OSTEONECROSIS (AVN) OF FEMORAL HEAD

CHANDLER'S DISEASE

- Hippocrates: Concept of bone death in living person
- Haenish (1925) and Freund (1926): Coined and described Idiopathic AVN
- Jaffe and Pomerads (1934): Pathological changes
- James Russel (1974): First book on Osteonecrosis

Q. 35 years asthmatic male (on steroids) with right sided hip pain since 2 months. X ray done. Has signs of AVN.

Treatment plan?

A. Core decompression

B. Core decompression with fibular grafting

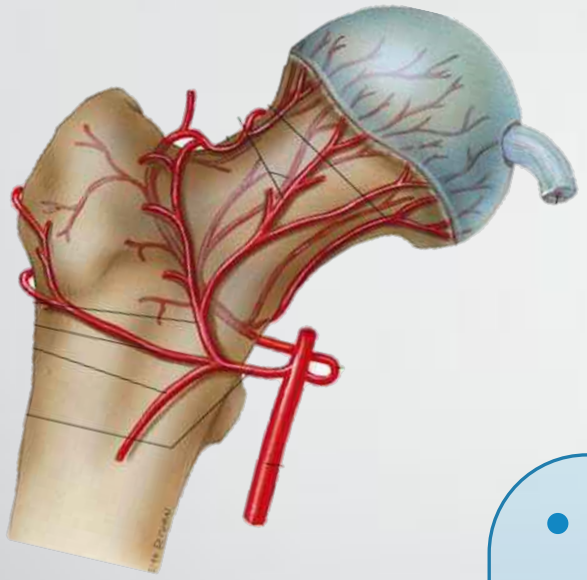
C. Osteotomy

D. THR

E. None of above

INTRODUCTION

Avascular Necrosis is condition in which there is loss of blood supply to the bone.



A. Phemister
B. Robert Jones
C. James Paget
D. Pletrogrande

- AVN associated with Trauma

  due to injury of femoral head blood supply (medial femoral circumflex artery)

- Non traumatic AVN (Chandler's disease)

  intravascular coagulation/ thrombosis is the final common causative pathway

CAUSES

Direct causes

- Irradiation
- Hypercoagulable states (smoking, pregnancy)
- Hematologic diseases (leukemia, lymphoma)
- Transplant patient
- Dysbaric disorders (decompression sickness, "the bends")
- Sickle cell disease

Indirect causes

- Alcoholism (fat accumulation)
- Steroids (increased marrow pressure from fat accumulation)
- Marrow-replacing diseases (e.g. Gaucher's disease)

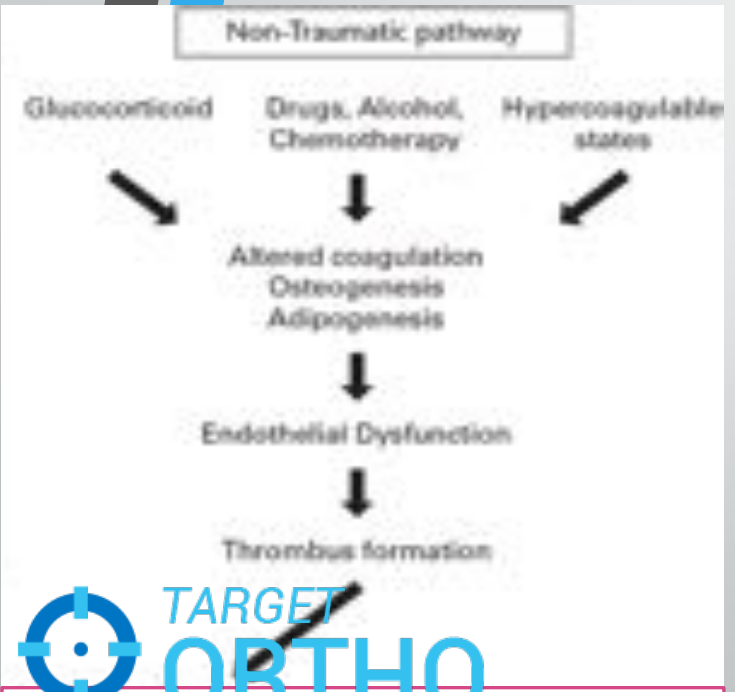
- Systemic lupus erythematosus (vasculitis)
- Viruses (CMV, hepatitis, HIV, rubella, rubeola, varicella)
- Protease inhibitors (type of HIV medication)

Idiopathic

Most common

? COVID

? DM



Q. Not a DEFINITE cause of AVN?

A. Alcohol abuse

B. Gaucher's disease

C. Irradiation

D. SLE

PROBABLE

- Alcohol abuse
- Gout
- Idiopathic

DEFINITE

- Gaucher's disease
- Hemoglobinopathies
- Irradiation
- Post-traumatic
- Dysbaric conditions
- Steroids
- SLE
- Transplant patient

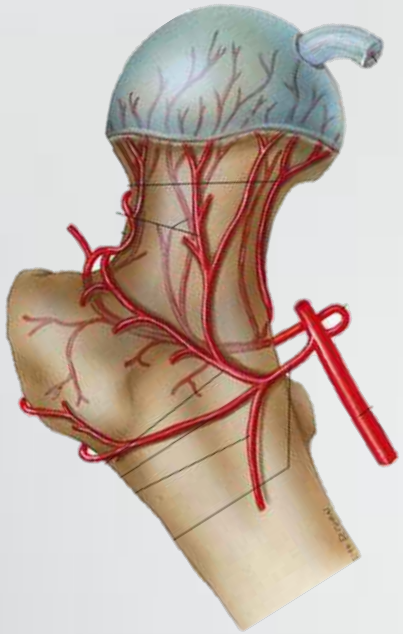
EPIDEMIOLOGY

DEMOGRAPHICS

- Males > females
- Average age at presentation is 30 to 50 years
- Bilateral hips involved 50-75 % of the time
- Multifocal osteonecrosis (disease in three or more different joints)

3% of patients with osteonecrosis have multifocal involvement

PATHOPHYSIOLOGY



The subarticular (subchondral) areas lie at the most distant part of the bone's vascular territory and are largely enclosed by cartilage, restricting their access to local blood supply. So that's where the changes start!

Generally anterolateral part of superior weight-bearing zone of head (in the subchondral region) gets involves first!

PRESENTATION

- Pain (insidious in onset), groin area.
- Internal rotation is the first movement to be restricted followed by abduction.
- "Sectoral sign" is positive, *the range of internal rotation is less in hip flexion compared to when in hip extension.*

IMAGING

X rays

Radiographs recommended views

- AP hip
- Frog-lateral of hip
- AP and lateral of contralateral hip

Crescent sign

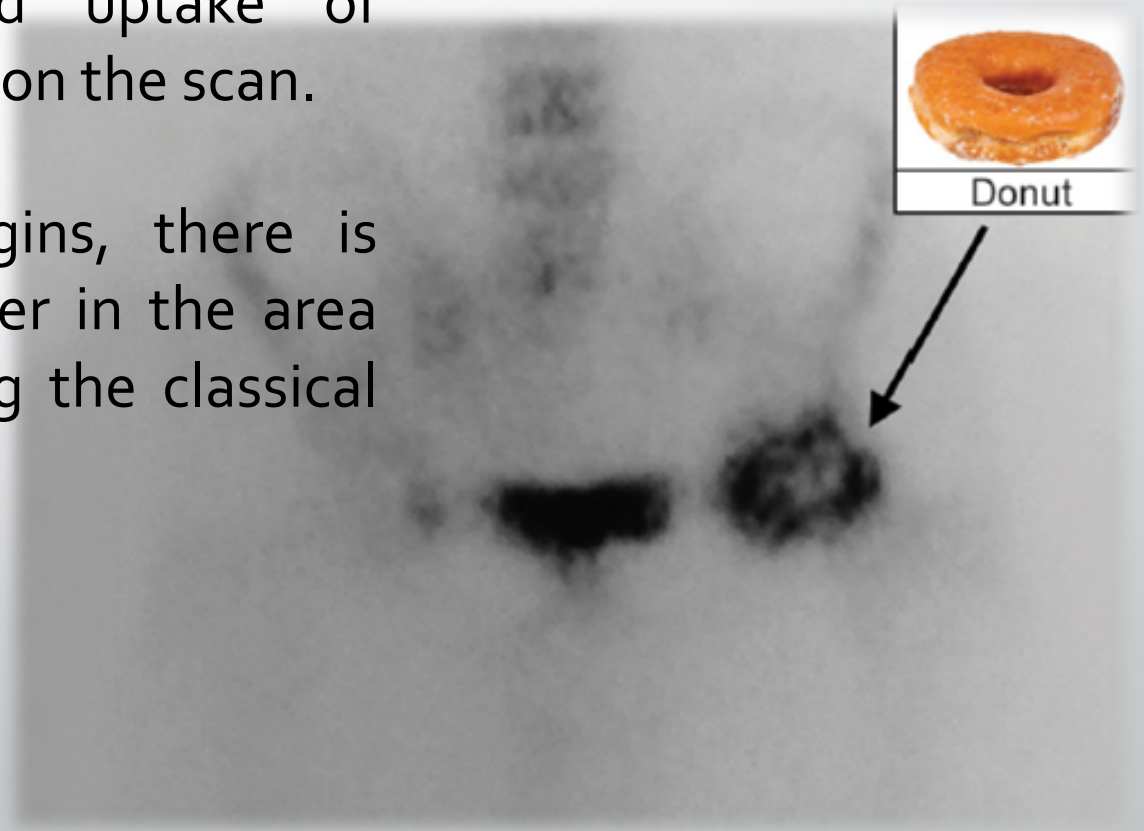
IMAGING

Bone Scan

Very sensitive investigation for early diagnosis

Early phase there is decreased uptake of radiotracer, producing a "cold area" on the scan.

Once the reparative process begins, there is increased uptake of the radio tracer in the area surrounding the cold spot, creating the classical "Donut sign"



IMAGING

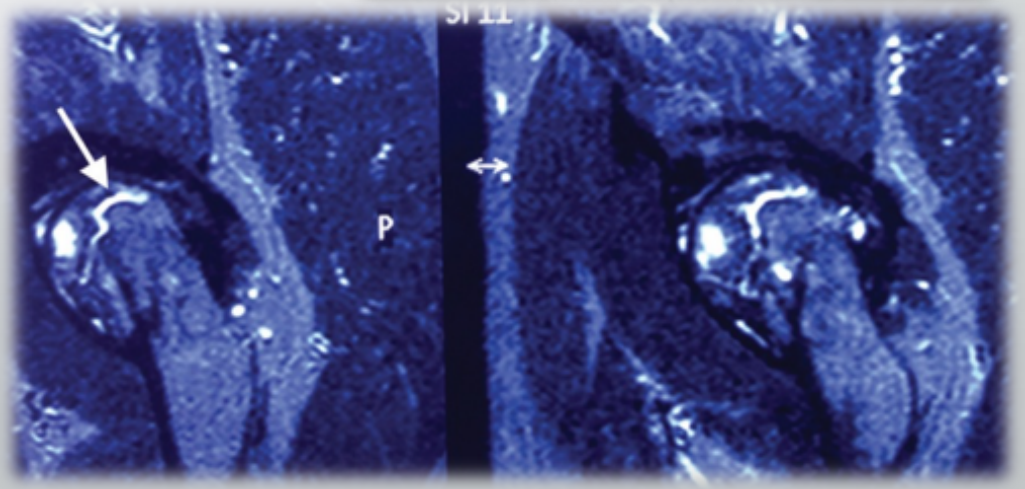
MRI

MRI highest sensitivity (99%) and specificity (99%)

T1: dark (low intensity band)

T2: focal brightness or classical "double line sign"

Presence of bone marrow edema on MRI is predictive of worsening pain and future progression of disease



FUNCTIONAL BONE MARROW INVESTIGATIONS

- Bone seeking isotopes
- Bone marrow pressure
- Oxygen saturation measurements
- Intra-medullary venography
- Core biopsy

A. < 10 mm-Hg

B. 10-20 mm-Hg

C. 20-30 mm-Hg

D. 30-50 mm-Hg

BLOOD BIOCHEMISTRY

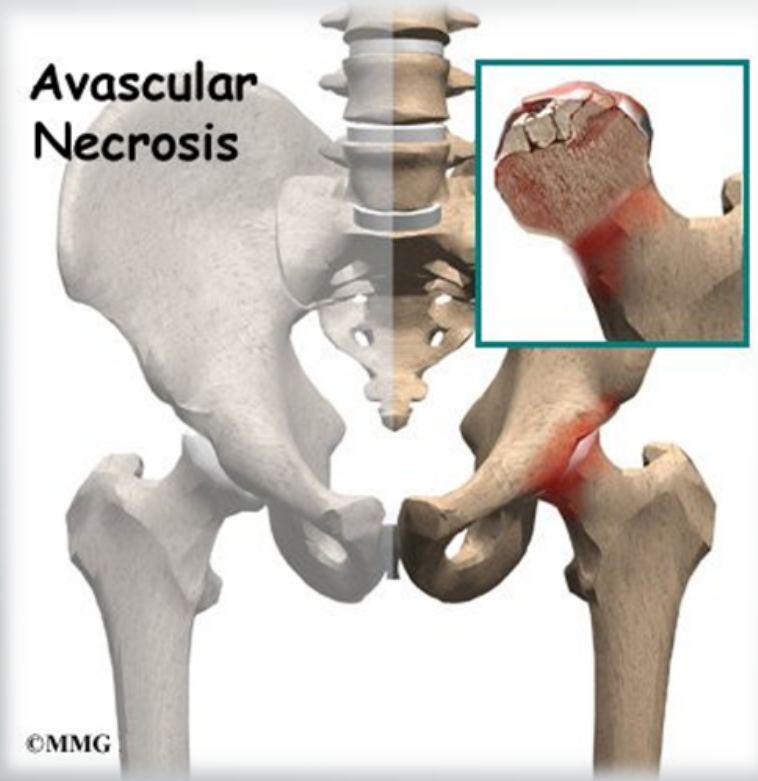
- Hemogram
- Hemoglobin Electrophoresis
- Serum Lipid Profile
- LFT; KFT and Uric Acid
- Coagulation profile
- Autoimmune antibodies for SLE
- Viral markers

NATURAL HISTORY

Necrosis → Fragmentation of bone → Head Collapse → OA Hip

Revascularization

Repair



Not a bad prognostic factor:

A. Large extent of lesion
B. Location: Antero superior area of head
C. Bilateral disease
D. Presence of bone marrow edema in proximal femur on MRI

BAD PROGNOSTIC INDICATORS

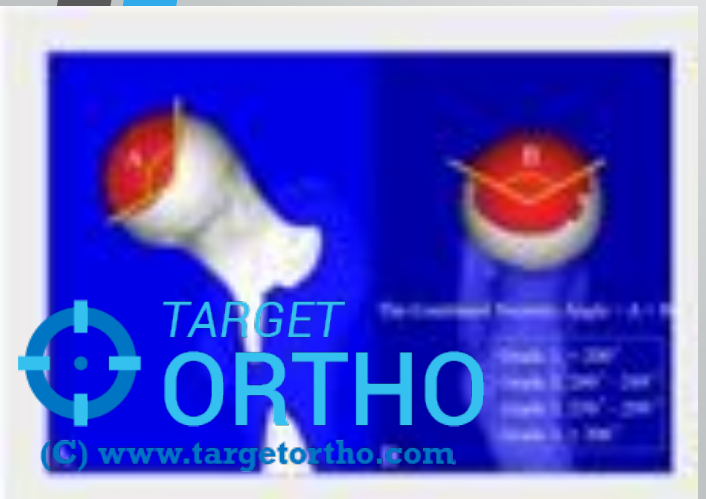
- Extent of Osteonecrotic lesion
- Presence of subchondral collapse
- Location of lesion: Antero supero lateral area
- Presence of marrow edema in proximal femur
- Age > 50 years

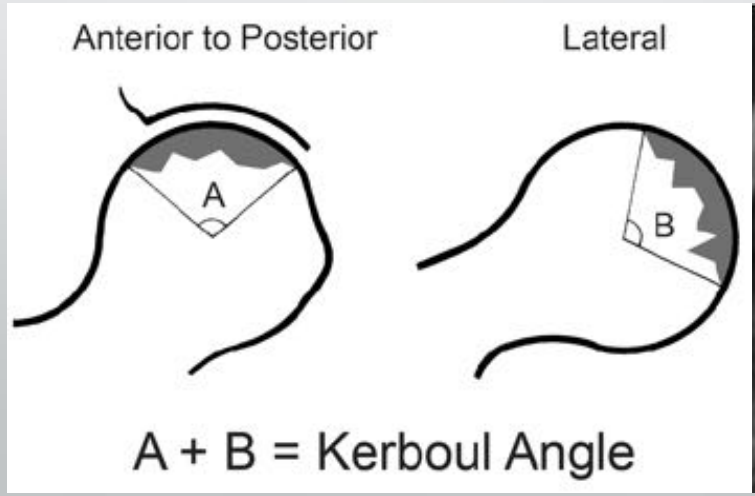
MODIFIED KERBOUL COMBINED NECROTIC ANGLE

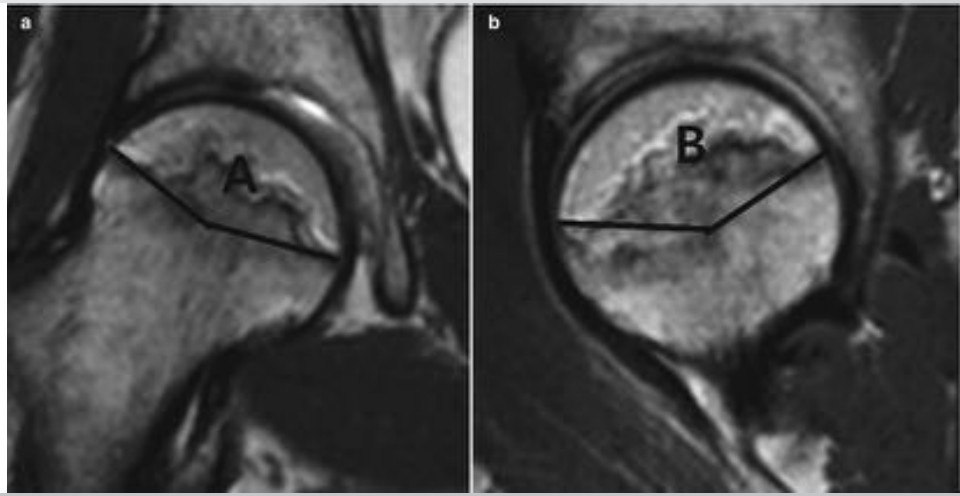
Predicts risk of head collapse, progression to OA (& hence *prognosis*)

Calculated by adding the arc of the femoral head necrosis on a mid-sagittal and mid-coronal MR image

Low-risk = combined necrotic angle less than 190°
Moderate-risk = combined necrotic angle between 190° & 240°
High-risk = combined necrotic angle of more than 240°







CLASSIFICATIONS

Mont et al.; 2006; Clin Ortho Rel Res

- Ficat Arlet (1964 → 1985): 62%
- University of Pennsylvania by Steinberg MG (1984): 20%
- ARCO: *Association Research Circulation Osseous* (1992): 12%
- Japanese Orthopaedic Association: 5%

- *MRI*
- *Bone scan*
- *Functional bone marrow investigations*
- *Clinical symptoms*

- *MRI*
- *Extent of involvement/ flattening*

FICAT ARLET CLASSIFICATION (Modified)

STAGING

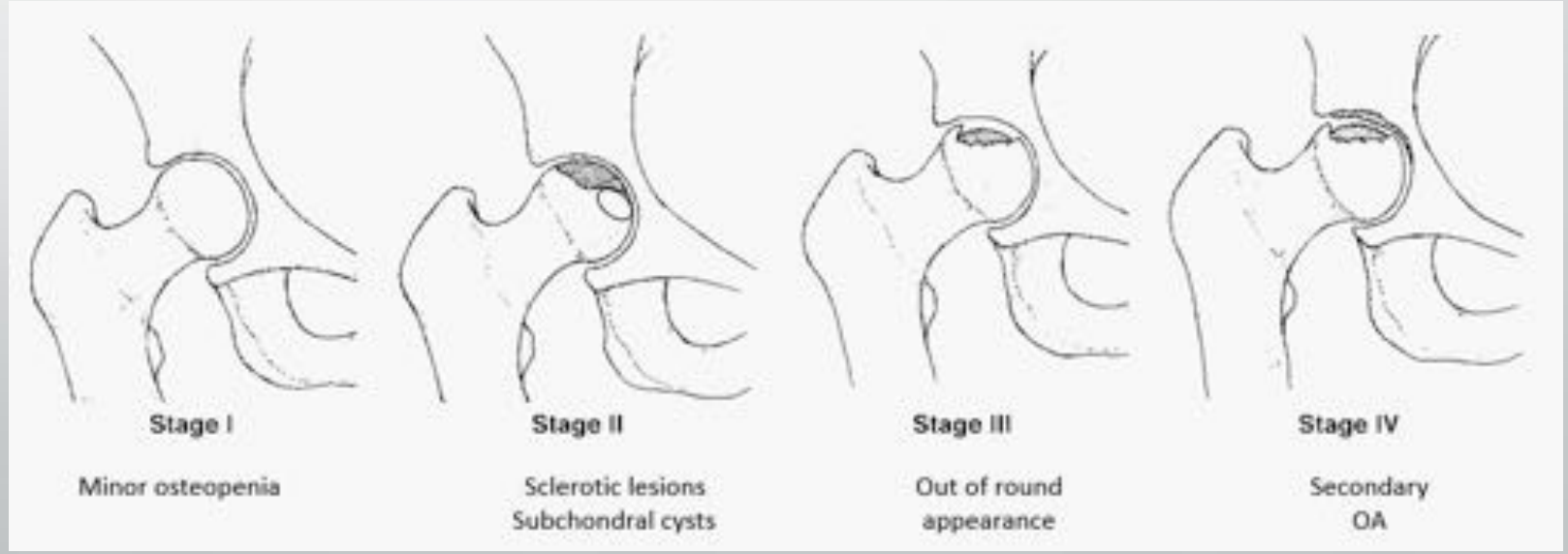
1 Normal X ray (Bone scan- cold spot, MRI- edema)

2A Diffuse or localized osteoporosis, sub chondral cyst or sclerosis (no collapse of head)

2B Crescent sign (subchondral collapse with maintained sphericity)

3 Loss of sphericity (but joint space present)

4 Joint space narrowing, arthritic changes on acetabular side



TREATMENT

AVN is irreversible: no drugs can restore blood supply to femoral head

Aim of medical management is to retard progression and save other hip

MEDICAL MANAGEMENT

Depends on Stage of disease

SURGICAL MANAGEMENT

MEDICAL MANAGEMENT

- Analgesics
- Bisphosphonates: indicated for pre-collapse AVN (Ficat stages I-IIA)

  Risedronate/ Alendronate/ Ibandronate/ Zoledronic Acid

- Statins → Steroid/ Alcohol induced AVN
- ? Blood thinning drugs (for maintaining precarious blood supply)
- Hyperbaric oxygen therapy
- Extracorporeal shock wave therapy

MEDICAL MANAGEMENT

- Analgesics
- Bisphosphonates: indicated for pre-collapse AVN (Ficat stages I-IIA)

  trials have shown that Alendronate, BEST prevents femoral head collapse in osteonecrosis with subchondral lucency
- Statins → Steroid/ Alcohol induced AVN
- ? Blood thinning drugs (for maintaining precarious blood supply)
- Hyperbaric oxygen therapy
- Extracorporeal shock wave therapy

Core Decompression

SURGICAL MANAGEMENT

Indications

- for early AVN, before femoral head collapse occurs
- Reversible/ treatable etiology

Principle

- relieves intraosseous hypertension
- stimulates a healing response via angiogenesis

Technique

- traditional method
  - drill an **8-10 mm** hole through the subchondral necrosis
- alternative method
  - pass a 3.2 mm pin into the lesion three times for decompression

BONE GRAFTING CHOICES

SURGICAL MANAGEMENT

Autograft/ Allograft

Non vascularized fibula

Vascularized free-fibula transfer

Technique

- remove the necrotic area with large core hole
- fibular strut is placed under subchondral bone to help
  - prevent collapse or tamp up small areas of collapse

Outcomes

- some centers demonstrating 80% success at 5 to 10
  - year follow-up less predictable in patients >40

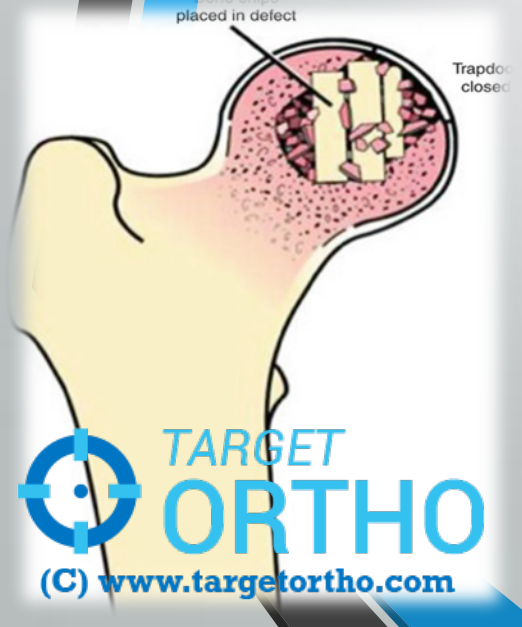
?? Muscle pedicle grafting

BONE GRAFTING TECHNIQUES

SURGICAL MANAGEMENT

Curettage and bone grafting through Mont trapdoor technique or Merle D'Aubigne lightbulb technique

LIGHTBULB - through the cortex of the femoral neck-head junction to access the necrotic area of the femoral head and place bone graft



TRAPDOOR – Enter through the articular surface

RETROGRADE GRAFTING

Alternatives to Bone grafts!!!

- Bone morphogenetic proteins
- Bone marrow aspirate concentrate
- Platelet rich plasma
- Porous tantalum rods
- Mesenchymal stem cells

Zhou et al

SURGICAL MANAGEMENT

Rotational osteotomies

Indications

only for small lesions (<200 Kerbaul Angle, i.e. <30% head involvement; preferably < 15%) in which the lesion can be rotated away from a weight bearing surface; No acetabular pathology (< Stage 3); Age < 40 years; Normal ROM

Technique

Typically performed through intertrochanteric region

For medial disease: perform varus rotational osteotomy

For anterolateral disease: perform valgus flexion osteotomy

Sugioka's trans-trochanteric rotation osteotomy

Outcomes

reported success rate of 60% to 90%, mainly in Japan

distorts the femoral head making THA more difficult

OVERVIEW

SURGICAL MANAGEMENT

FA I and IIa: Core decompression +/- BG
Osteotomy *if Kerboul angle < 200*

FA IIb: Core decompression + BG
Osteotomy *if Kerboul angle < 200*

FA III: Osteotomy *if Kerboul angle <200*
THR

FA IV: THR

A. Core decompression

B. Core decompression with fibular grafting

C. Osteotomy

D. THR

E. None of above

28 years “newly married” female

Sex related issue !!!

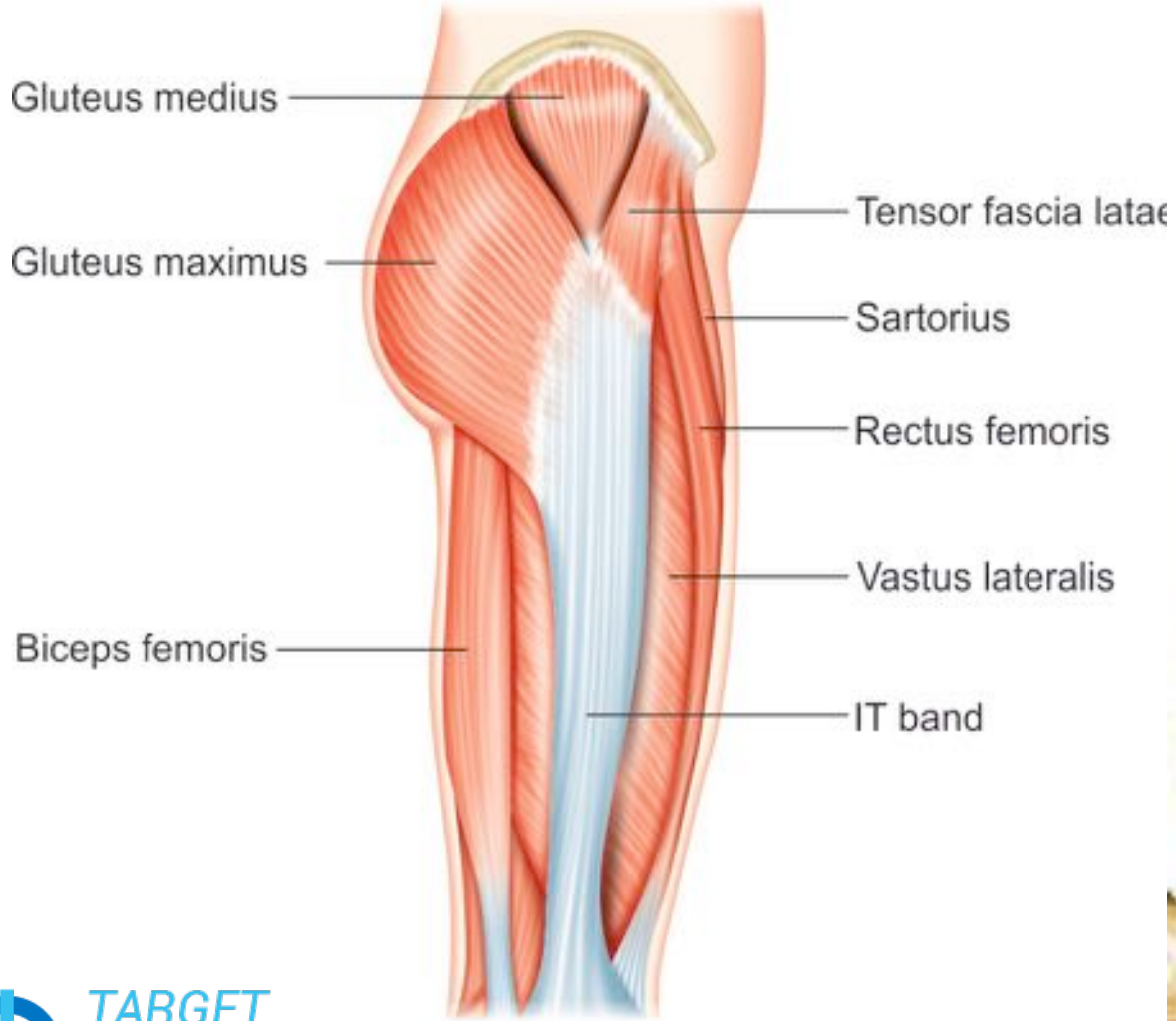
SURGICAL APPROACHES

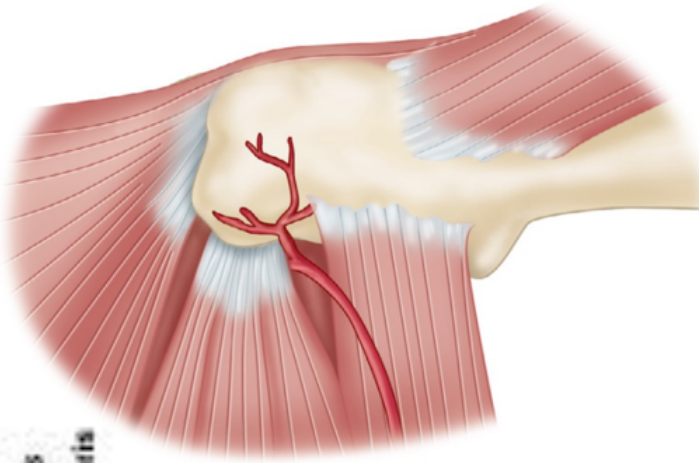
ANTERIOR APPROACHES

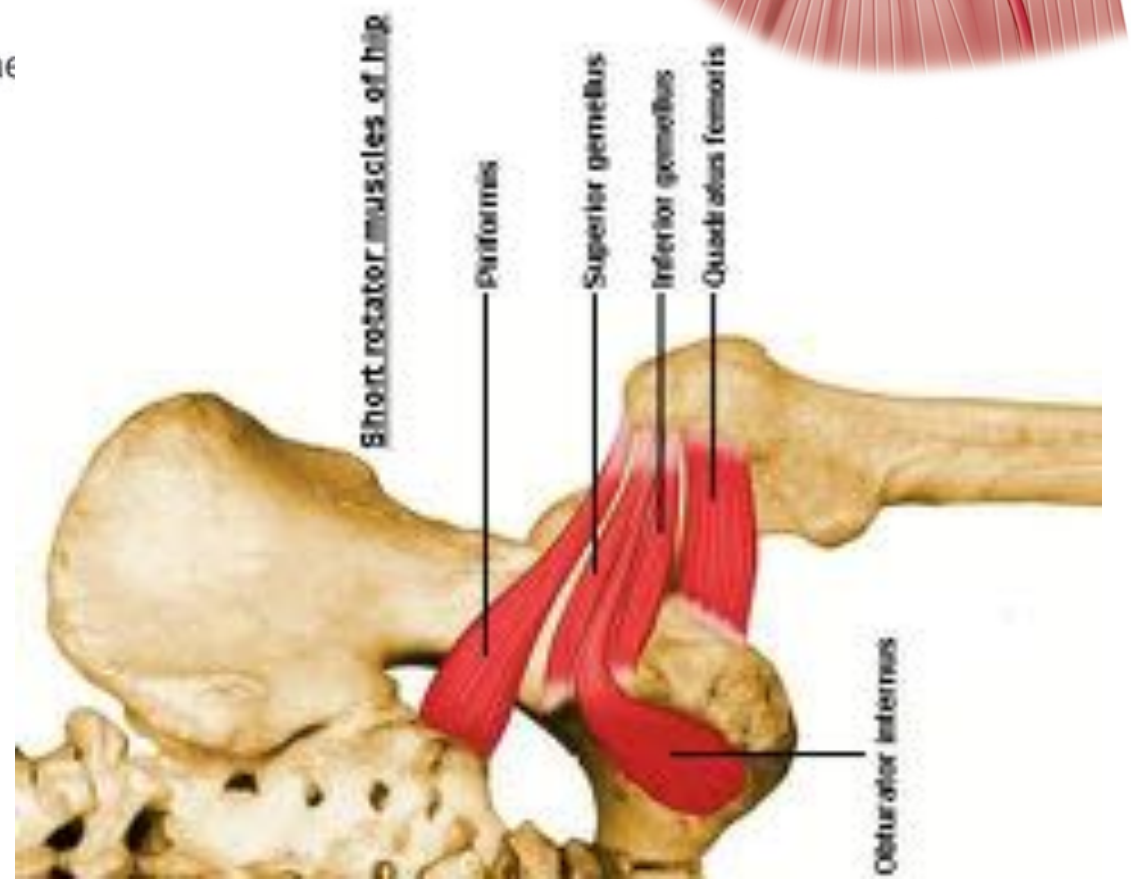
- ANTERO-LATERAL
  WATSON JONES
- DIRECT-LATERAL
  HARDINGE

POSTERIOR APPROACHES

- POSTERO-LATERAL
  GIBSON
- DIRECT-POSTERIOR
  OSBORN & MOORE/
  SOUTHERN

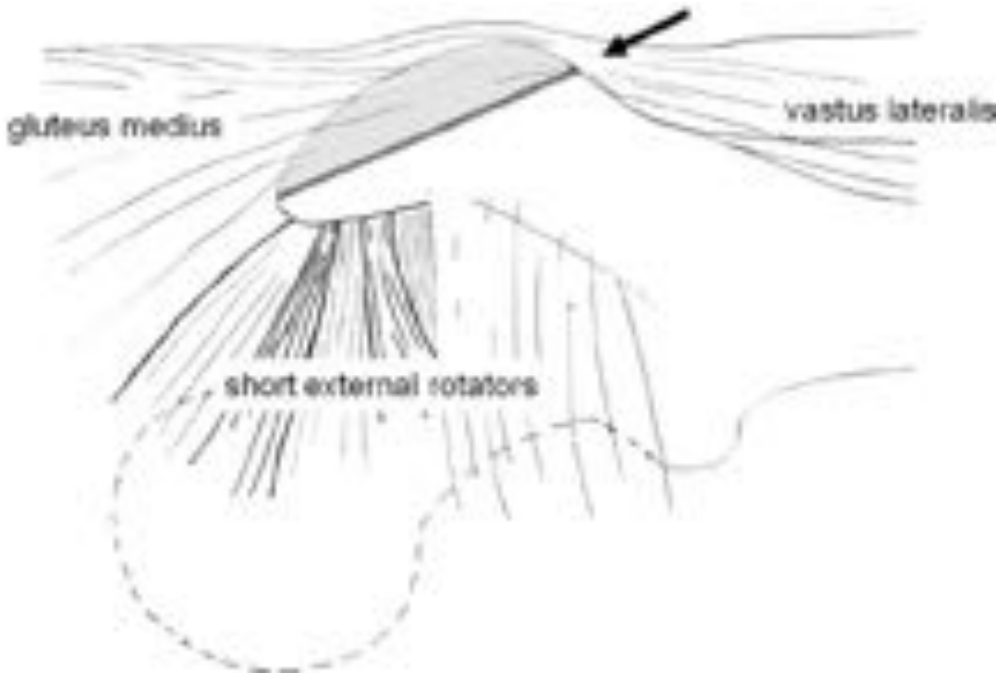


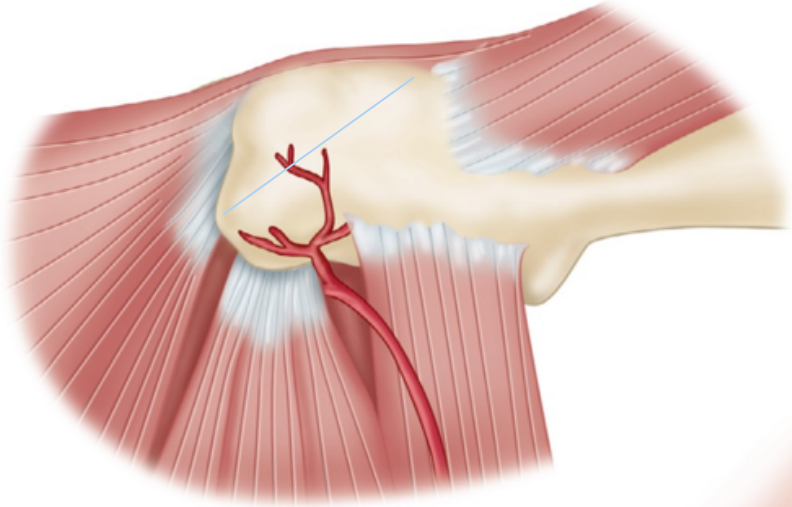


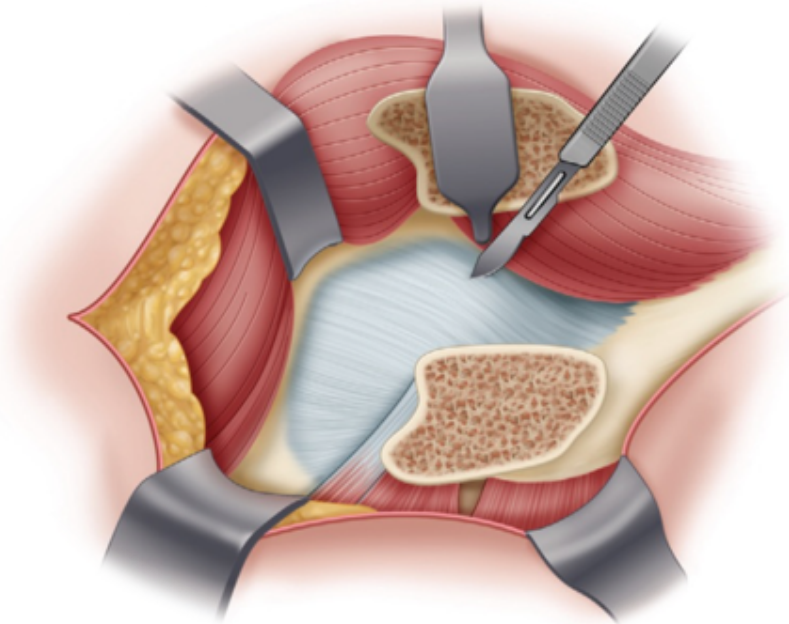


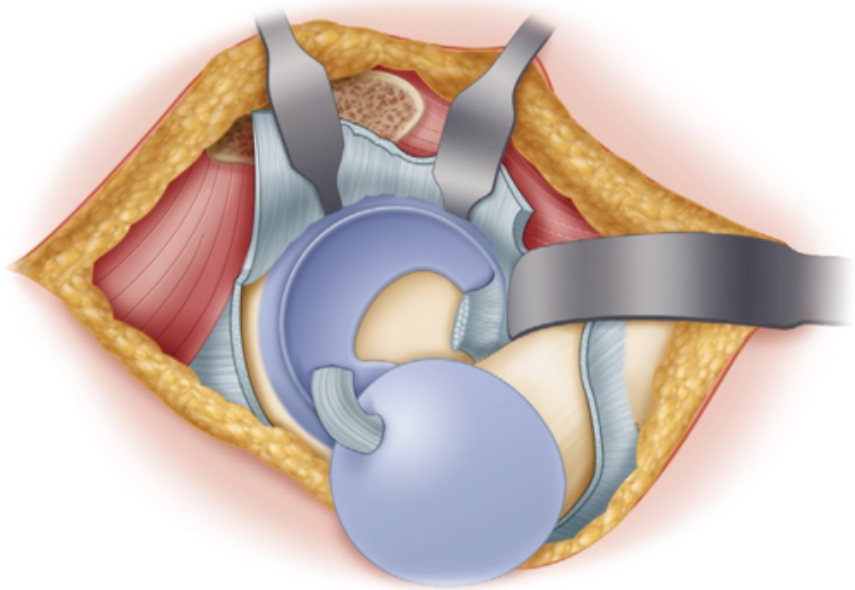
Trochanteric flip osteotomy

Osteotomy runs from the postero superior trochanteric edge to the posterior border of ridge of vastus lateralis. (maximal thickness of trochanteric fragment is 1.5 cm) and the trochanteric fragment is mobilised anteriorly with the fibres of vastus lateralis. A successful osteotomy means the upper edge of the osteotomy passes just anterior to the most posterior border of gluteus medius.









DR. MUKUL MOHINDRA

mukulmohindra@gmail.com

M.S [ORTHO], DNB, MNAMS
Diploma SICOT [Belgium]
FNB *[Arthroscopy & Sports Medicine]*
SICOT Fellowship in Minimally Invasive Arthroplasty (Athens)