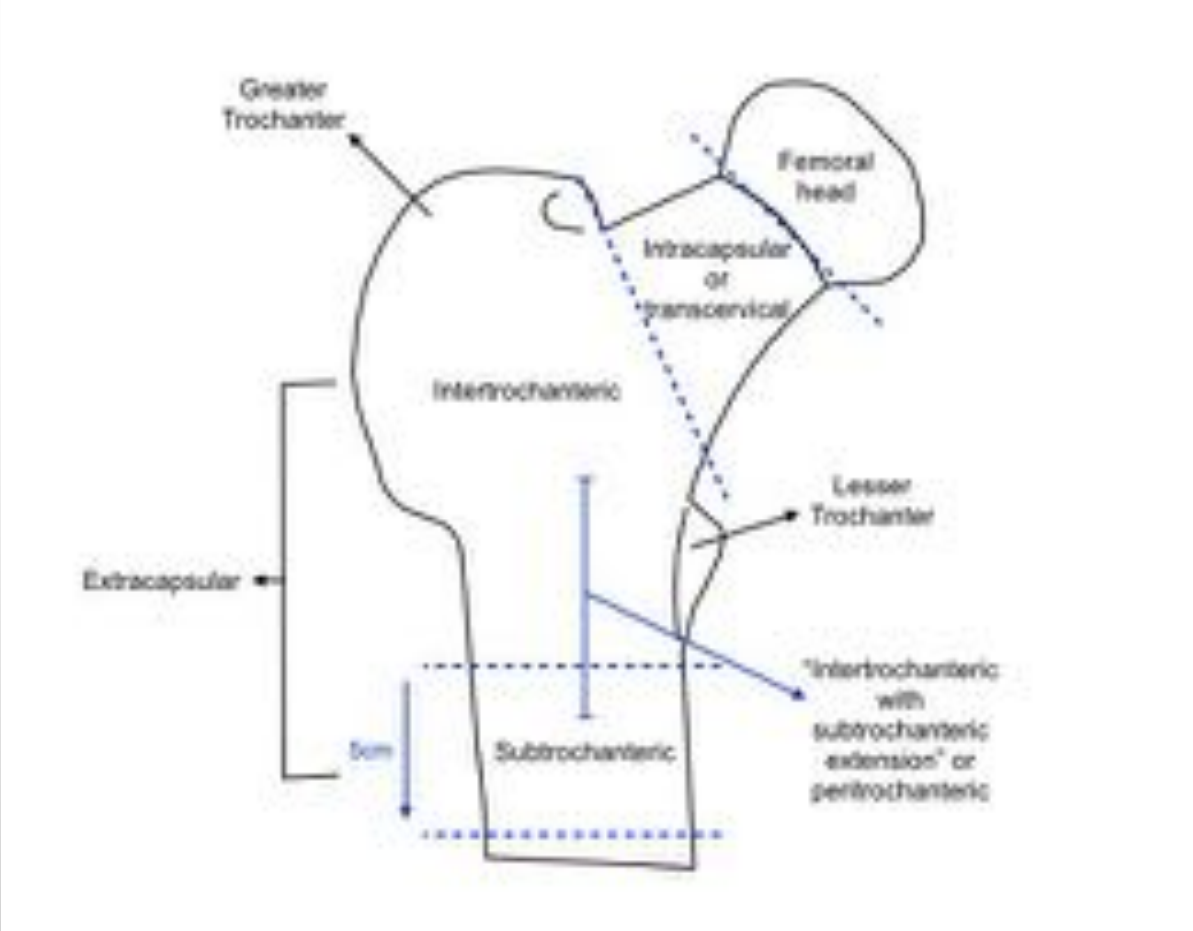
Dr.Daivik T Shetty

Dept. of Orthopedics

Shimoga Institute of Medical Sciences

INTRODUCTION

- Almost half of hip fractures are EXTRACAPSULAR fractures



INTRODUCTION

- **Old age > Young age**
- More common in older, frailer patient with moderate / minimal trauma
- Less in young – Significant trauma
- Increasing aging population – prevalence of osteoporosis continues to rise

- **Women > Men**

3 FACTORS INFLUENCING FRACTURES

- **Influence of fall/trauma**

Increased age, medical illness, medically impaired, abnormal gait, physical disability, undernourished , visual abnormality, stroke, postural imbalance

- **Impairment of protective mechanisms**

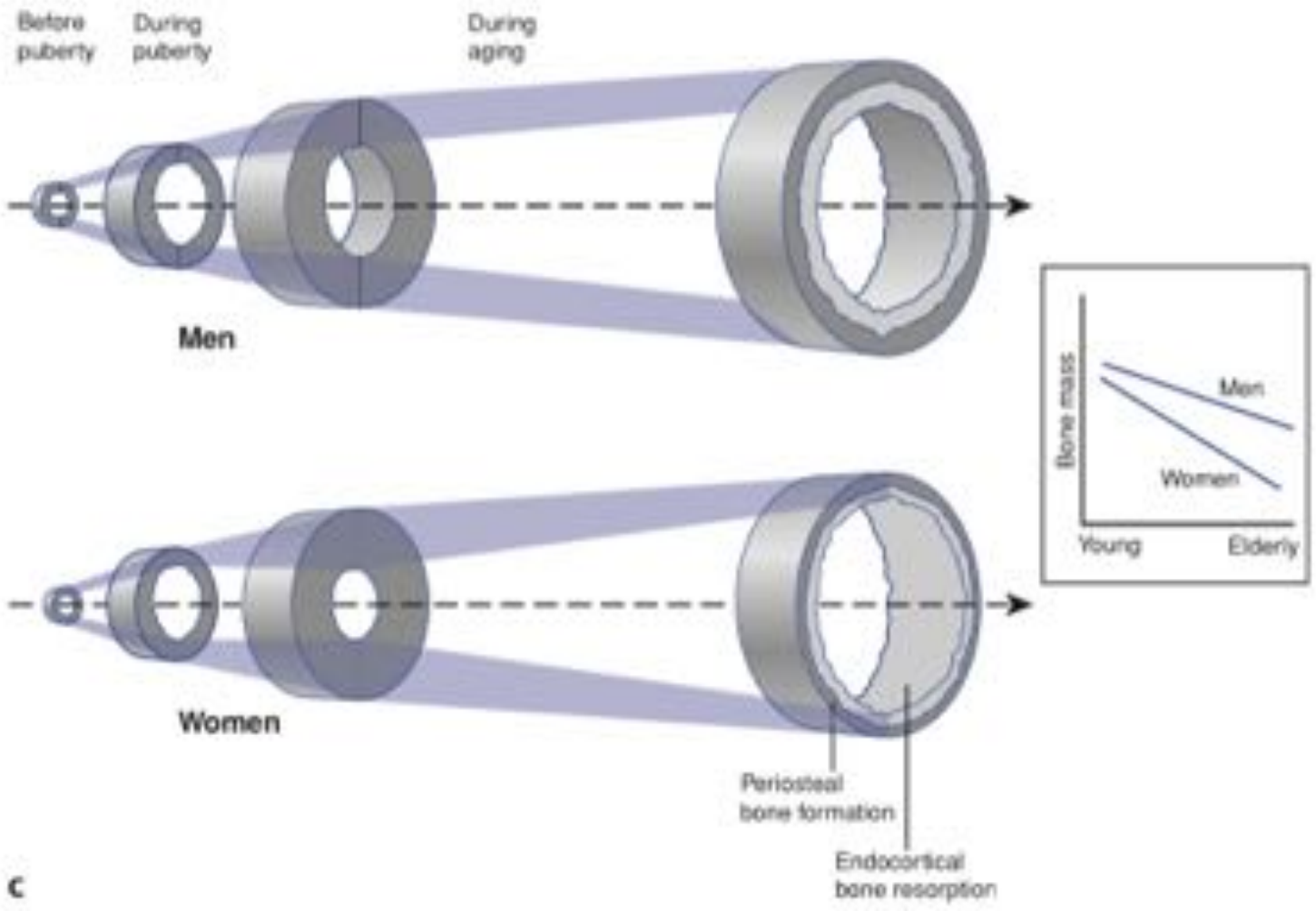
- **Strength of bone – reduced osteoporosis**

Medical comorbidities , alcohol

CUMMING'S FACTOR DETERMINING FRACTURE AT HIP

- **The faller must be oriented to fall or 'impact' near the hip**
- **Local soft tissue absorb less energy than necessary – INADEQUATE SOFT TISSUE COVERAGE**
- **Protective responses inadequate**
- **Residual energy of the fall applied to proximal femur must exceed its strength (bone strength at the hip must be insufficient)**

EFFECT OF AGING ON PROXIMAL FEMUR

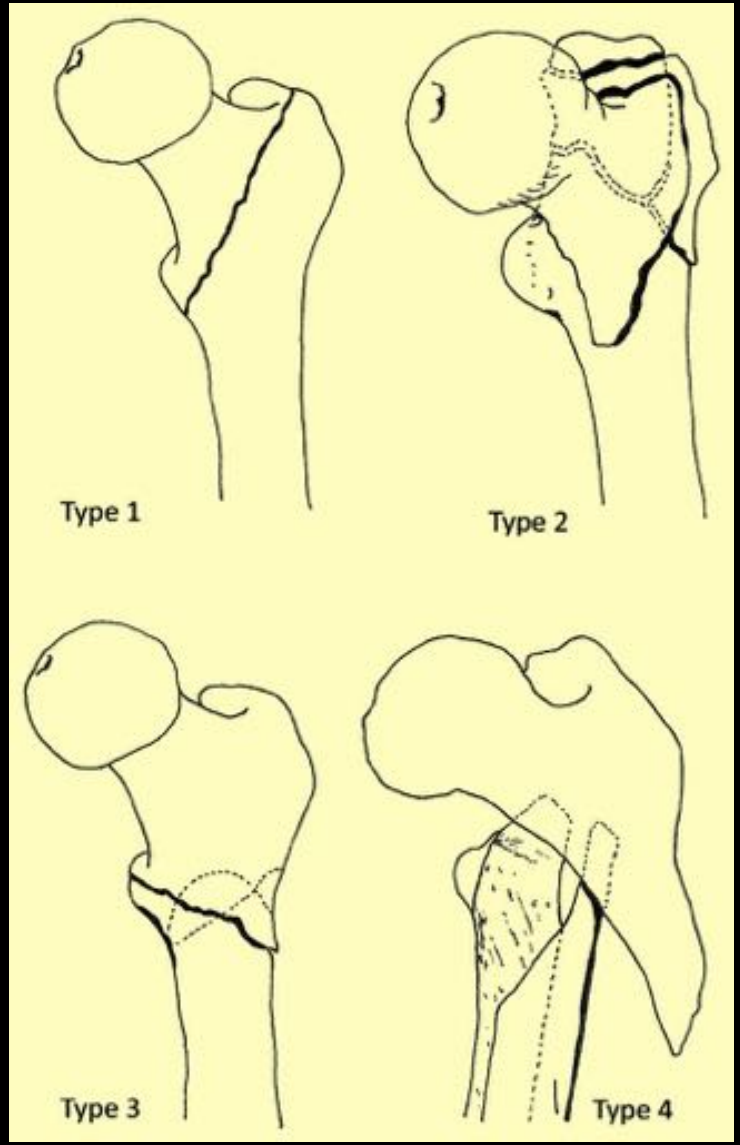


CLASSIFICATION

- AO Classification
- Boyd & Griffin classification
- Evan's description

BOYD & GRIFFIN CLASSIFICATION

TYPE 1	STABLE, TWO PART
TYPE 2	UNSTABLE,COMMINUTED
TYPE 3	UNSTABLE,REVERSE OBLIQUE
TYPE 4	INTERTROCHANTERIC & SUBTROCHANTERIC WITH 2 PLANE OF FRACTURE



EVANS DESCRIPTION

1960, DESCRIPTIVE STUDY – 110 patients

TYPE 1

STABLE – 72%

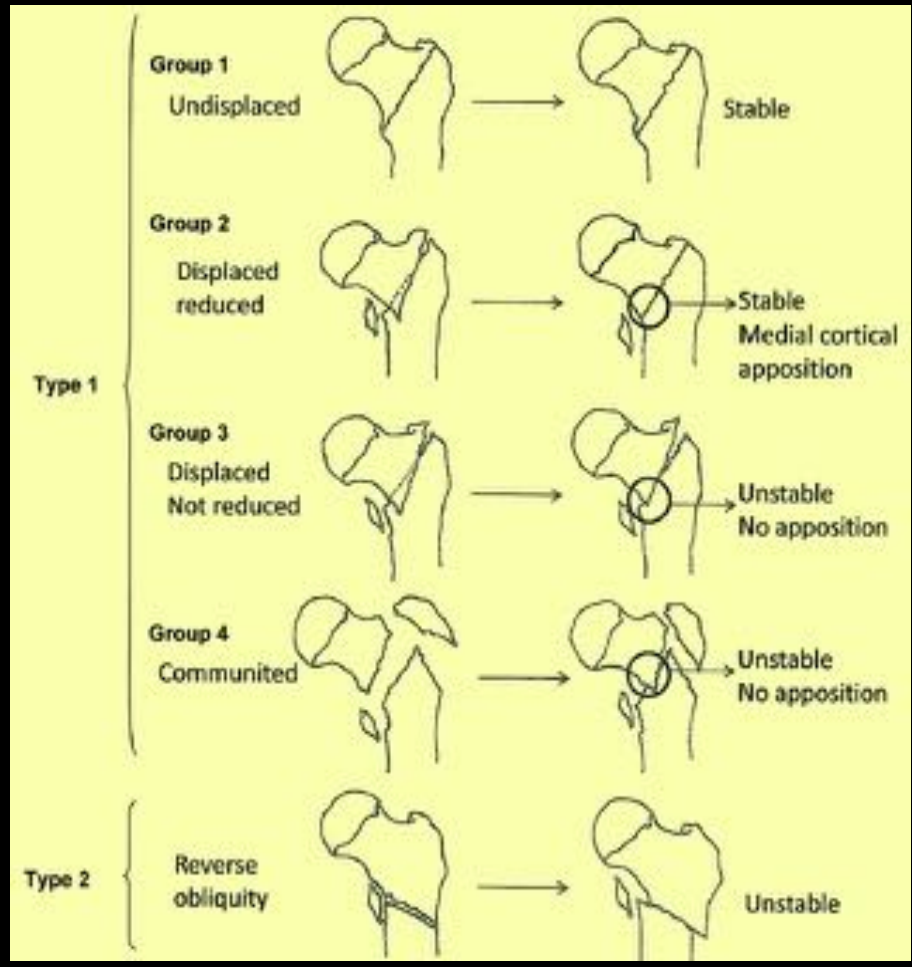
- UNDISPLACED – 65%
- DISPLACED BUT CAN BE REDUCED – 7%

UNSTABLE – 28%

- DISPLACED BUT NOT REDUCED – 14%
- COMMINUTED- 6%

TYPE 2

- REVERSE OBLIQUITY- 8%



JENSEN MODIFICATION

TYPE 1	UNDISPLACED
TYPE 2	DISPLACED
TYPE 3	TWO FRACTURE LINES INVOLVING GT
TYPE 4	TWO FRACTURE LINES INVOLVING LT
TYPE 5	COMMINUTED WITH BOTH GT, LT SEPARATED
TYPE R	REVERSE OBLIQUE

AO CLASSIFICATION (OLD)

- 3- FEMUR : 1- PROXIMAL : A- TROCHANTER

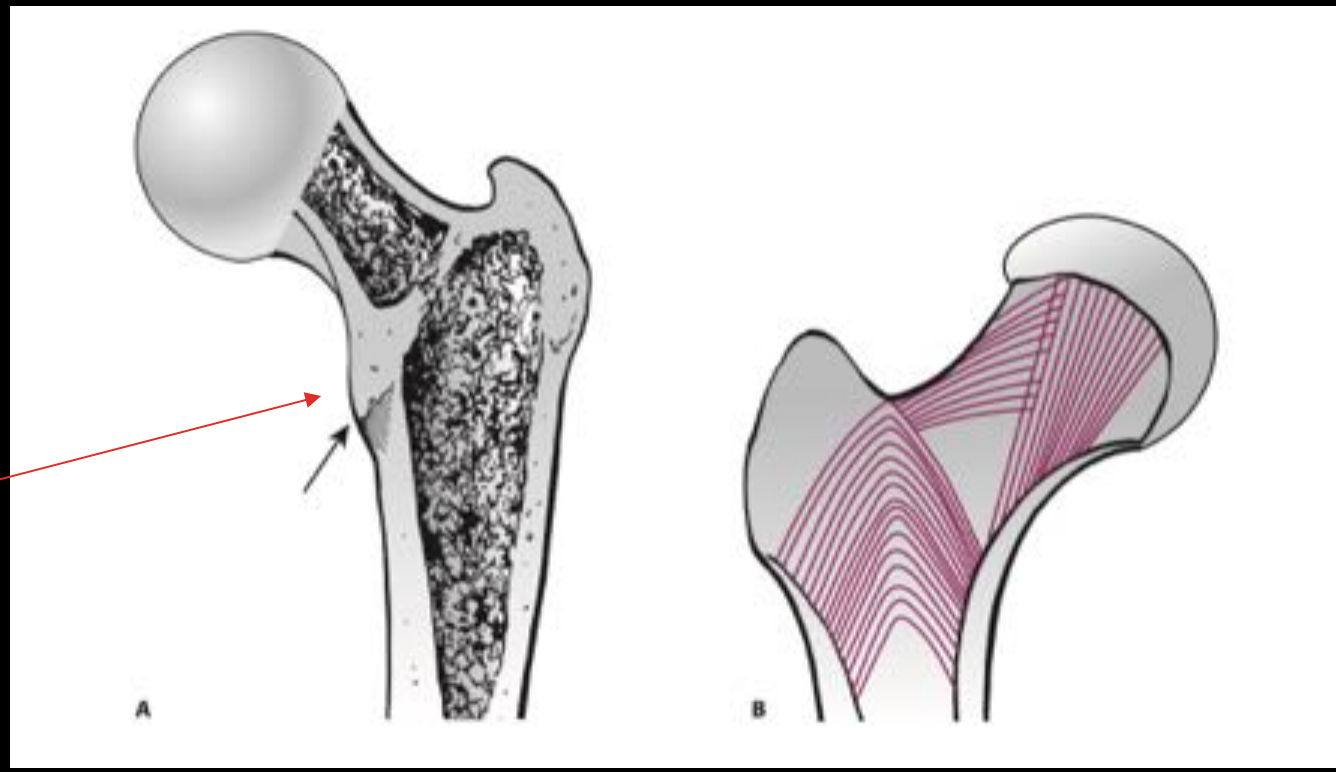
FRACTURES NOT CLASSIFIED BY A.O

- Pathological fracture from Primary, Secondary bone tumor
- Presence of sub trochanteric extension
- Loss of lateral cortical support
- Medialization of femur
- Severe angulation or displacement of fracture on lateral radiograph

PATHOANATOMY

Trochanteric region has a variable combination of cortical and cancellous bone

THE STRONG PLATE OF BONE POSTEROMEDIALLY IS NAMED **CALCAR FEMORALE/ ADAM'S ARC**

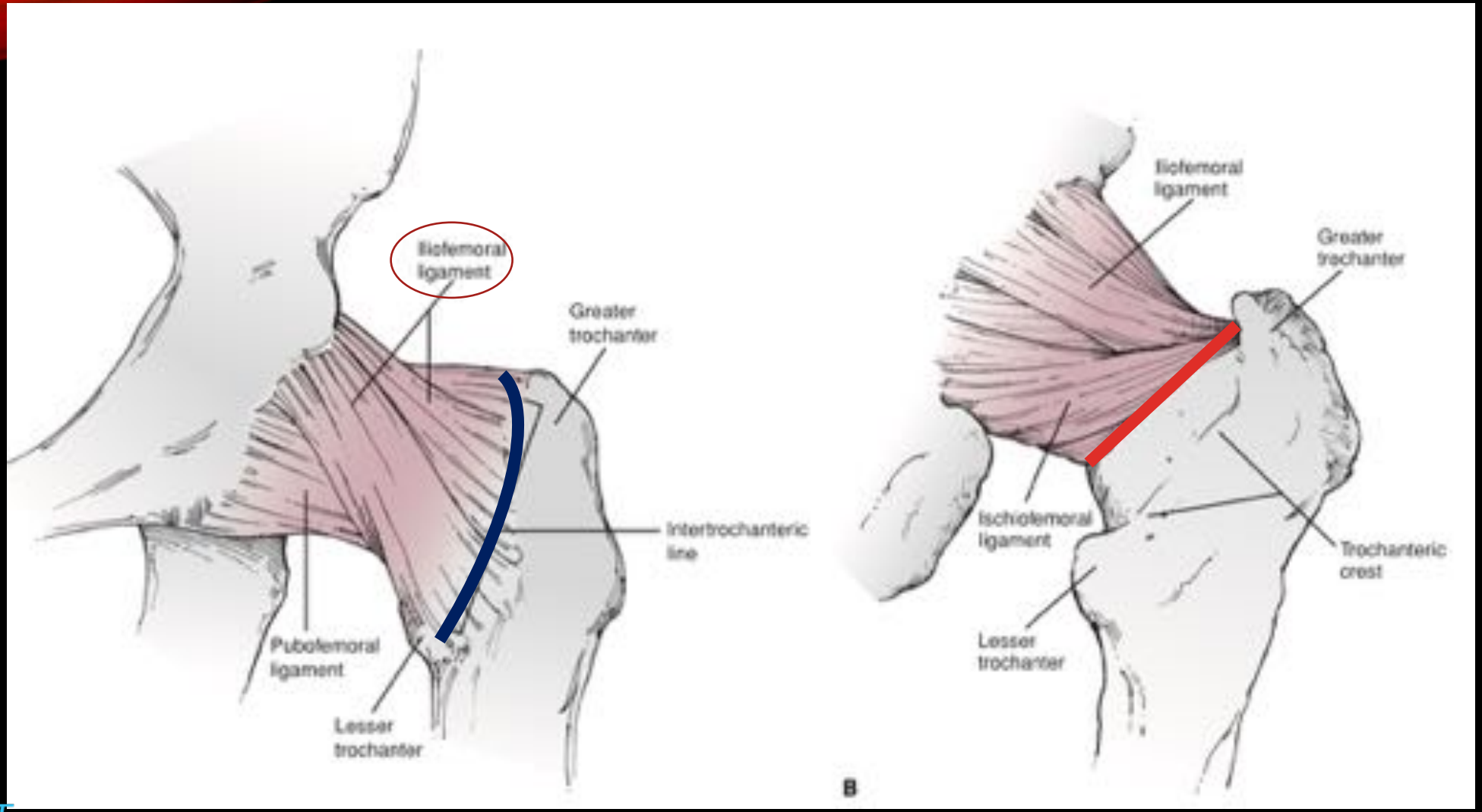


STRUCTURAL ATTACHMENT TO PROXIMAL FEMUR

- HIP CAPSULE
- MUSCULOTENDINOUS

MUSCULOTENDINOUS

- To greater trochanter – GLUTEUS MEDIUS, GLUTEUS MINIMUS
- To lesser trochanter – ILIOPSOAS
- Medial aspect of greater trochanter posteriorly – SHORT EXTERNAL ROTATORS
- Lateral femur distal to GT – VASTUS LATERALIS



DEFORMING FORCES IN INTERTROCHANTERIC FRACTURE

Gluteus medius , short external rotators ABDUCTED, EXTERNALLY ROTATED, PROXIMALLY MIGRATED

Iliopsoas displaces Lesser trochanter medially, proximally

PROXIMAL FRAGMENT FLEXION

Adductors and hamstring displace the shaft POSTERIORLY , MEDIALLY PROXIMALLY MIGRATED

MANAGEMENT – CONSERVATIVE

- Considered in elderly , non ambulatory or bedbound – IMMOBILIZATION & TRACTION

- Complications

❑Longer hospital stay
❑Complications of recumbency

ISOLATED FRACTURE OF LESSER AND GREATER TROCHANTER

ISOLATED GT

Conservative
Analgesia
Mobilization as soon as able

ISOLATED LT

Conservative

If secondary to tumor, Internal fixation advised

CHOICE OF IMPLANT

JEWETT NAIL - 1930

1950 - PUGH AND BADGLEY SLIDING NAIL

CHOICE OF IMPLANTS

- 1962- MOSSIE – MODIFIED SLIDING DEVICE TO ALLOW COLLAPSE AND IMPACTION OF FRAGMENTS

- 1966- KUNTSCHER
- 1970- ENDERS

} Condylo-cephalic intramedullary nail

- 1984- RUSSELL TAYLOR – IM nail for Per trochanteric and sub trochanteric fracture

- 1992 – Halder & Williams – GAMMA NAIL

GAMMA NAIL

FIXED NAIL PLATE

- Applying a plate in lateral side of femur attached to a cross screw of pin passed up the femoral neck

- IMPLANTS

Jewett nail

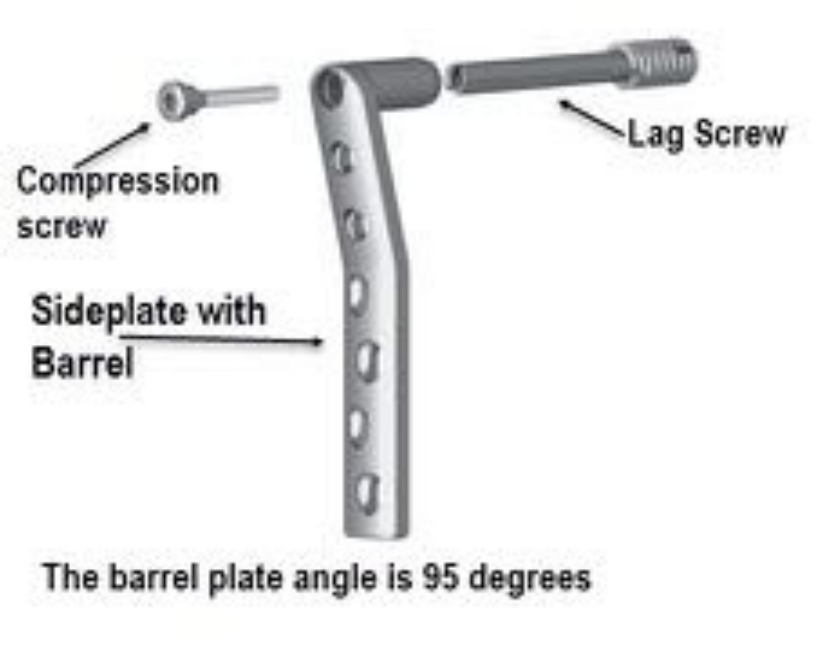
McLaughlin plate

Problem

Penetration of cross screws into the hip as fracture collapses

ANGLE BLADE PLATE

- Device in which insertion is below the tip of the trochanter
- Goes into the inferior part near the calcar region
- Angled 95 degree or 120 degree

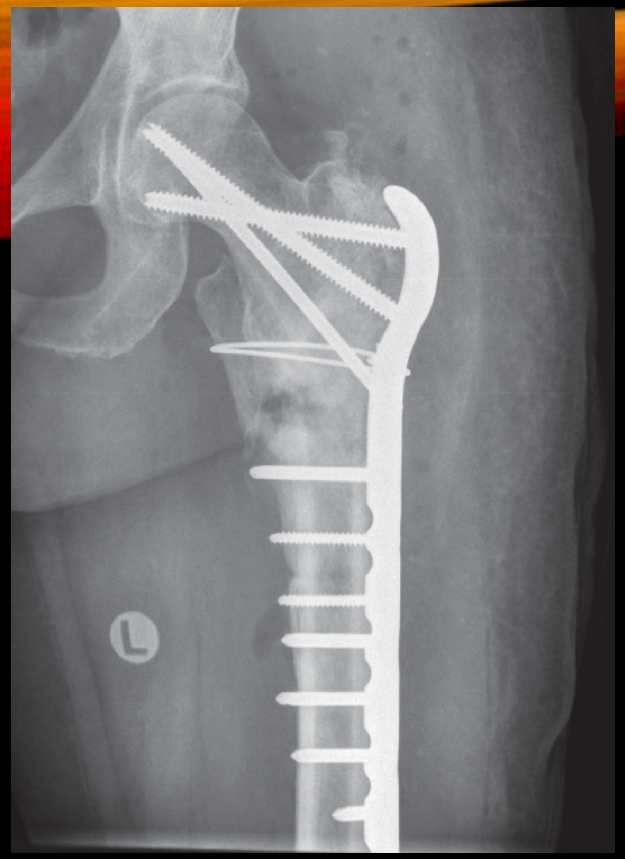


DYNAMIC CONDYLAR SCREW WITH SIDE PLATE

Screw goes from tip of GT to calcar region

PROBLEM

- Rigid fixation for fracture , no opportunity for any controlled collapse to occur at fracture site
- High rate of complications hence not used for primary treatment



PROXIMAL FEMUR LOCKING PLATE

Surface implant

Locked screws placed within proximal femur at varying angles

ANGLE STABLE FIXATION

Resultant fixation is static with no opportunity for collapse to occur at fracture site

YOUNGER PATIENTS WITH COMPLEX FRACTURES AND GOOD BONE STOCK IN WHICH ANATOMIC RECONSTRUCTION OF PROXIMAL FEMUR IS DESIRABLE

SLIDING HIP SCREWS

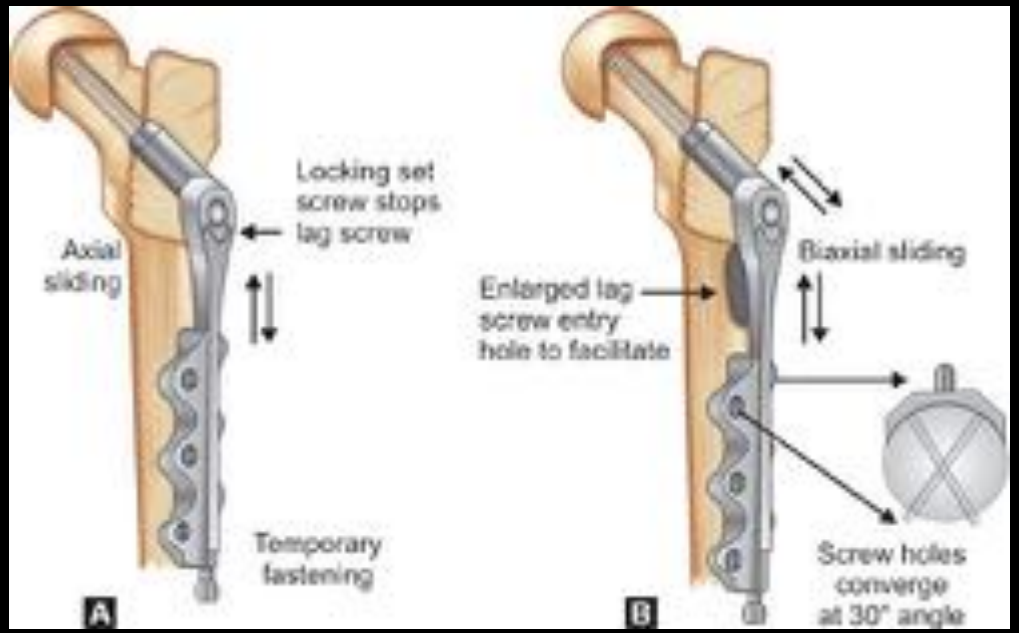
1. DYNAMIC HIP SCREW
2. COMPRESSION HIP SCREW
3. AMBI HIP SCREW

MEDOFF PLATE

All other plates provide dynamic compression only along the axis of the femoral neck

MEDOFF PLATE provides dynamic compression along the Femoral shaft as well

"***BIAXIAL DYNAMIZATION***"



Standard lag screw

Another sliding component TO IMPACT PARALLEL TO LONGITUDNAL AXIS OF FEMUR

USED IN REVERSE OBLIQUE FRACTURE A3 TYPE

LATERAL STABILIZATION PLATE

- Another modification with sliding hip screw is SIDE PLATE CLIPS
- Used to reconstruct the greater trochanter and provide support for lateral femoral wall disrupted cases
- RESISTS MEDIALIZATION

CEPHALOMEDULLARY (INTRAMEDULLARY NAILS)

- Previously GAMMA NAILS
- Now PROXIMAL FEMORAL NAIL is gold standard

EXTERNAL FIXATOR

Pin 1 & 2
CANCELLOUS BONE PIN

Pin 3 & 4
CORTICAL BONE PIN

ARTHROPLASTY

- HEMIARTHROPLASTY
- TOTAL HIP REPLACEMENT

- Used in trochanteric hip fractures with symptomatic arthritis of hip

➢Long stem implant used
➢Supplementary cerclage wiring of femur

WHAT IMPLANT TO USE ??

PFN

EX FIX

DCS

DHS

TSP

JEWETT

MEDOFF

FBP

LOCKING PLATE

GAMMA

HEMI ARTHROPLASTY

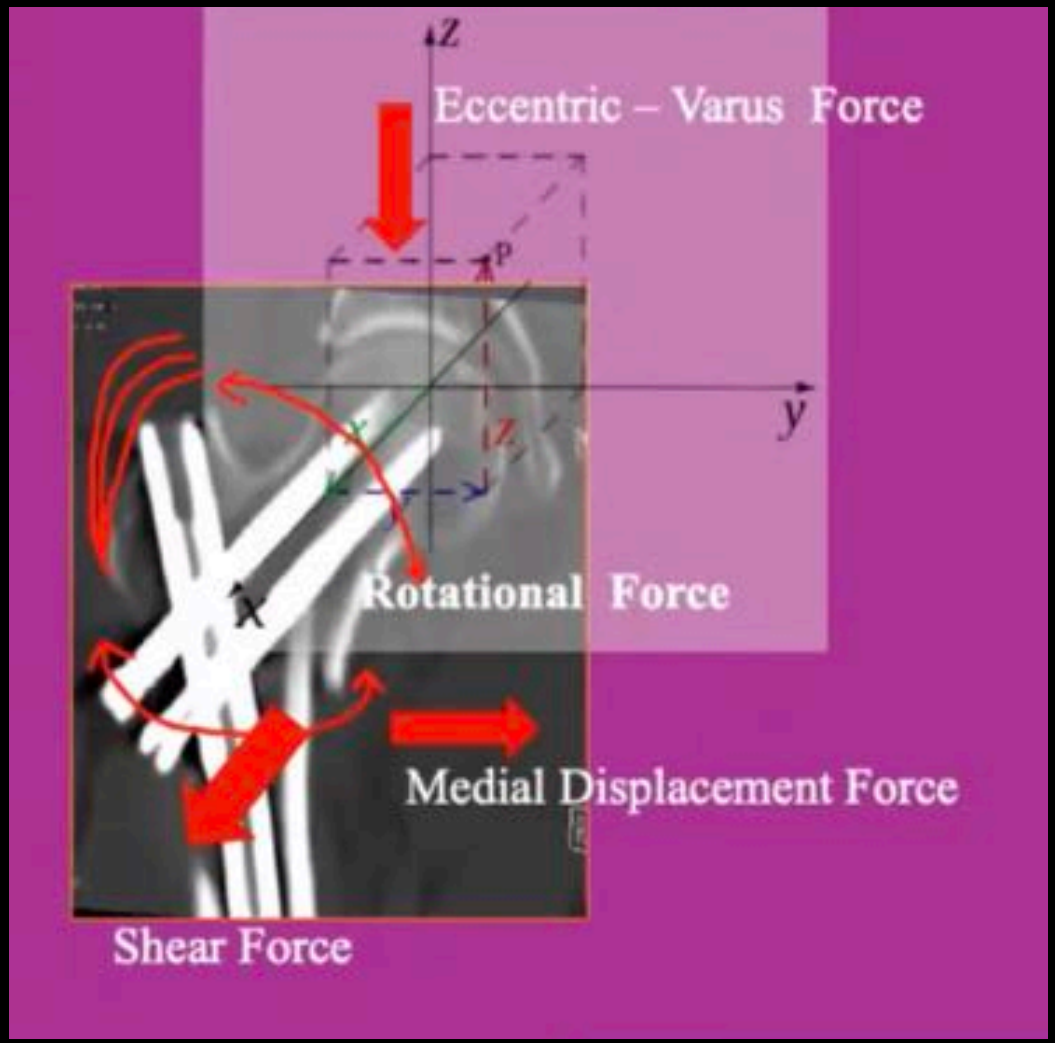
FIXED NAIL PLATE

THR

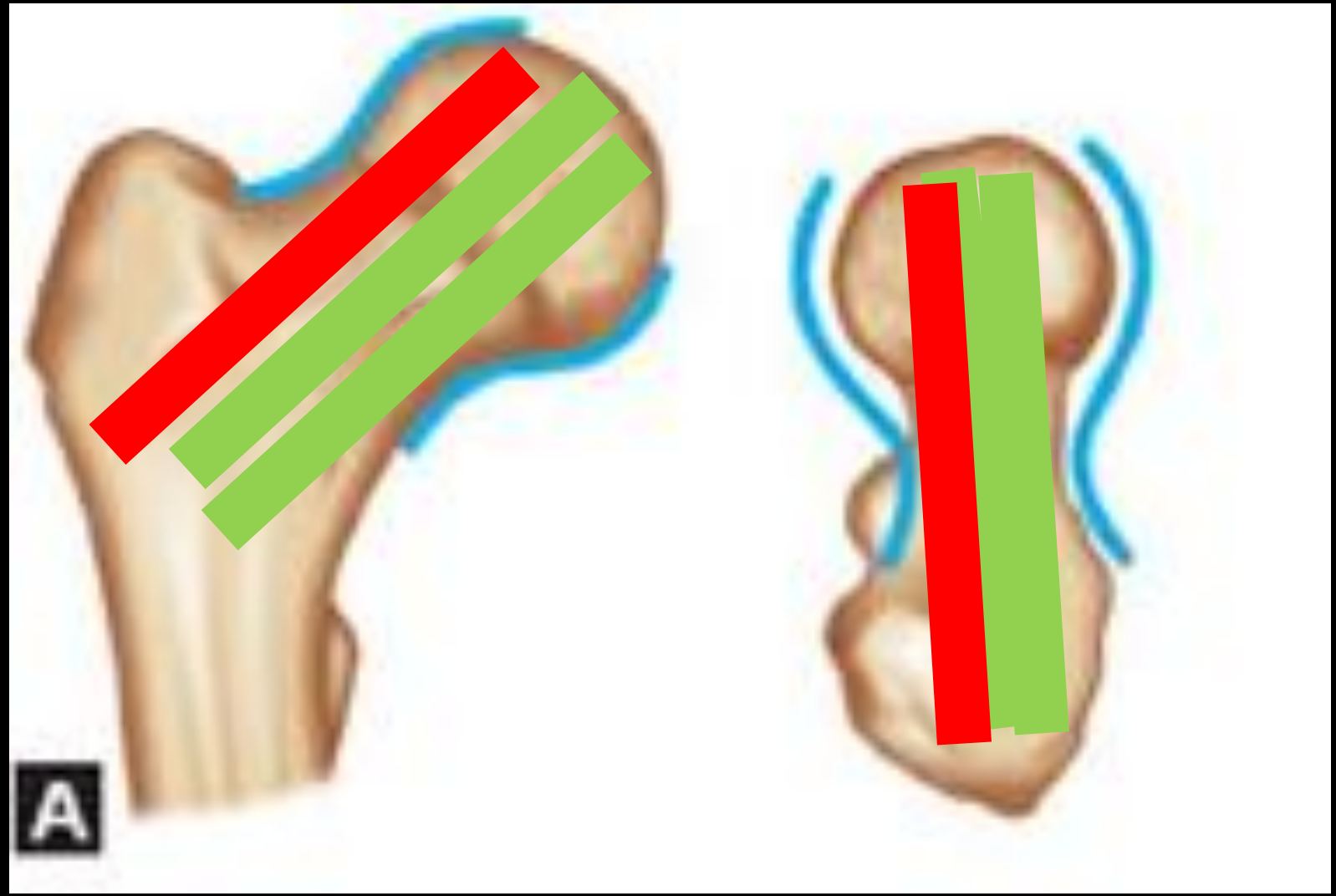
TRACTION

DHS + TSP

FORCES ACTING AFTER FIXATION



POSITIONING OF LAG SCREW



ANGLE OF SIDE PLATE

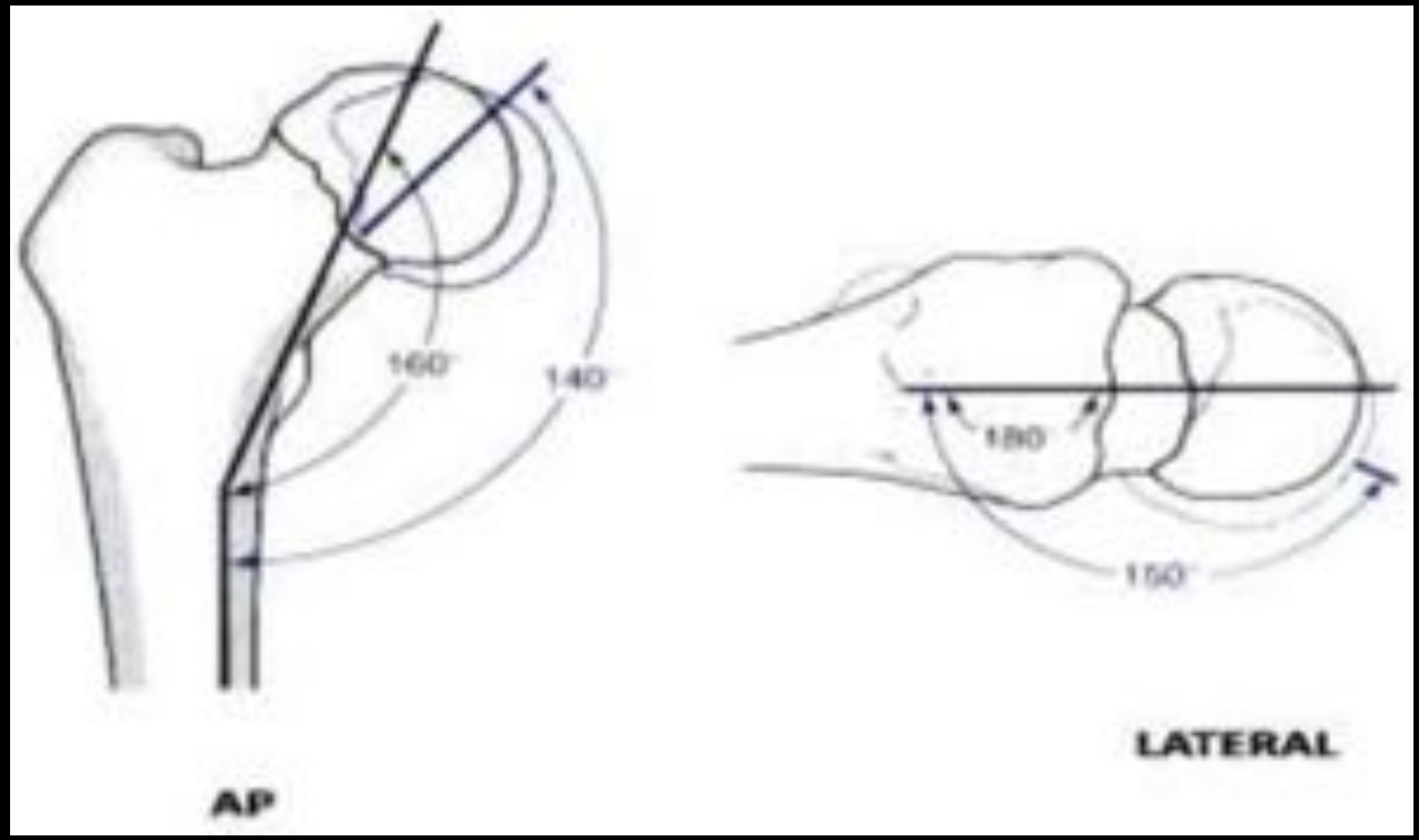
- In patients with normal neck shaft angle , 130-135 degree angled side plate is optimal

- If lower angle is used , higher risk of SCREW JAMMING

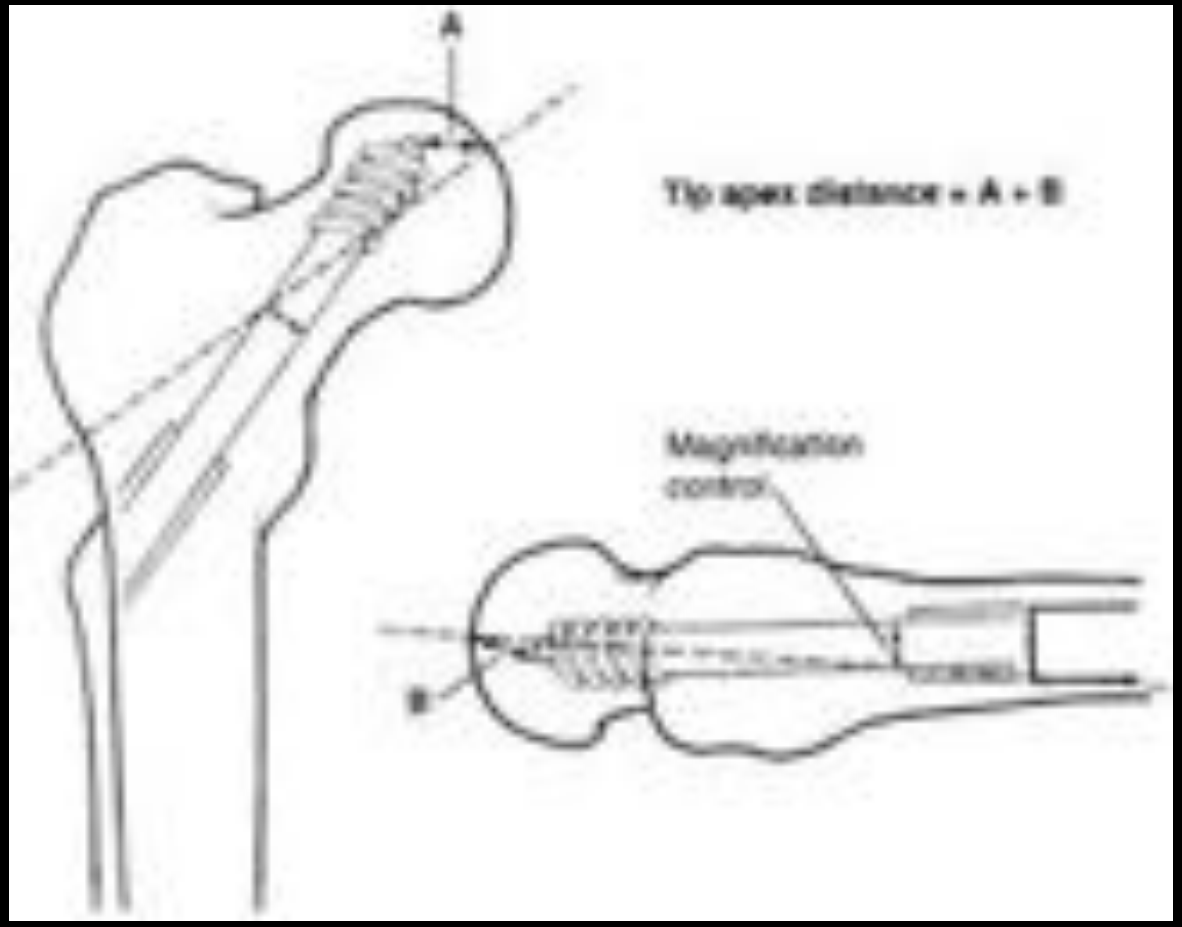
Becomes a STATIC IMPLANT

- If higher angles, Increased risk of cutout

ASSESS FRACTURE REDUCTION- GARDEN ALIGNMENT INDEX

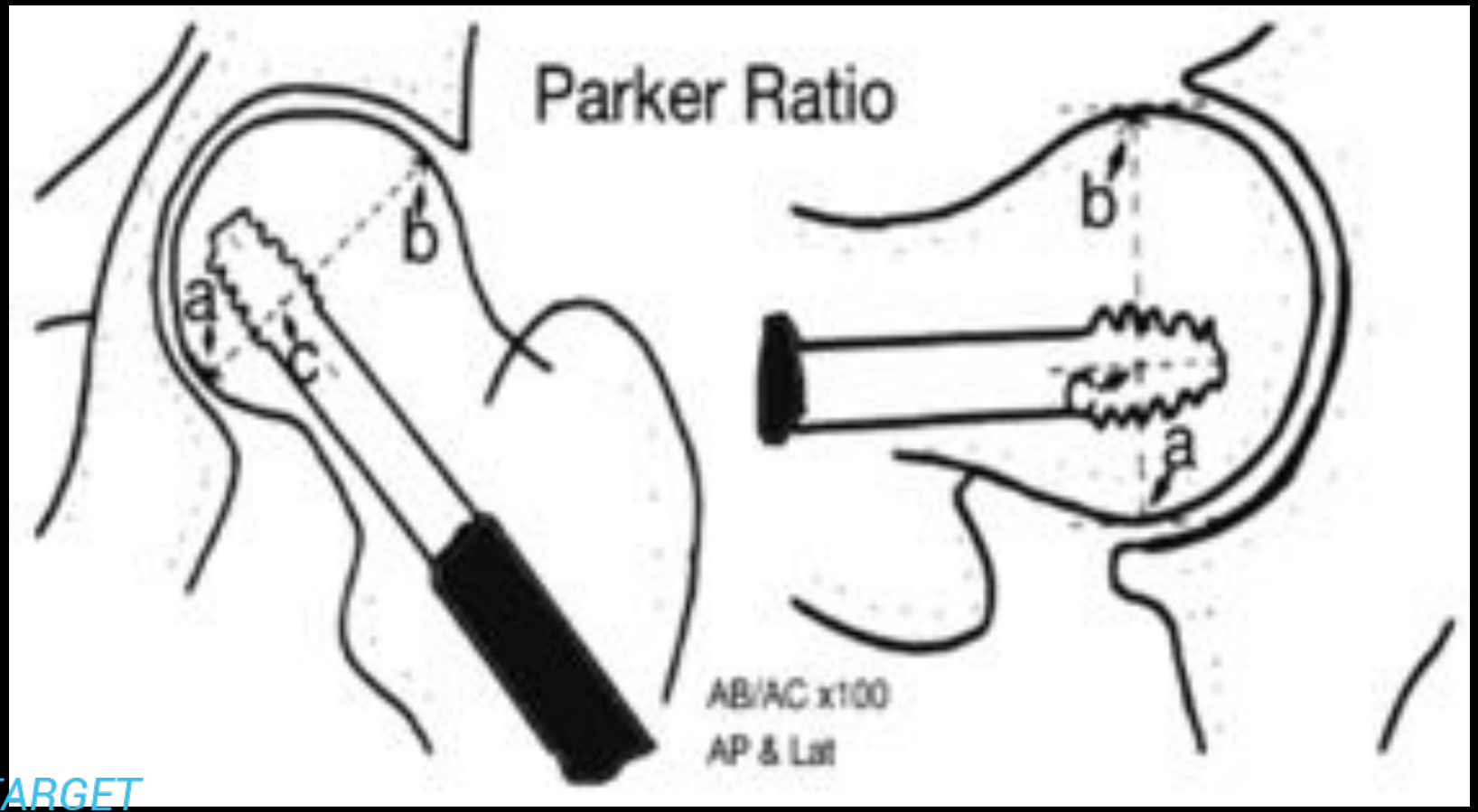


TIP APEX DISTANCE



TAD
< 25 MM

PARKER RATIO METHOD



A- Inferior and posterior Border of femoral head

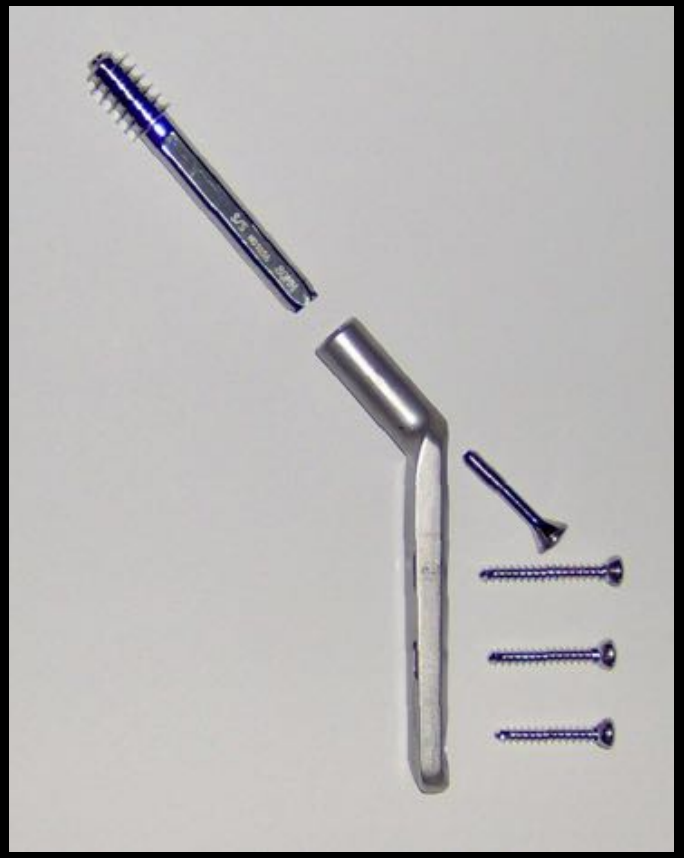
B- Mid point of lag screw

C- Superior and anterior Border of femoral head

IN AP, 0 – Inferior screw Placement
100 – Superior placement

IN LATERAL, 0 – Posterior
100 – Anterior

DYNAMIC HIP SCREW



Principle

- Controlled collapse
- Dynamic action reduces incidence of screw cut out and penetration of screw into hip joint

RICHARD SCREW

RICHARD SCREW PARTS	DIMENSIONS
THREAD DIAMETER	14MM
CORE DIAMETER	8MM
PITCH	3MM
THREAD LENGTH	22MM

SHORT BARREL VS LONG BARREL

- SIDE PLATE → LONG BARREL 38mm
  → SHORT BARREL 25mm

BARREL LENGTH – 38MM
THREAD LENGTH – 22MM
COLLAPSE – 25MM

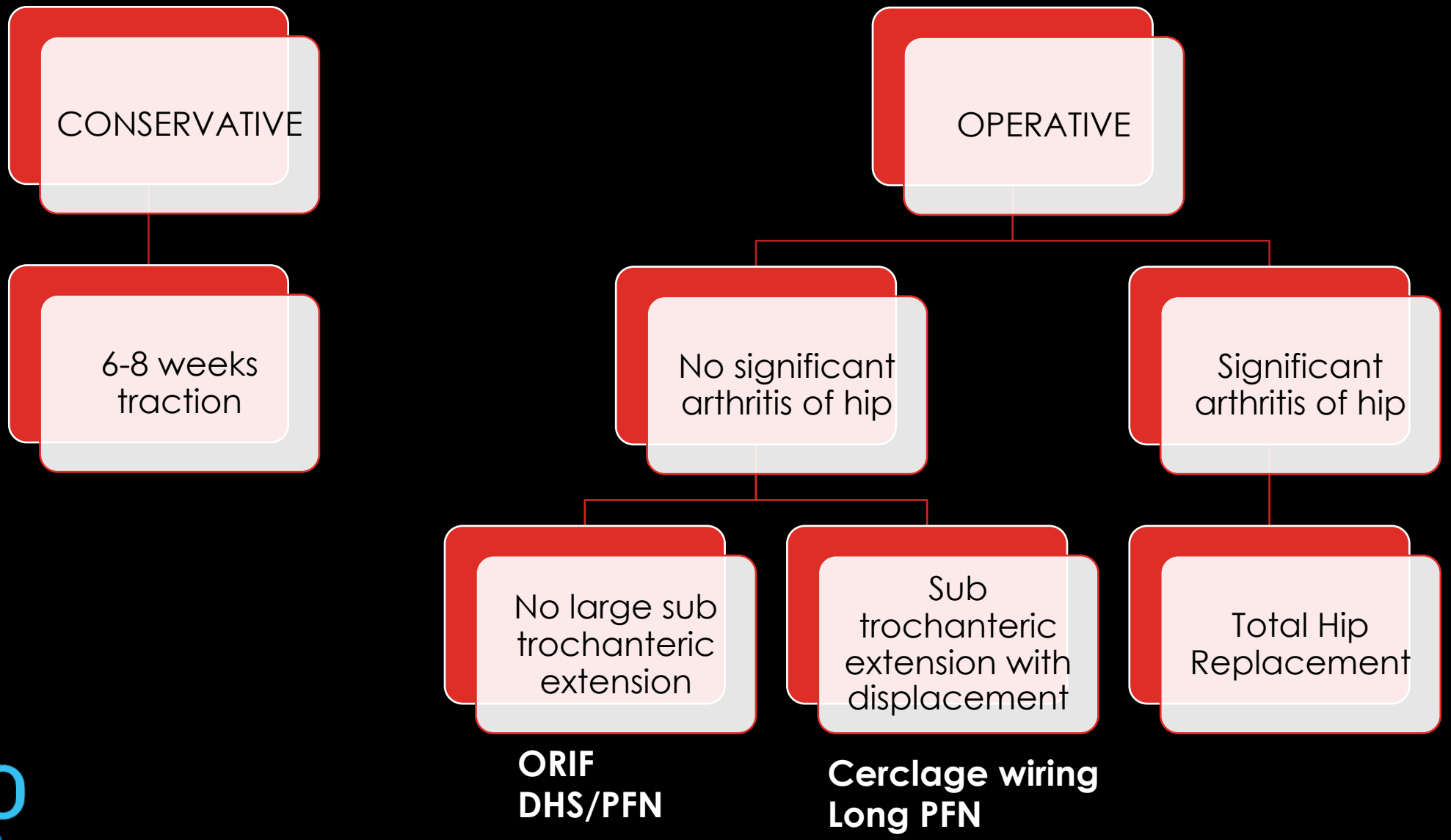
IF LAG SCREW > 85MM
LONG BARREL

IF LAG SCREW < 85MM
SHORT BARREL

IF THERE IS LOSS OF LATERAL SUPPORT

1. TROCHANTERIC STABILIZING PLATE IS USED
2. SHORT BARREL PLATE USED
3. 5 HOLE PLATE PREFERRED

TROCHANTERIC HIP FRACTURES



PFN OR DHS ???

FACTORS IN DECISION MAKING

- Fracture pattern
- Patient profile

X-RAY EVALUATION

Comminution

Instability
- Postero-medial
- Lateral wall
- Greater trochanter

FRACTURE PATTERN

- **FRACTURE GEOMETRY**

➢STABLE VS UNSTABLE

Stability-

The ability of fracture to support physiological loading

Not just number of fragments, but fracture plane as well

E.g.- Reverse oblique

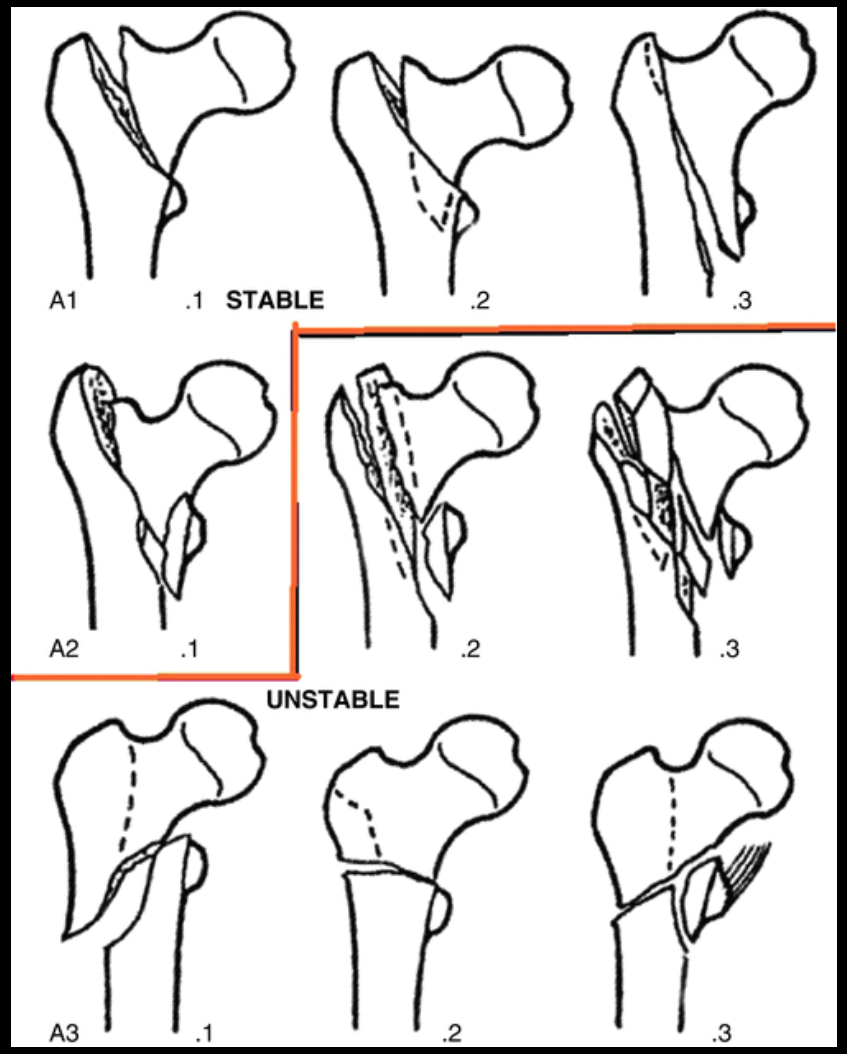
- **FRACTURE EXTENT**

➢LATERAL WALL

➢POSTEROMEDIAL COMMUNITION

➢EXTENDING SUBTROCHANTERIC

BASED ON STABILITY



CHOICE OF IMPLANT

- BY AAOS

❖FOR UNSTABLE FRACTURES – Moderate evidence suggests use of **PFN**

❖FOR REVERSE OBLIQUE FRACTURES – Strong evidence suggests use of **PFN**

BASED ON OLD A.O CLASSIFICATION

REVISITING THE A.O CLASSIFICATION

- **Previous classification addressed**

❑Postero-medial comminution

❑Reverse oblique pattern

❑Sub trochanteric extension

- **Did not address**

❑Lateral wall integrity

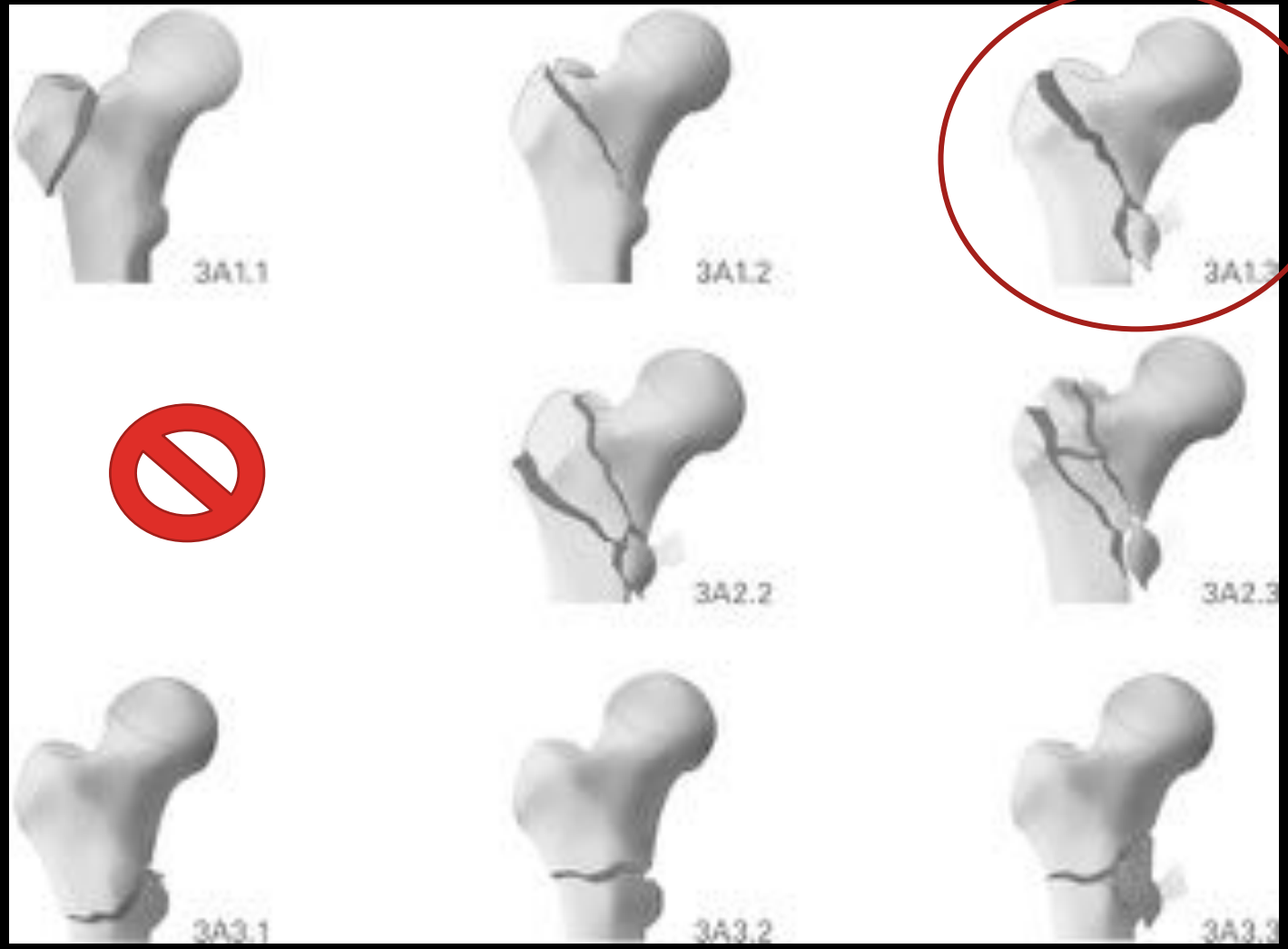
❑Coronal integrity

NEW AO CLASSIFICATION - 2018

Simple
Per trochanteric fracture

Multifragmentary
Per trochanteric Fracture
Lateral wall incompetent <20.5mm

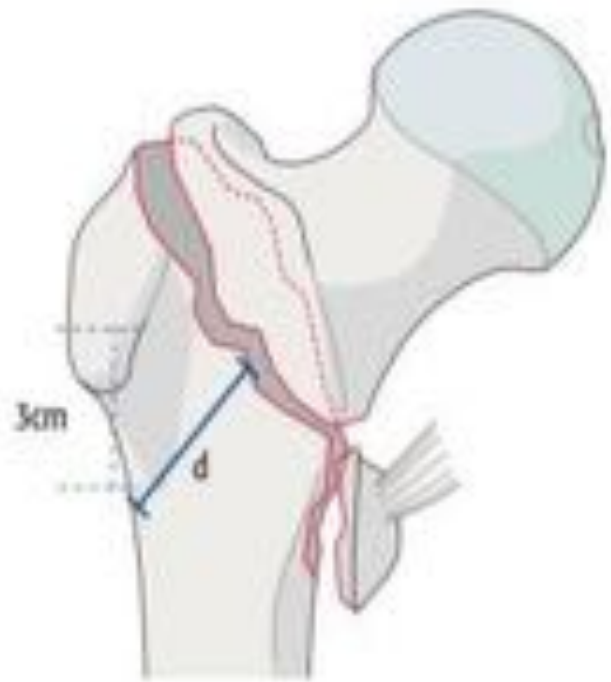
Reverse oblique



Lateral wall intact
> 20.5mm

CONCEPT OF LATERAL WALL

CONCEPT OF LATERAL WALL



- Lateral wall thickness is defined as distance in millimeters (mm) from a reference point 3 cm below innominate tubercle of GT angled 135° upwards to the fracture line in the midpoint between the two cortex point on AP traction x-rays in neutral rotation
- The thickness must be less than 20.5 mm for the fracture to be A2

AO

D = < 20.5

↓

Lateral wall insufficiency

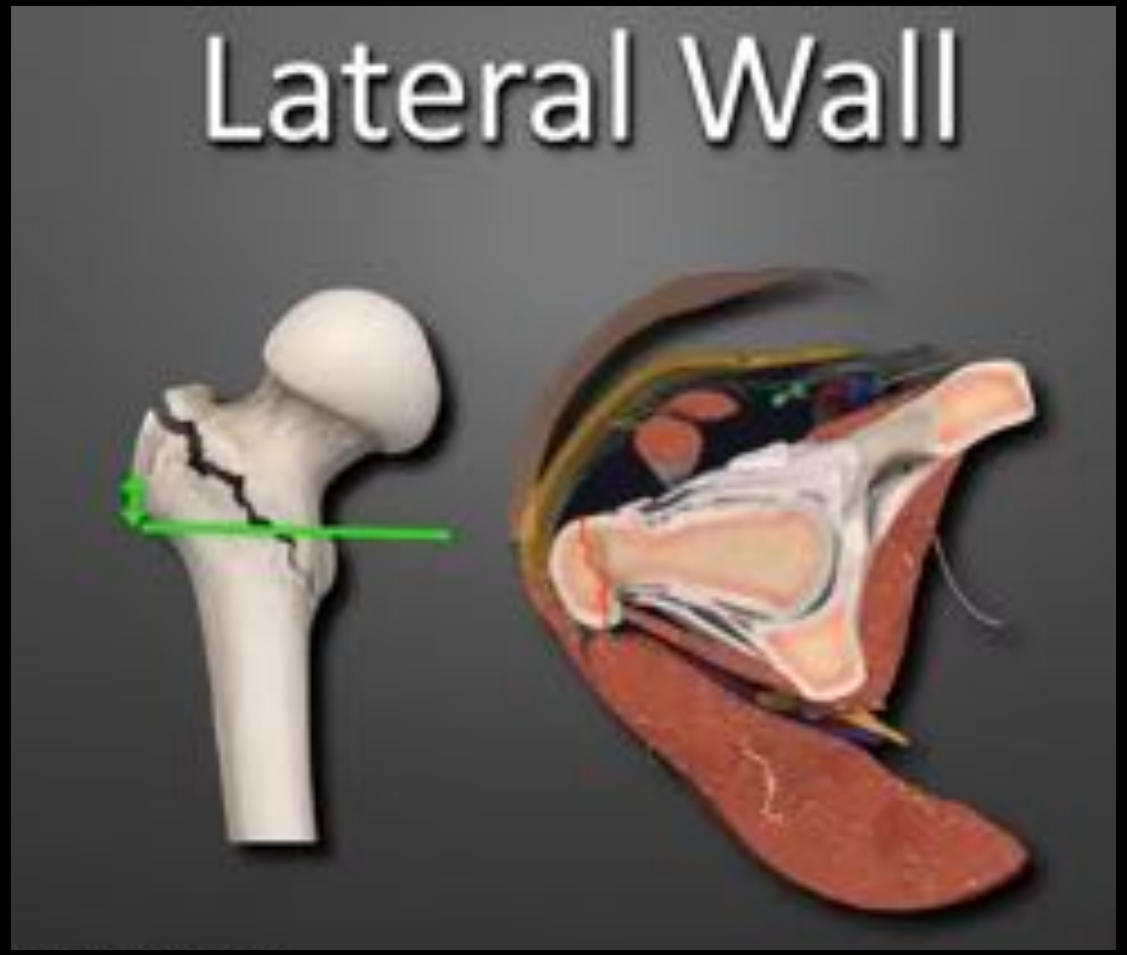
↓

UNSTABLE A2

STABLE FRACTURE – DHS
UNSTABLE FRACTURE – PFN

LATERAL WALL IN X-RAY ?

USE OF C.T



CT SCAN IN IT FRACTURES

Planning

Planning --

- CT with 3D an 2 d is must
- Reduction Tools
- All hidden instabilities are seen so that planning is easy

PFN VS DHS

Prevents medialisation-Shaft

Review of Literature - Biomechanical Observations

Fracture Geometry and Forces

Reverse Oblique and Transverse

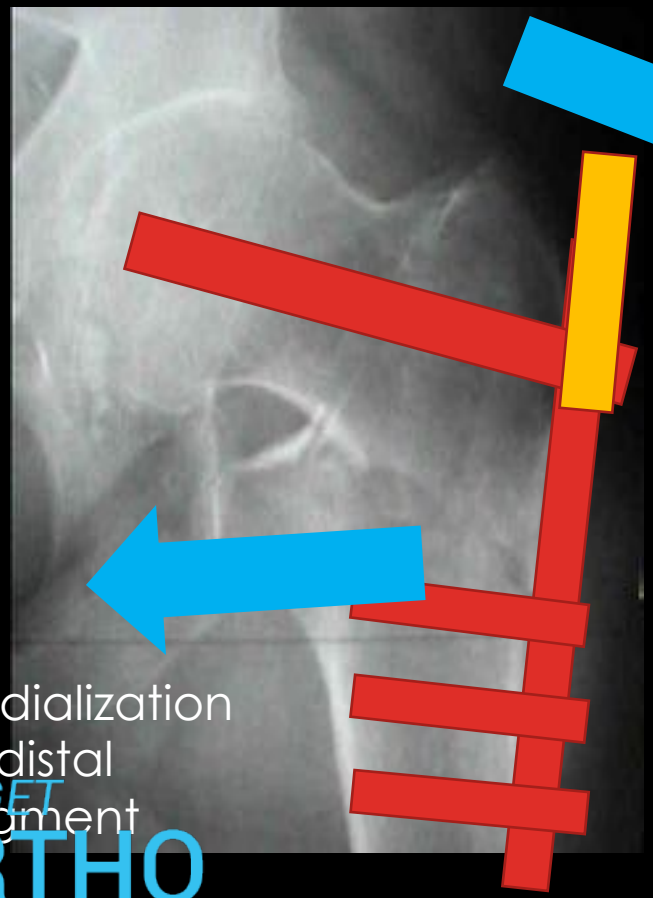
Medial Displacement - Shear Force is very high

Intra medullary implants are better than Extra medullary implant

Treatment of Reverse Oblique and Transverse Intertrochanteric Fractures with Use of an Intramedullary nail or a 95° Screw-Plate. A PROSPECTIVE, RANDOMIZED STUDY
CHRISTOPHE SADOWSKI, MD, ANNE LÜBBEKE, MD, MARC SAUDAN, MD, NICO RIAND, MD, RICHARD STERN, MD, AND PIERRE HOFFMEYER, MD

PFN VS DHS

REVERSE OBLIQUE FRACTURE



Shearing force
Proximal fragment to collapse

Medialization
Of distal
fragment

SOLUTION

PFN
DHS + TSP

ANGLE BLADE PLATE

LATERAL WALL FRACTURE

Lateral wall acts as a buttress
If lateral wall is fractured the buttress support is lost
Leading to instability
IMPLANT FAILURE
NONUNION

SOLUTION
DHS + TSP
ANGLE BLADE PLATE
PFN

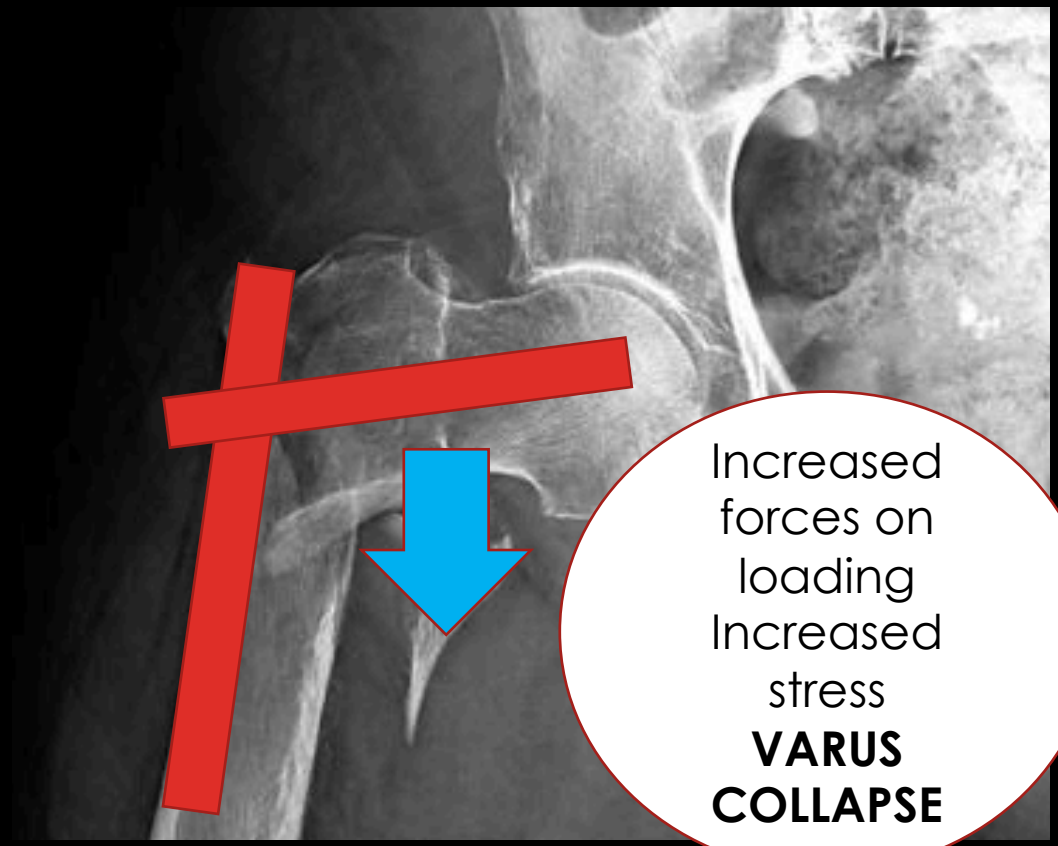
POSTEROMEDIAL COMMINUTION

- Considered unstable fracture
- Uncontrolled collapse post fixation
- Poor outcome

SOLUTION –

OSTEOTOMY
- VALGUS OSTEOTOMY
- DIMON HUGHSTON MEDIAL DISPLACEMENT

CEPHALOMEDULLARY NAIL



PATIENT PROFILE

- ANATOMIC PROFILE

Canal diameter

Neck shaft angle

- PHYSIOLOGICAL PROFILE

Comorbidities

Ambulatory status

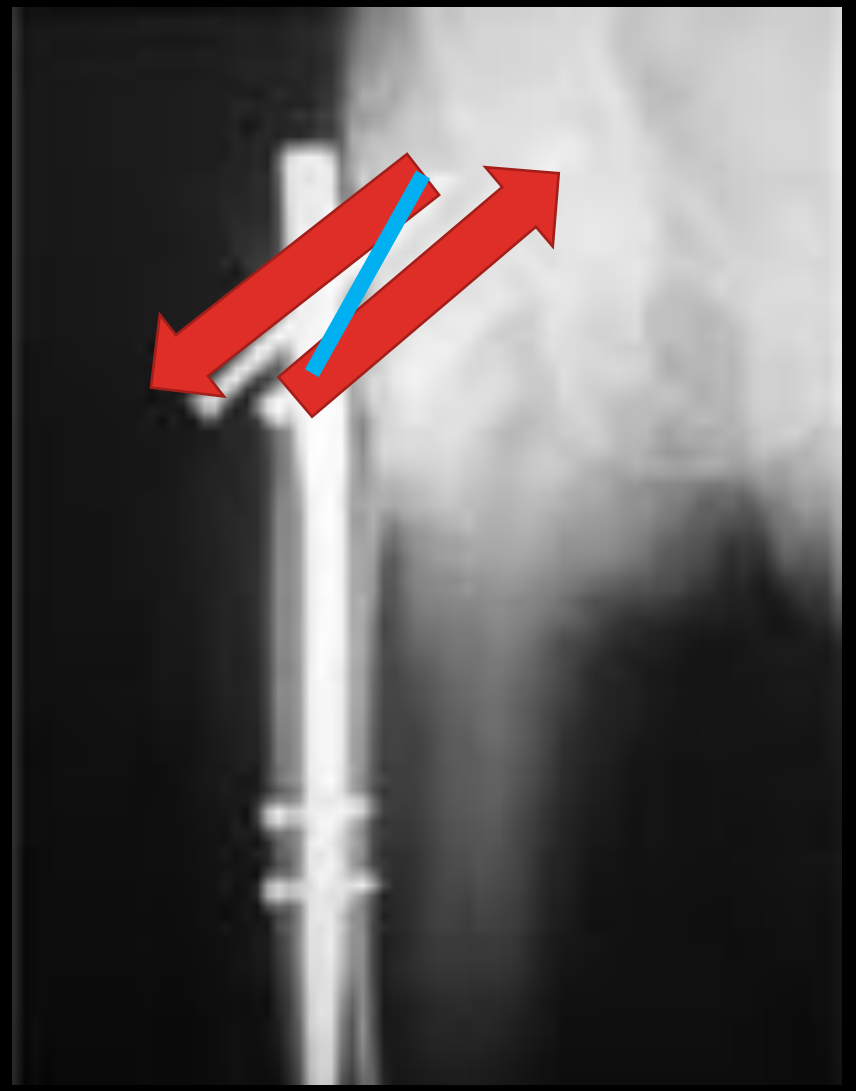
E.g. – Narrow canal – Excessive reaming- THERMAL NECROSIS
Hence use – PROXIMAL FEMUR LOCKING PLATE

Z EFFECT AND REVERSE Z EFFECT

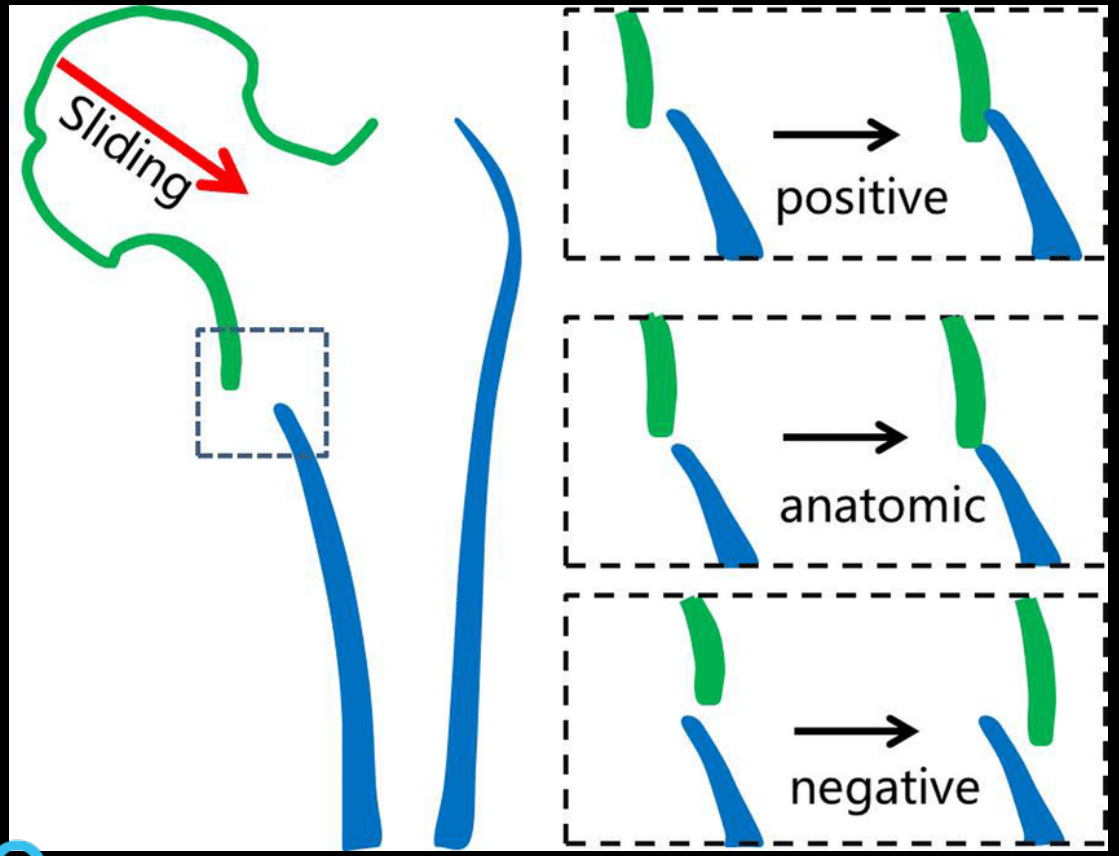
- Seen in two screw Cephalomedullary nail fixation

Mainly seen in

- POSTEROMEDIAL COMMUNITION
- VARUS ANGULATION



ANTEROMEDIAL BEAK THEORY



Calcar outside the shaft

Calcar at level of shaft

Calcar inside the shaft

Excessive collapse

DECISION MAKING

Stable , Young patient

DHS/ABP

Narrow canal

Proximal Femur LCP

Any fracture elderly

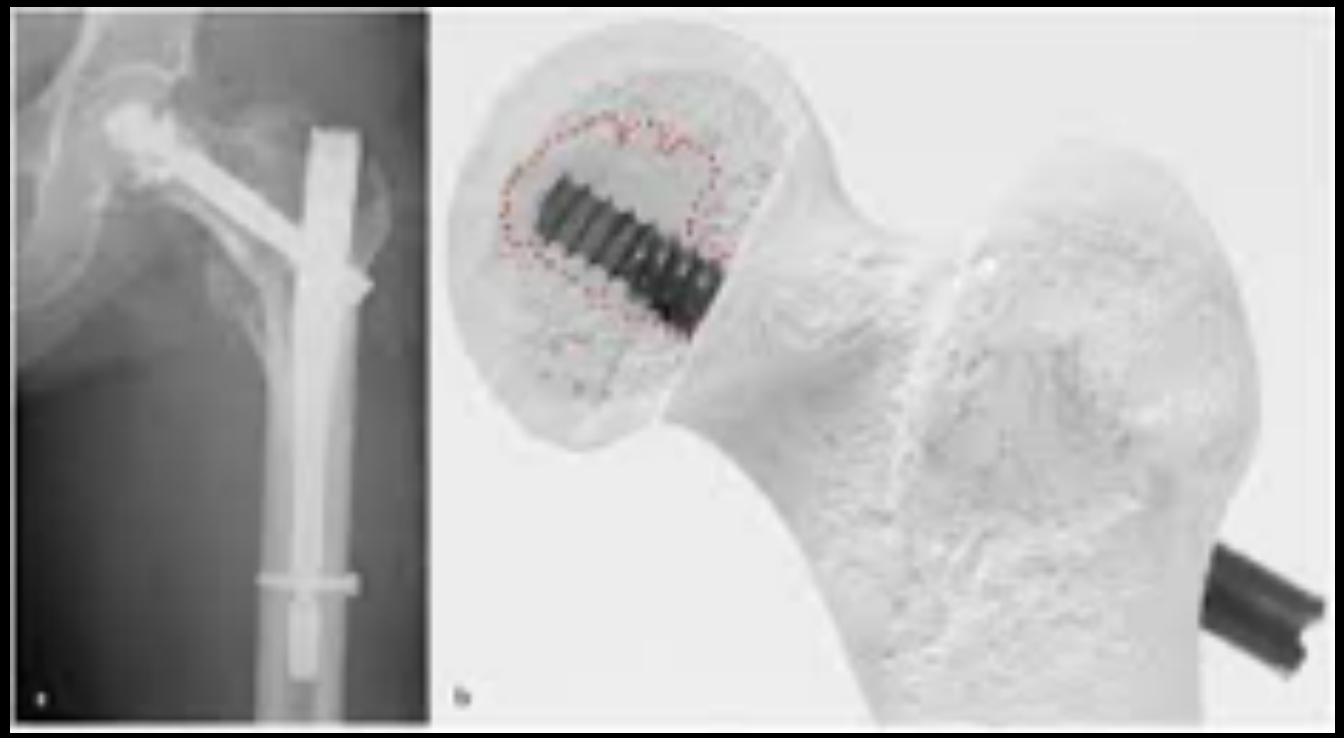
Arthroplasty

All others

PFN

ALWAYS ACCOUNT FOR OSTEOPOROSIS

SOLUTION – CEMENT AUGMENTED PFN



Cement leaks through the
Fenestrations in the periphery of the screw

THANK YOU !!