Hip Viva

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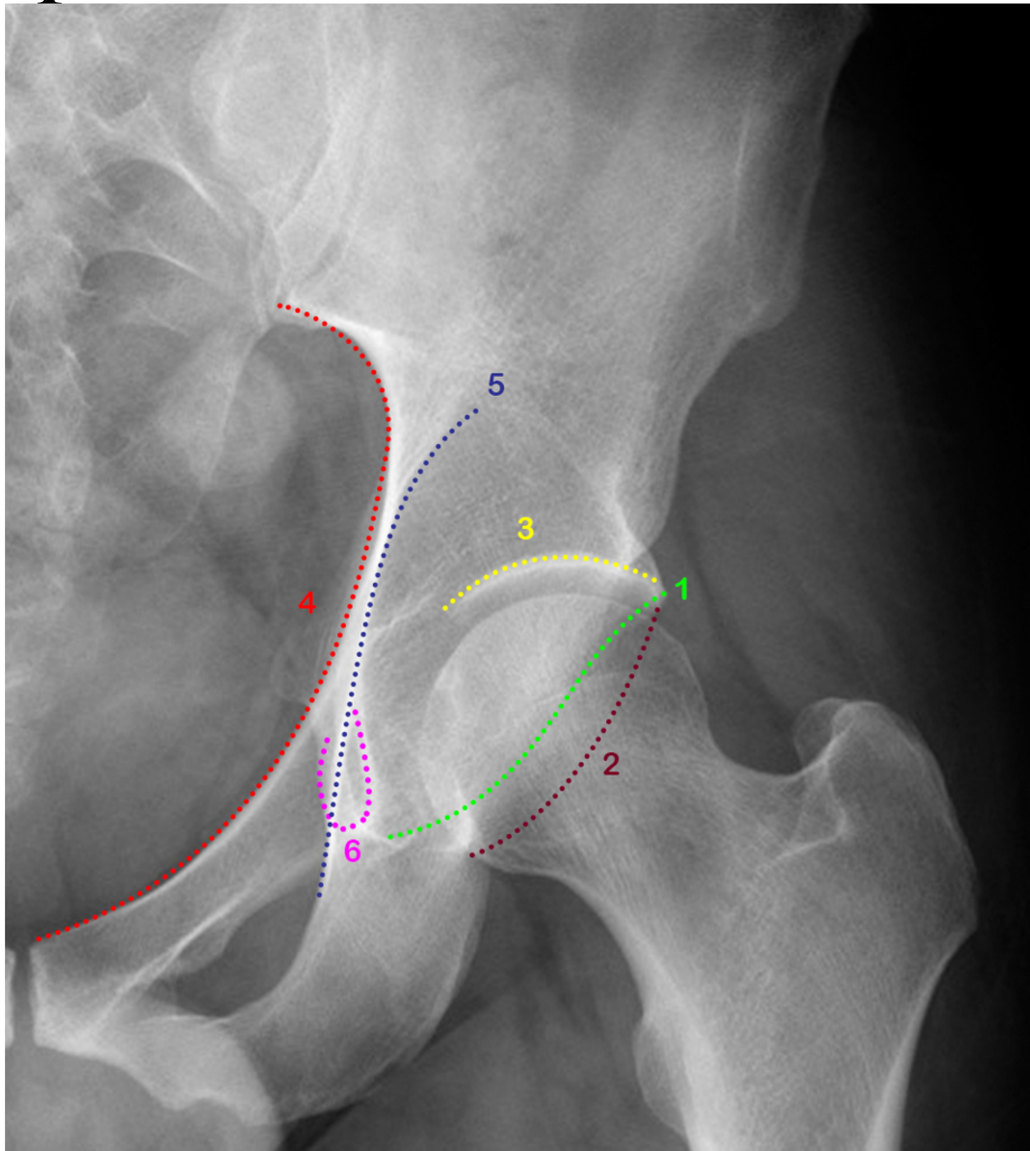
What can you see?

- *This an AP radiograph of the pelvis and both hips of …woman, taken on x date, showing bilateral hip dysplasia.*
- *There is right hip dislocation with proximal and superior migration of the proximal femur with formation of a false acetabulum, there is no contact between the femoral head and the true acetabulum. the femoral head is poorly developed or probably absent. With very narrow medullary canal. It is Crowe IV or Hartofilakidis type C hip.*
- *On the left side, the femoral head is still contained within the true acetabulum with low dislocation, the femoral head is distorted and poorly developed. It is Crowe III hip or Hartofilakidis type B hip.*

What are the normal anatomical landmark of a pelvic radiographs?

1. Anterior acetabular wall.
2. Posterior acetabular wall.
3. Acetabular roof.
4. Iliopectineal line. Anterior column
5. Ilioischial line. Posterior column
6. Radiographic U (Tear drop).



What is adult hip dysplasia?

- *Wide spectrum of hip pathology ranging from shallow acetabulum to completely dislocated high-riding hip. It is a common cause of secondary osteoarthritis in young adults*

What is the pathoanatomy of adult hip dysplasia?

- *Acetabular dysplasia :*

➢ *Too little coverage: lack of anterior and lateral coverage*

➢ *Too much coverage: excess anterior and lateral coverage*

➢ *Acetabular retroversion.*

- *Proximal femoral dysplasia :*

➢ *Altered version*

➢ *Altered head-neck offset.*

How does the patient with adult hip dysplasia present?

- *Hip pain, mainly with flexion*
- *Increased internal rotation before arthritis sets in*
  - *due to increased femoral anteversion*
- *Decreased internal rotation may represent osteoarthritis*
- *External rotation with ambulation*
- *Waddling gait in bilateral disease*
- *Limited hip abduction*
- *Positive anterior impingement test (pain with passive flexion, internal rotation and adduction)*

Describe the various angles and radiological features that can be seen hip dysplasia

- *Inadequate depth of acetabulum.* ***A/P***
- *False acetabulum.* ***A/P***
- *subluxation or dislocation or proximal migration of femoral head (Crowe).* ***A/P***
- *Change in femoral head sphericity.* ***All views***
- *Decreased head-neck offset ratio < 0.17 cam deformity.* ***Cross-table lateral view***

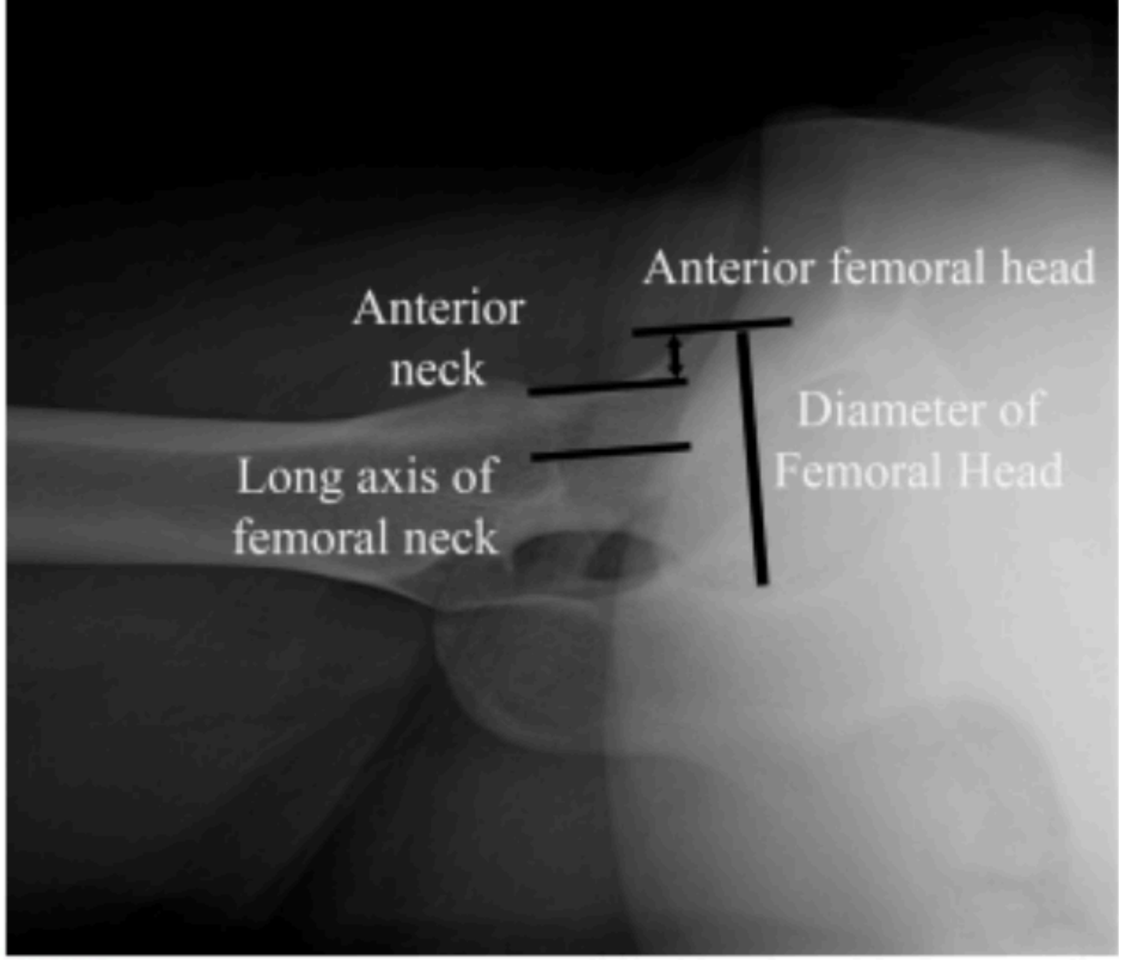


Fig. 19

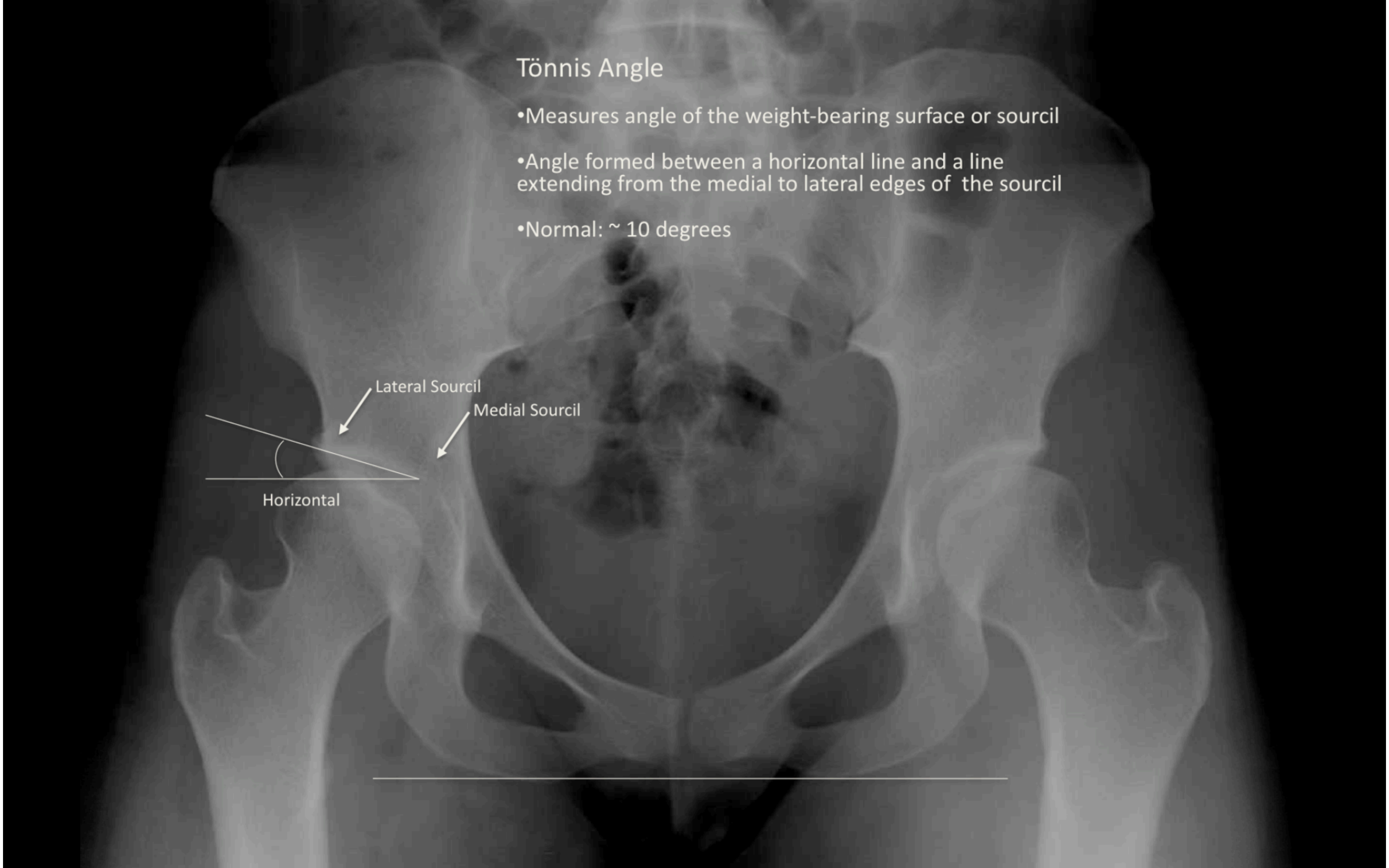
The technique for calculating the head-neck offset ratio. Three parallel lines are drawn, with line 1 drawn through the center of the long axis of the femoral neck, line 2 drawn through the anteriormost aspect of the femoral neck, and line 3 drawn through the anteriormost aspect of the femoral head. The head-neck offset ratio is calculated by measuring the distance between lines 2 and 3 and dividing by the diameter of the femoral head[3]. If the ratio is <0.17, a cam deformity is likely present.

Describe the various angles and radiological features that can be seen in hip dysplasia

- *Increased Tonnis angle (>10).* ***A/P***
- *Increased acetabular angle of sharp (>47).* ***A/P***
- *Lateral Centre Edge Angle of wiberg(<20).* ***A/P***
- *Anterior Centre Edge Angle (<20).* ***False profile view***
- *Acetabular retroversion. (cross-over sign on **A/P**)*

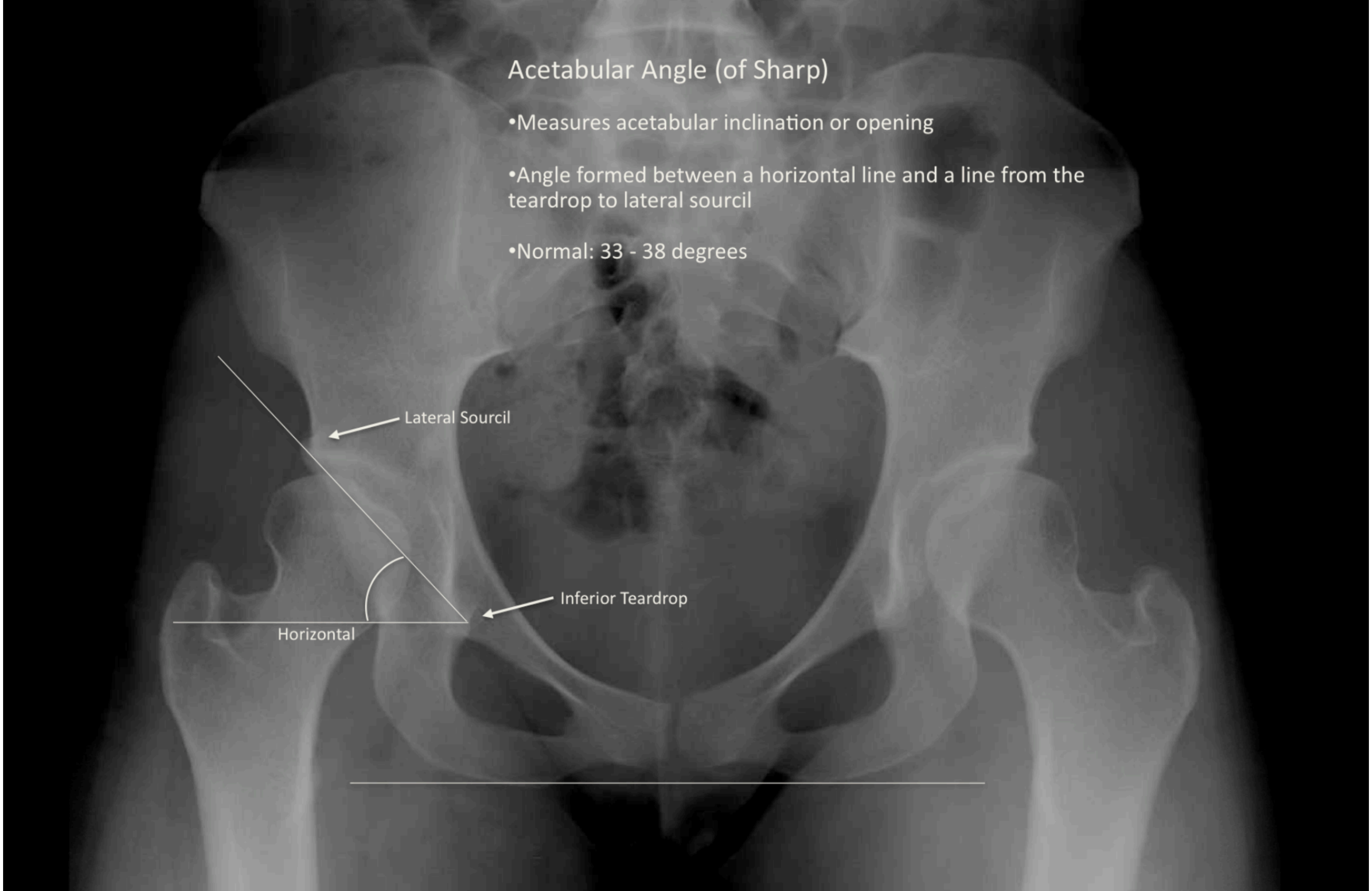
Tönnis Angle

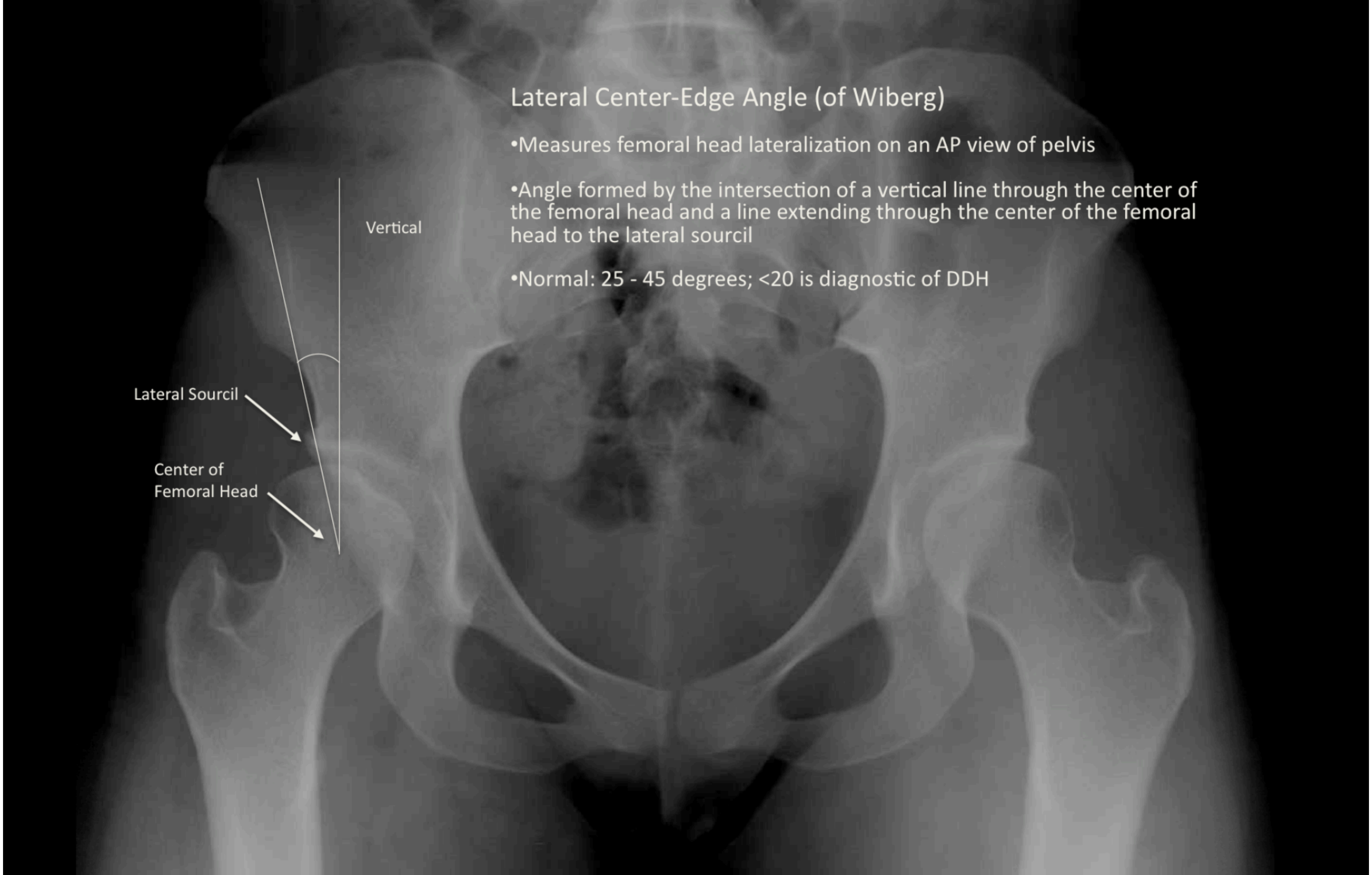
- Measures angle of the weight-bearing surface or sourcil
- Angle formed between a horizontal line and a line extending from the medial to lateral edges of the sourcil
- Normal: ~ 10 degrees

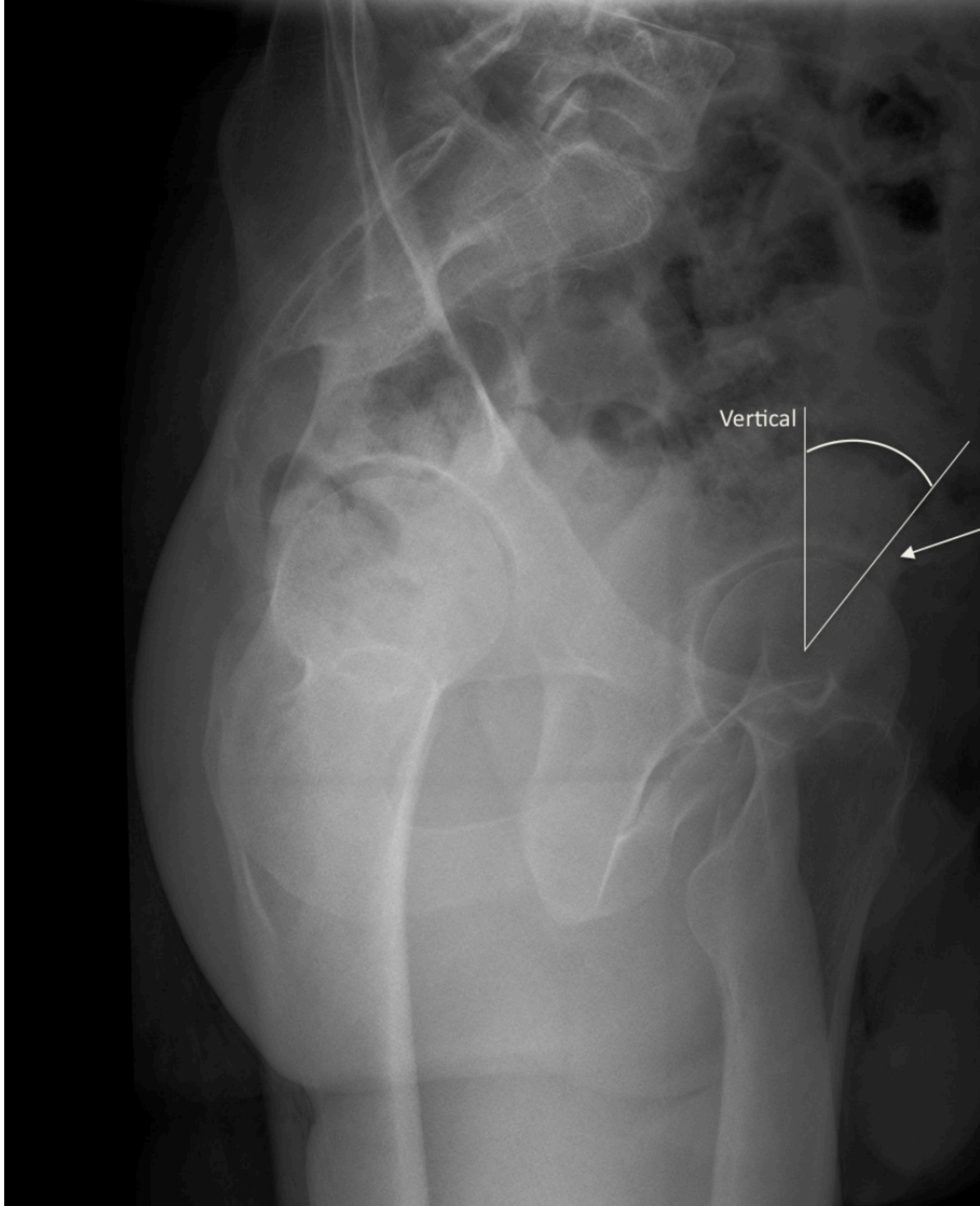


Acetabular Angle (of Sharp)

- Measures acetabular inclination or opening
- Angle formed between a horizontal line and a line from the teardrop to lateral sourcil
- Normal: 33 - 38 degrees

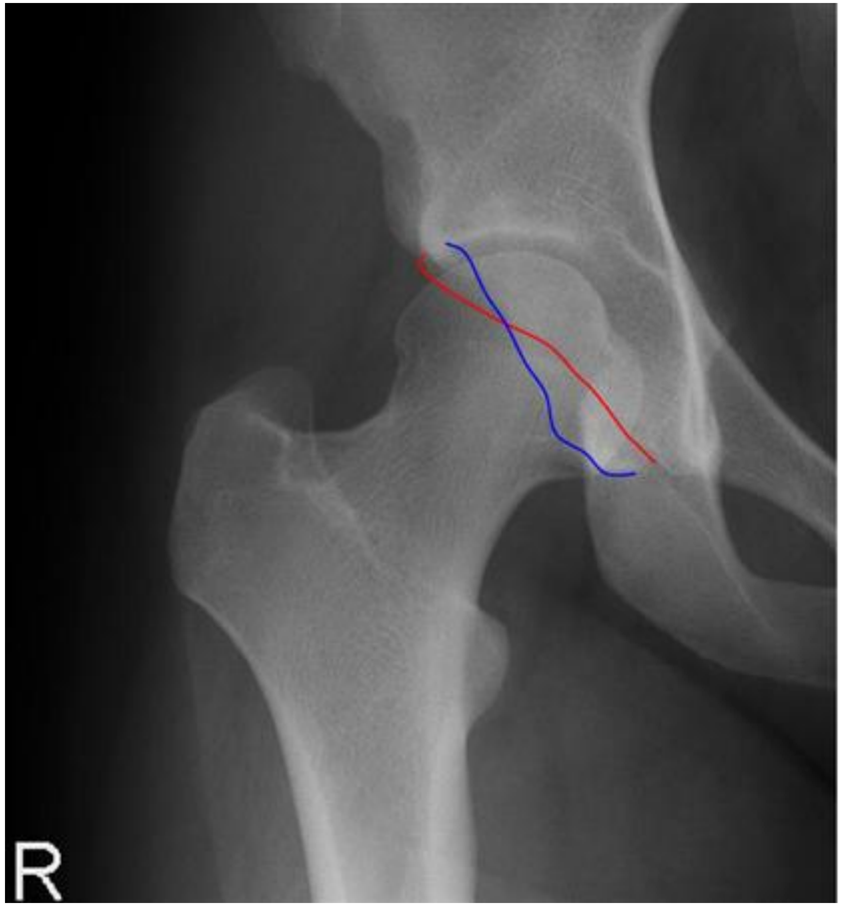



Lateral Center-Edge Angle (of Wiberg)
•Measures femoral head lateralization on an AP view of pelvis
•Angle formed by the intersection of a vertical line through the center of the femoral head and a line extending through the center of the femoral head to the lateral sourcil
•Normal: 25 - 45 degrees; <20 is diagnostic of DDH
Vertical
Lateral Sourcil
Center of Femoral Head



Anterior Center-Edge Angle (of Lequesne)

- Measures anterior dysplasia on the false profile view
- Angle formed by the intersection of a vertical line through the center of the femoral head and a line extending through the center of the femoral head to the anterior sourcil
- Normal: 25 - 50 degrees; <20 is diagnostic of DDH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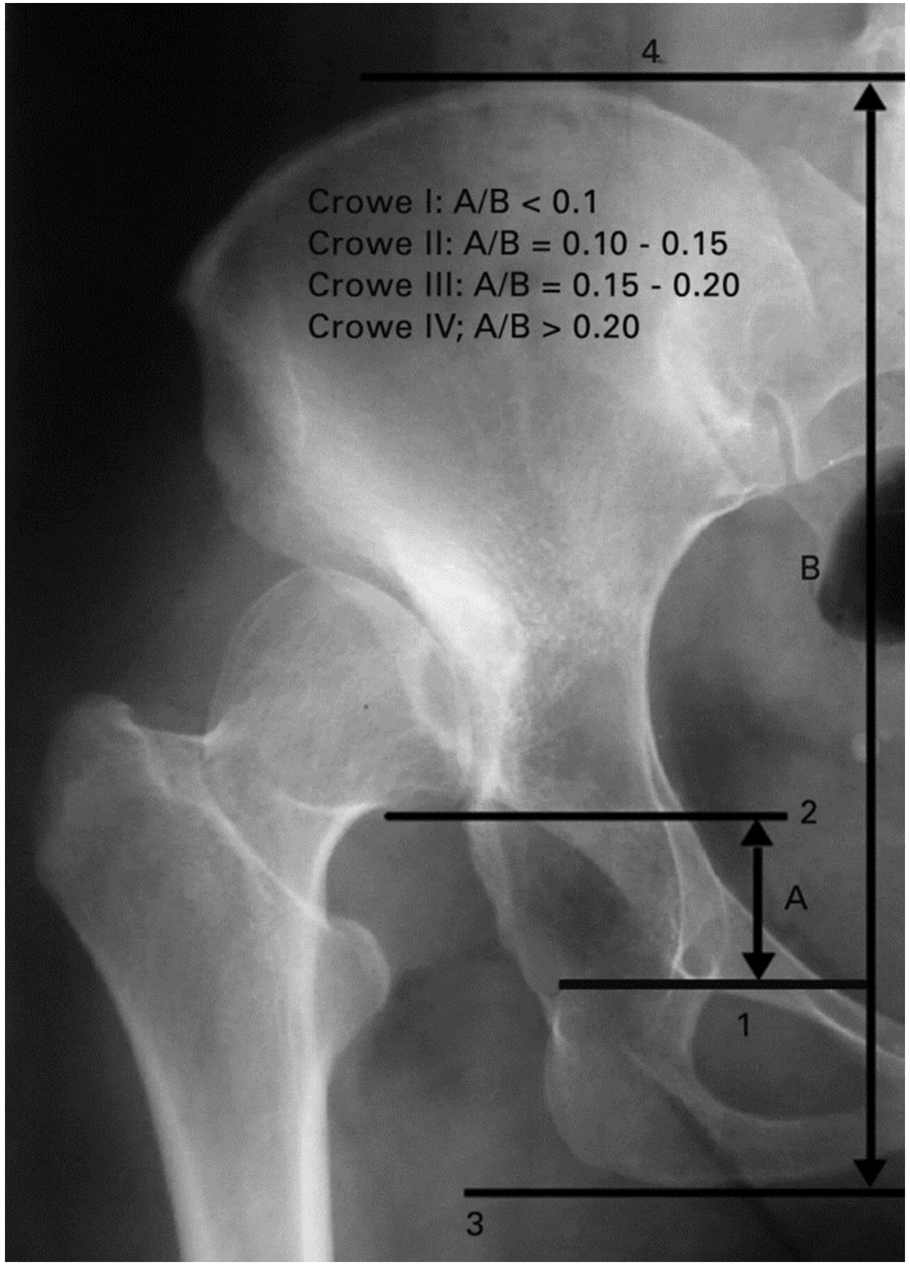
How would you classify the dysplasia?

Crowe classified dysplasia radiographically into four categories based on the proximal migration of the femoral head. 3 anatomic landmarks are identified:

- *the height of the pelvis;(from the iliac crest to the pubic tubercles)*
- *the medial head-neck junction in the affected hip*
- *the inferior margin of the acetabulum (the teardrop).*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Crowe I: A/B < 0.1
Crowe II: A/B = 0.10 - 0.15
Crowe III: A/B = 0.15 - 0.20
Crowe IV; A/B > 0.20
B
2
A
1
3

How would you classify the dysplasia?

Table 1

Crowe's classification

Group	Description
I	Subluxation < 50% or proximal dislocation < 0.1% of the pelvic height
II	Subluxation 50%–75% or proximal dislocation of 0.1% to 0.15% of pelvic height
III	Subluxation 75%–100% or proximal dislocation of 0.15% to 0.20% of pelvic height
IV	Subluxation > 100% or proximal dislocation of > 0.20% of pelvic height

How would you classify the dysplasia?

- *An alternative to this is the classification described by Hartofilakidis.*

➢ ***Dysplasia (Type A):***

   ➢ *Femoral head within acetabulum despite some subluxation.*

   ➢ *Segmental deficiency of the superior wall.*

   ➢ *Inadequate depth of the true acetabulum.*

➢ ***Low dislocation (Type B):***

   ➢ *Femoral head creates a false acetabulum superior to the true acetabulum.*

   ➢ *complete absence of the superior wall.*

   ➢ *Inadequate depth of the true acetabulum.*

➢ ***High dislocation (Type C):***

   ➢ *Femoral head is completely uncovered by the true acetabulum and has migrated superiorly and posteriorly.*

   ➢ *Segmental deficiency of the entire acetabulum.*

Any further tests would you like to do and why?

- *CT scans are useful in assessing available bone stock, and the morphology, dimensions and orientation of both the acetabulum and femur.*
- *Various measurements include:*
  - *femoral neck shaft angle,*
  - *Femoral neck anteversion,*
  - *medial head offset.*

What treatment would you offer for this patient?

- *I would start with non-operative management in term of : analgesia- activity moderation- weight reduction- walking aids- hip injection- avoid impact sports (choose swimming and cycling instead)*

What are the surgical options for management?

- periacetabular osteotomy +/- femoral osteotomy
- salvage pelvic osteotomy (chiari, shelf)
- Arthroplasty (resurfacing/THA)

What are the criteria for periacetabular osteotomy +/- femoral osteotomy?

- symptomatic dysplasia in an adolescent or adult with
  - concentrically reduced hip
  - Congruent joint space with good joint space

❑ involves multiple osteotomies in the pubis, ilium, and ischium. This allows improved three-dimensional correction of the acetabulum configuration

- It provides hyaline cartilage coverage.
- Preserve the abductors.
- Delay the need for arthroplasty.

- Technically challenging
- hip arthroplasty performed after PAO may lead to increased incidence of a retroverted acetabular cup

What are the criteria for salvage pelvic osteotomy?

- *recommended for patients with inadequate femoral head coverage and an incongruent joint. cover femoral head with fibrocartilage (**NOT articular cartilage**)*

- *Shelf osteotomy: increase the weight bearing surface by adding extra-articular buttress of bone over the subluxed femoral head.*

- *Chiari osteotomy: make cut above acetabulum to sciatic notch and shift ileum lateral beyond edge of acetabulum*

What are the indications for THA?

- *treatment of last resort for those with severe arthritis*
- *preferred treatment for older patients (>50) and those with advanced structural changes*

How do you preoperatively plan for ADH surgery?

- *the position of the true acetabulum should be identified*
- *the decision should be made whether to restore the acetabulum to its true position or not.*
- *The degree of anteversion of the acetabulum should be measured*
- *the adequacy of bone stock for satisfactory cup fixation and coverage should be assessed.*
- *estimation of the acetabular component size.*
- *the preferred method of fixation (cement/uncemented).*
- *The need for bone graft.*

How do you preoperatively plan for DDH surgery?

- *The size of the femoral canal.*
- *The degree of femoral anteversion.*
- *The need for femoral shortening.*
- *The amount and the method of femoral shortening.*
- *Management of LLD and restoration of abductor function.*

What are the technical difficulties in performing a THA in a ADH patient?

- There is deficiency of the superior wall of the acetabulum
- inadequate bone stock in the acetabulum to achieve adequate bone coverage.
- may need trochanteric osteotomy to improve visualization in Crowe type III or IV patients.
- It can be technically difficult for anatomical placement of the acetabular component.
- Excess femoral anteversion. Attempting to implant an uncemented stem in a deformed anteverted femur may result in a proximal femoral fracture.
- LLD
- If one attempts to fully correct a significant leg length discrepancy a sciatic nerve palsy may occur

What are the treatment options for these difficulties?

- *when there is inadequate bone stock in the acetabulum to achieve adequate host bone coverage>> a high hip centre can be used .*
- *excessive femoral anteversion>> use either a cemented or modular stem that allows control of anteversion*
- *Significant LLD>> performing a shortening subtrochanteric osteotomy.*

What are the advantages and disadvantages of placing the acetabular cup in either the anatomic position (low hip centre) or non-anatomic position (high hip centre)?

❖ **Anatomic position (low hip centre)**

- **Advantages**:

➢ *facilitates lengthening.*

➢ *better hip function*

➢ *diminished joint reaction forces.*

- **Disadvantages**:

➢ *difficult surgery*

➢ *The need for grafting. Femoral head can be used to augment the superolateral aspect of the acetabular rim*

➢ *May need shortening subtroahcnteric femur osteotomy*

➢ *osteotomy of the greater trochanter and resection of the proximal femoral metaphysis may be necessary*

What are the advantages and disadvantages of placing the acetabular cup in either the anatomic position (low hip centre) or non-anatomic position (high hip centre)?

❖**Non-anatomic position (high hip centre)**

- **Advantages**:

➢ *technically easier.*

➢ *avoid the need for bone grafting.*

➢ *decreases the need for a concomitant shortening femoral osteotomy.*

- **Disadvantages**:

➢ *increased shearing forces due to increased lever arm may lead to early loosening*

➢ *higher rate of dislocation*

➢ *limited amount of leg lengthening*

➢ *can only use a very small acetabular component with a small acetabular cup and thin PE, the ceramic bearing surface is often not possible because a bigger acetabular shell is needed.*

Viva 2

A 38-year-old man presents to you with a 6-week history of bilateral hip pain. There is no history of trauma.

- What do you see?
- What is AVN?
- What further information would you want from this gentleman on history?
- What is the aetiology and what risk factors are associated with this condition?
- What is the pathophysiology of AVN?
- What other areas are commonly affected?
- How does AVN of the hip present?
- What further investigations would you request if any? And why?
- How is AVN classified?

A 38-year-old man presents to you with a 6-week history of bilateral hip pain. There is no history of trauma.

- Any other classification systems?
- what is crescent sign?
- What is the Kerboull necrotic angle and its importance?
- What treatment options are available?
- How you would treat this patient?
- What complications can occur with a free vascularized fibular graft?
- What is the natural history of the disease?

What do you see?

- *This is an anteroposterior (AP) view of the pelvis showing increased density and sclerosis of both hips, more obvious in the left hip. Features suspicious of bilateral AVN. With no evidence of subchondral collapse with mild distortion of the normal shape of the femoral head in left side.*
- *Atraumatic AVN is bilateral in 80% but typically asymmetrical.*

What is AVN?

- *AVN is the death or necrosis of bone due to interruption of the blood supply to the femoral head.*
- *It commonly affects patients in the third, fourth, or fifth decades of life.*
- *Affecting men more than women 4:1*

What further information would you want from this gentleman on history?

- *history of steroid use, alcohol abuse and whether he has had any radiotherapy.*
- *Also it is essential to rule out sickle-cell disease, Gaucher's disease and decompression sickness, malignancy, thrombophilia, SLE*

What is the aetiology and what risk factors are associated with this condition ?

- The aetiology of AVN remains unclear and is likely to be multifactorial. Factors thought to contribute to the disruption of the microcirculation include:

- Trauma. The most common cause
- Caisson disease (dysbaric osteonecrosis, also known as divers disease, caused due to release of nitrogen gas bubbles that impinge the blood vessels)
- High alcohol intake
- Autoimmune disease: Systemic lupus erythematosus (SLE)
- Corticosteroid usage
- Ionizing radiation
- Haemoglobinopathy (sickle cell anaemia)
- Gaucher's disease
- Hypercoagulation disorders (Thrombophilia – low protein C or S)
- Idiopathic (40 %)

What is the pathophysiology of AVN?

- *Interruption of the blood flow to the femoral head can occur in one of five areas:*

➢ ***Extraosseous arterial factors:*** *are the most important. The femoral head is at increased risk because the blood supply is an end-organ system with poor collateral development. Blood supply can be interrupted by trauma.*

What is the pathophysiology of AVN?

- *Interruption of the blood flow to the femoral head can occur in one of five areas:*

➢ ***Intraosseous arterial factors:*** *may block the microcirculation of the femoral head through circulating microemboli. These can occur in sickle cell disease (SCD), fat embolization or air embolization from dysbaric phenomena.*

What is the pathophysiology of AVN?

- *Interruption of the blood flow to the femoral head can occur in one of five areas:*

➢ ***Extraosseus extravascular (capsular) factors:*** *involve the tamponade of the lateral epiphyseal vessels located within the synovial membrane, through increased intracapsular pressure. This manifests as trauma, infection and arthritis, causing hip effusion that may affect the blood supply to the epiphysis.*

What is the pathophysiology of AVN?

- *Interruption of the blood flow to the femoral head can occur in one of five areas:*

➢ ***Intraosseous extravascular factors:*** *affect the femoral head by increasing the Intraosseous pressure, resulting in a femoral head compartment syndrome. For example: fat cells hypertrophy after steroid administration, or abnormal cells, such as Gaucher.*

What is the pathophysiology of AVN?

- *Interruption of the blood flow to the femoral head can occur in one of five areas:*

➢ ***Intraosseous venous factors:*** *affect the femoral head by reducing venous blood flow and causing stasis. These factors may accompany conditions such as Caisson disease, SCD*

What other areas are commonly affected?

- *humeral head.*
- *capitellum (Panner’s disease).*
- *Scaphoid (Preiser's disease)*
- *lunate (Kienböck’s disease)*
- *medial femoral condyle.*
- *Talus.*
- *Navicula (Kohler’s disease).*
- *metatarsal head (Freiberg’s disease)*

How does AVN of the hip present?

- *Early in the disease process, the condition is painless, however, the patient may present with hip pain, localized to the groin area, but occasionally radiates to the ipsilateral buttock and knee.*
- *pain is usually a deep intermittent, throbbing pain, with an insidious onset.*
- *Painful symptoms are usually exacerbated with weight bearing but relieved by rest, eventually occurs at rest and may be present or even worsen at night.*

How does AVN of the hip present?

- *Physical examination reveals pain with both active and passive range of motion, especially with passive internal rotation.*
- *Range of motion is important as this helps determine the extent of the disease. In general, more limited flexion and abduction indicate more extensive articular damage, whereas limited internal rotation alone may indicate less destruction.*
- *A careful examination of the contralateral hip should always be undertaken as AVN is bilateral in 40–80% of cases.*

What further investigations would you request if any? And why?

- ***MRI***

➢ *Most sensitive and specific means of diagnosing AVN.*

➢ *90% sensitive &100% specific*

➢ *MRI may detect disease as early as 5 days after an ischemic insult.*

➢ *To evaluate how much of the bone is affected*

➢ *May show early asymptomatic AVN (in the opposite hip)*

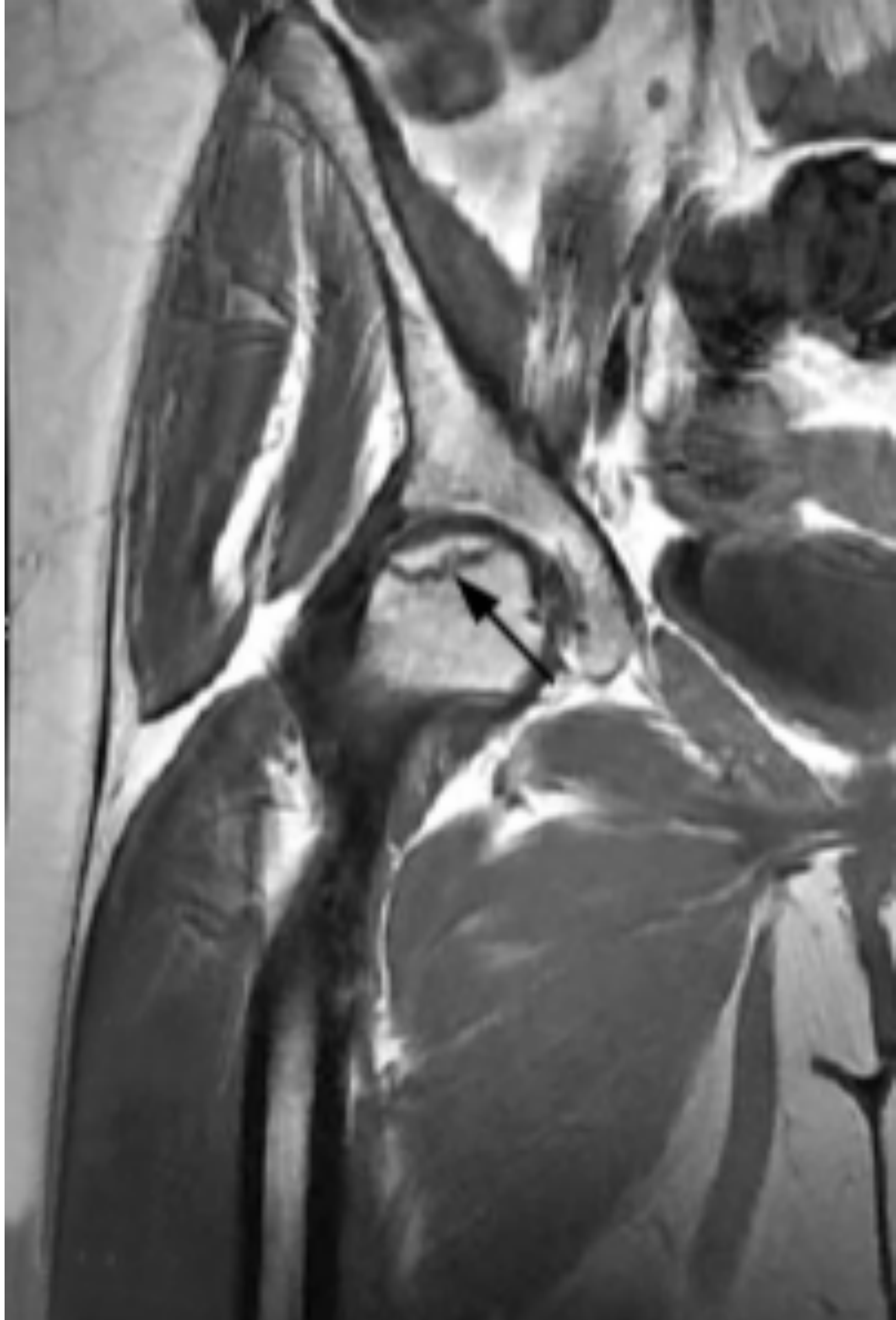
➢ *Detects early changes that may not show up in an x-ray*

What further investigations would you request if any? And why?

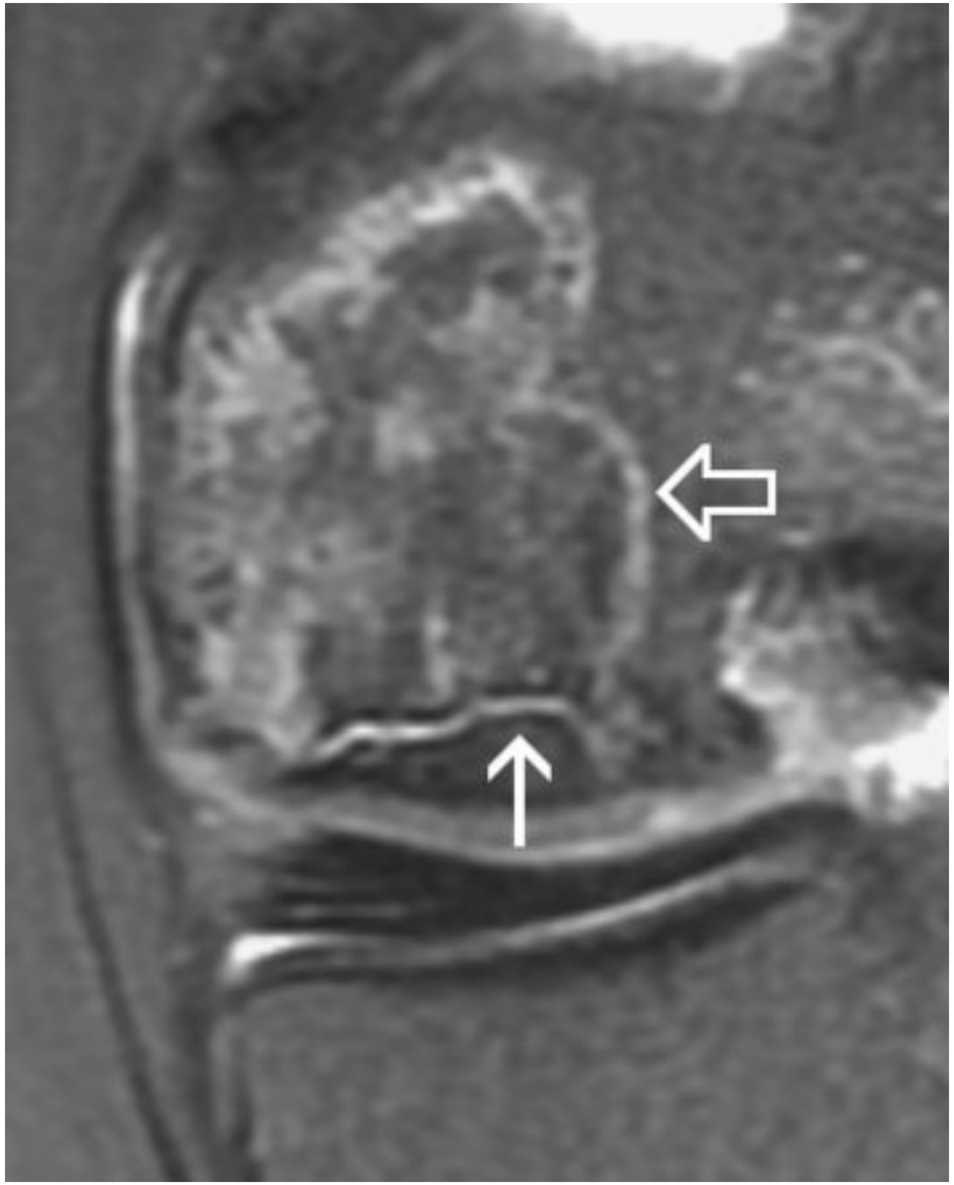
- ***MRI***

➢ *Shows low signals in T1 and high signal in T2 (representing edema)*

➢ *A single-density line on T1-weighted images delineates the necrotic–viable bone interface*



- *Double density line sign is pathognomonic for AVN it* consists of an inner bright T2 line representing granulation tissue and surrounding dark zones representing adjacent sclerotic bone.



How is AVN classified?

- *Several classification systems for AVN exist.*
- *Radiographic staging of AVN was first proposed by Ficat and Arlet in the 1968 and is one of the most simple to use, includes 4 stages:*

➢ *Stage 1: no bony changes seen on plain X-ray. Known as the silent hip.*

➢ *Stage 2: sclerotic and cystic changes within the femoral head . A: no collapse. B: crescent sign (subchondral collapse)*

➢ *Stage 3: flattening of the femoral head*

➢ *Stage 4: secondary osteoarthritis with decreased joint space and articular collapse*

- *It doesn't grade the severity of the disease and It doesn't quantify the size and extent of the lesion.*

Any other classification systems?

- *Steinberg expanded the staging system into seven stages and quantified the amount of involvement of the femoral head* ***based on radiographs into:***

- *mild A(< 15%)*
- *moderate B(15–30%)*
- *severe C(> 30%)*

- *It is considered more useful than Ficat because it grades the severity and extent of the involvement, both of which are thought to affect prognosis.*

Steinberg Classification (modification of Ficat classification)		
Stage	*Radiographs*	*MRI*
0	normal	normal MRI and bone scan
I	normal	abnormal MRI and/or bone scan
II	cystic or sclerosis changes	abnormal MRI and/or bone scan
III	crescent sign (subchondral collapse)	abnormal MRI and/or bone scan
IV	flattening of femoral head	abnormal MRI and/or bone scan
V	narrowing of joint	abnormal MRI and/or bone scan
VI	advanced degenerative changes	abnormal MRI and/or bone scan

Any other classification systems?

- *Mitchell MRI staging classification of AVN*

➢ *Class A: bright on T1, intermediate on T2 (fat)*

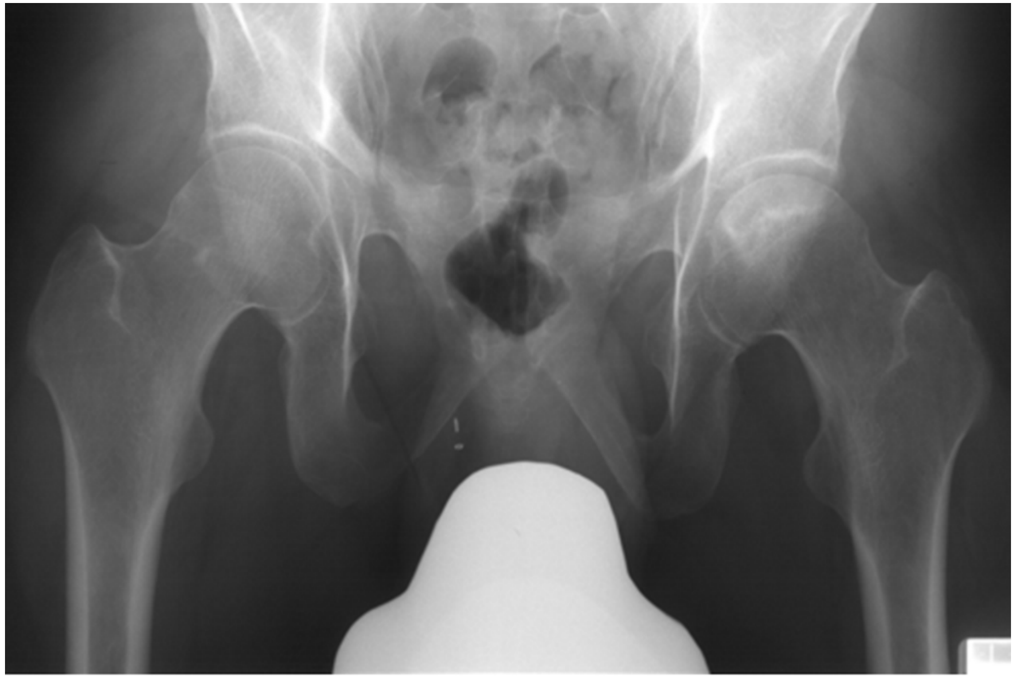
➢ *Class B: bright on T1 and T2 (blood)*

➢ *Class C: intermediate on T1, bright on T2 (fluid or edema)*

➢ *Class D: dark on T1 and T2 (fibrous tissue)*

what is crescent sign?

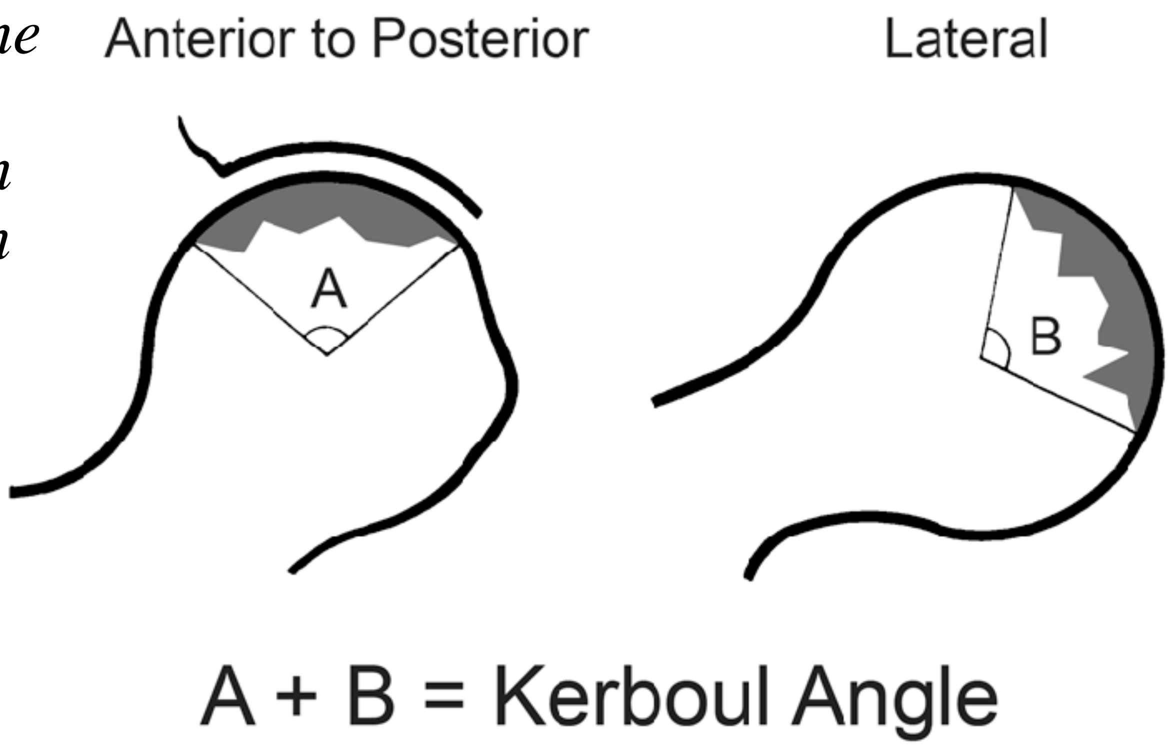
- A linear subcortical lucency, situated immediately beneath the subcortical bone, representing a fracture line and impending femoral head collapse



Osteonecrosis
Xray.Ap.Pelvis: Shows crescent sign of left femoral head (Ficat III)

What is the Kerboull necrotic angle and its importance?

- *The kerboull necrotic angle is used to calculate the size of the necrotic segment. It is the sum of the angle of the necrotic segment as measured on both the AP and frog-lateral radiographs. Patients with a Kerboull angle > 200 has poor results with certain head preserving procedures.*
- *Modified Kerboull necrotic angle is measured on mid-sagittal and mid-coronal MRI*



how you would treat this patient?

- ***<u>The choice of management depends on:</u>***

➢ *Patient age*

➢ *Cause*

➢ *Extent of the disease*

➢ *Rate of progression*

- ***<u>Goals of management:</u>***

➢ *Address and eliminate (if possible) underlying risk factors (if present)*

➢ *Relieve pain*

➢ *Improve function*

➢ *Prevent or delay progression*

➢ *Minimize morbidity*

What treatment options are available?

- *In the absence of level I evidence, it is not possible to make definitive treatment recommendations. However, based on the available data, treatment recommendations can be summarized as follows: (Simple algorithm)*

➢ *Patients with small asymptomatic lesions → follow up with serial clinical and radiographic examination*

➢ *Patients with symptomatic small lesions in pre-collapse hips can be treated with → head-sparing(preserving) procedure (Core decompression – Rotational osteotomies)*

➢ *large lesions in pre-collapse hips → may be treated with a head-sparing procedure in younger patients, but it is reasonable to consider THA in older patients.*

➢ *patients with collapsed femoral head should not have a femoral head-sparing procedure → THA is the most reliable option for these patients*

What treatment options are available?

- Small asymptomatic lesions do not warrant surgical intervention and are closely monitored with serial examination.
- If symptoms ensue, repeat imaging and surgical treatment are indicated

❖ *Patient follow-up continued until collapse or for a minimum of 5 years when no collapse occurred.*

how you would treat this patient?

- Identification and elimination of risk factors. (alcohol –steroids)
- In pre-collapse stages I would start with conservative management which includes:

➢ *Adequate pain control.*

➢ *Activity modification.*

➢ *It has been now universally agreed that conservative treatment of AVN by restriction of weight bearing is not appropriate*

➢ *Contraindication of impact sports participation, The athlete can maintain fitness with swimming, biking.*

➢ *Bisphosphonates to delay femoral head collapse (trials have shown that alendronate prevents femoral head collapse in osteonecrosis with subchondral lucency. However, other studies have also shown no benefit of preventing collapse with bisphosphonates)*

how you would treat this patient?

- It is thought that the success seen in smaller lesions is due to the natural history of these lesions which often do not progress to collapse even in the absence of any treatment.

how you would treat this patient?

➢Core decompression:

- *This is simple, safe and a relatively successful way of managing early-stage AVN. It effectively relieves intraosseous venous hypertension, increases vascularity and stimulates bone healing, which reduces hip pain and prevent collapse.*
- *Results have been satisfactory when core decompression is combined with either non-vascularized or vascularized fibular grafts in patients with Ficat stage II lesions.*
- *Some studies showed superior results with vascularized grafting.*
- *Core decompression prevents AVN from progressing to severe OA and the need for THR in 25% to 85% of cases I &II.*
- *achieves the best results when AVN is diagnosed in its early stages and in small lesions (<15 % of femoral head or Kerboul angle <200°)*

how you would treat this patient?

➢ Core decompression:

- *It takes a few months for the bone to heal, and a walker or crutches will be needed to prevent putting stress on the damaged bone.*
- *When AVN is diagnosed after collapse CD is not usually successful & the best treatment is with THR(in other words don't do CD for stage 3 and 4)*

how you would treat this patient?

➢Core decompression: technique

- *The patient is placed under anesthesia on traction table which allows fluoroscopic guidance in the lateral and antero-posterior directions and is then prepared and draped in an aseptic manner. Under fluoroscopic guidance, entry point is identified laterally, but superior to the lesser trochanter medially, 1.5 cm incision is made. A 3.2-mm diameter fluted guide wire is introduced into the necrotic lesion. Once it is determined that the guide wire is in the appropriate place, an 8- to 10-mm-wide cannulated drill bit is used to extend the diameter of the drill hole and a wire-guided trephine is used to harvest the cancellous bone from the femoral neck with care not to penetrate the femoral head nor to violate the articular cartilage.*
- *A core of bone is removed from the lesion and filled with:*

➢ *bone graft (vascularised/non vascularised)*

➢ *Mesenchymal stem cells*

➢ *tantalum rod*

how you would treat this patient?

- Core decompression: technique

- *Following surgery, patients are discharged home the same day and are allowed 50 % weightbearing on the affected leg, for 6 weeks. After 6 weeks, patients can progress to full weight-bearing. Patients are then given abductor strengthening exercises and educated to avoid high impact activities for 1 year*

how you would treat this patient?

- Trapdoor procedure:

- *This is indicated for pre-collapse.*
- *The patient lay in the lateral decubitus position. An anterolateral approach. The anterior two thirds of gluteus medius and all of gluteus minimus are elevated from the bone to expose the capsule of the hip. The capsule is incised at the superior rim of the acetabulum. The hip is dislocated and the area of the segmental collapse exposed and opened like trapdoor. Necrotic bone is removed and a power burr is used to expose bleeding bone. The defect is then filled with cancellous bone graft.*

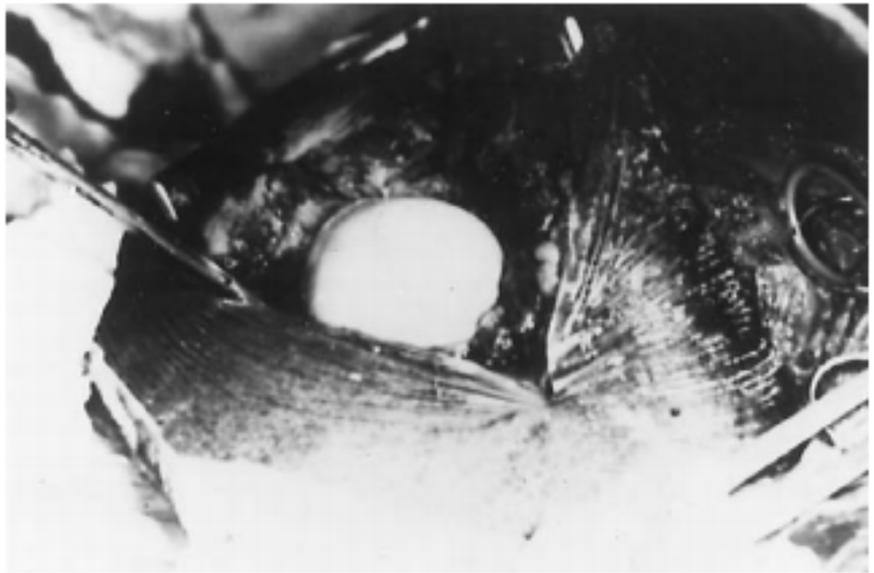


Fig. 2a

Fig. 2b

Fig. 2c

Fig. 2d


R

the patient underwent this procedure. What can you see?

- *The patient had core decompression performed on the left hip and a core decompression with tantalum rod inserted in the right hip. This functions as a structural graft to provide mechanical support and allows bone growth into the femoral head.*
- *Advantages of tantalum rod: It avoids the morbidity associated with autogenous bone harvesting and the risk of disease transmission with allograft bone*

What complications can occur with a free vascularized fibular graft?

- *sensory deficit*
- *motor weakness*
- *FHL contracture*
- *tibial stress fracture from side graft is taken*

What are other options of treatment?

❖ **Realignment osteotomy**

➢ Indicated in small lesions (<15%) in which the lesion can be rotated away from a weight bearing area in young patients

➢ Performed at the intertrochanteric area either angular (varus – valgus) or rotational

➢ Varus rotational osteotomy.

➢ Outcomes: reported success rate of 60% to 90%-distorts the femoral head making THA more difficult

What are other options of treatment?

- **Hip arthrodesis**
  - Indicated in the young patient with unilateral disease (trauma) in a labour intensive occupation.

What are other options of treatment?

❖ **Resurfacing arthroplasty**

➢ Current recommendations are that resurfacing is contraindicated if the avascular area exceeds one third of the femoral head.

❖ **Total hip arthroplasty**

➢ Indicated in advanced stages-irreversible etiology (chronic steroid use).

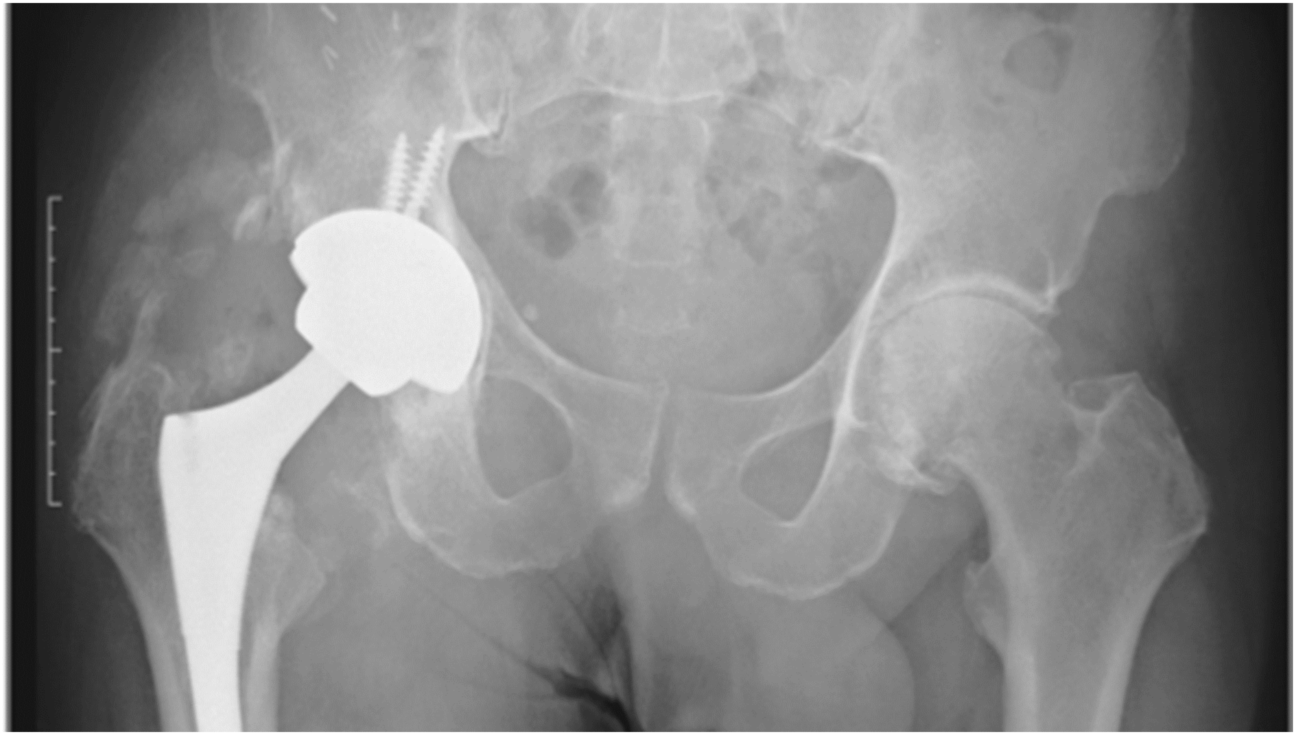
What is the natural history of the disease?

- *If AVN untreated, progression to subchondral collapse occurs in 67% of individuals with asymptomatic hips and in more than 85% of symptomatic hips.*
- *Prognostic factors for progression include: the extent of the osteonecrotic lesion (Kerboul angle),location of the lesion within the femoral head (> 2/3 of wt bearing area), and the presence of bone marrow edema in the proximal femur.*

❖ *Transient osteoporosis of the hip should be included in the differential diagnosis when osteonecrosis is suspected. Transient osteoporosis of the hip, commonly affecting pregnant women and men in the fifth and sixth decades of life, presents with severe groin pain and an antalgic gait. MRI demonstrates bone marrow edema extending into the femoral neck and metaphysis. A differentiation between osteonecrosis and transient osteoporosis is essential because the latter is a self-limiting condition.*

Viva 3

- Describe the abnormalities on the radiograph, taken three months after revision hip arthroplasty.
- What is the pathological process of HO?
- What are the risk factors of Heteropic ossification in THA?
- What is the common classification used for this disease process?
- What can be done to reduce the incidence of this process?
- How would you treat this patient?



Describe the abnormalities on the radiograph, taken three months after revision hip arthroplasty.

- *This is an A/P radiograph of the pelvis and both hips of a woman taken on the X date, shows right THR. There is heterotopic ossification (HO) around the right hip joint looks like grade III according to Brooker classification.*
- *the x-rays also show features of osteoarthritis in the left hip, and there is an element of LLD*

What is the pathological process of HO?

- *Heteropic ossification is formation of bone within soft tissue.*
- *It is thought to be due transformation of primitive cells of mesenchymal origin, present in the connective tissue septa within muscle, into osteogenic cells*
- *It is associated with painless reduced ROM*

What are the risk factors of Heteropic ossification in THA?

- *Hypertrophic OA*
- *Inflammatory arthritis.*
- *Male gender.*
- *Obesity.*
- *Prolonged surgical time*
- *Excessive soft tissue handling.*
- *Revision surgery of the hip*

What is the common classification used for this disease process?

- ***Brooker grading system(for HO in THA):***

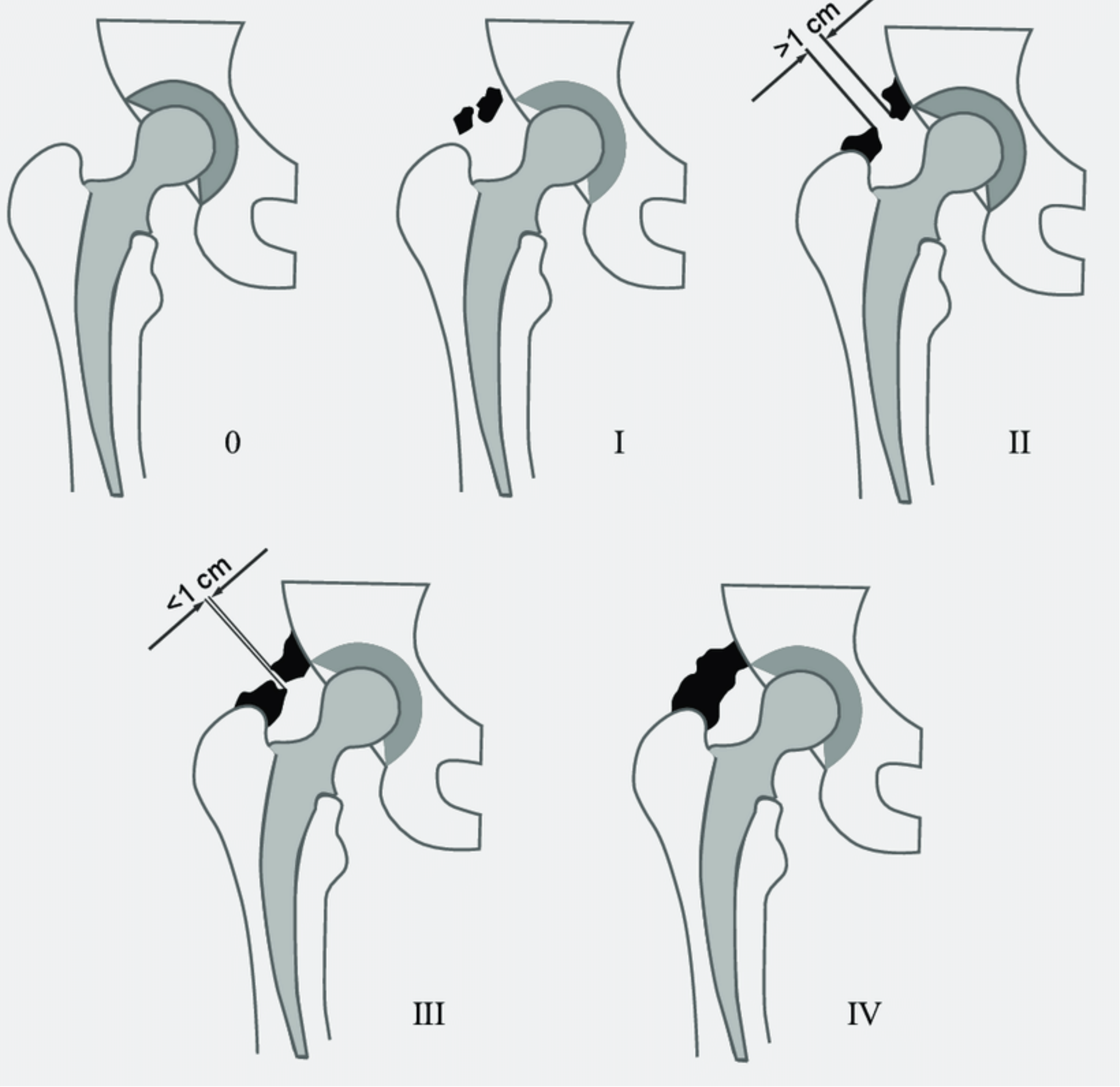
➢ *Grade 0: no ossification.*

➢ *Grade I: There are islands of bone in the soft tissue about the hip.*

➢ *Grade II: there are bone spurs from the pelvis or proximal end of the femur, with at least 1 cm between the opposing surfaces of bone.*

➢ *Grade III: the bone spurs from the pelvis or proximal end of the femur reduce the space between the opposing surfaces to <1cm.*

➢ *Grade IV: osseous ankylosis of the hip*


0
I
>1 cm
II
<1 cm
III
IV

What can be done to reduce the incidence of this process?

- *Non-steroidal anti-inflammatory drugs (NSAIDs) and radiation have been shown to reduce the incidence of HO.*
- *Indomethacin 25mg TID (3 to 6 weeks) or radiation 600 – 800 cGy within 24 – 72 hours following the surgery or within 24 hours pre operative.*

How would you treat this patient?

- *I would like to take detailed history of this patient and perform proper examination. After exclusion of all the other causes of hip pain, I would recommend the patient to wait for more 3 months at least allowing complete maturation and formation of the capsule, surgical excision prior to complete maturation is associated with high risk of recurrence.*
- *I would like to follow the patient with repeated serum ALP level, which is elevated initially and return to normal upon maturation. Another method is bone scan, which will show decreased activity once the HO has matured.*
- *It takes around 6 months for complete maturation of the HO*

Viva 4

- Describe the X-ray
- Who are the best candidates for this procedure? (Indications)
- What are the contraindications for resurfacing?
- What are the pros and cons compared with THA?
- What are the outcomes of hip resurfacing compared with conventional THA?
- What factors are associated with higher revision rates for hip resurfacing procedures?
- Is resurfacing contraindicated in women of childbearing age?
- what is the preferred size of components of resurfacing?

Describe the X-ray

- *The anteroposterior (AP) radiograph demonstrates right hip resurfacing with higher abduction (cup) angle.*
- *It is a procedure that preserves the proximal femur.*
- *Prior versions of resurfacing have failed due to large femoral head on PE which led to high volumetric wear and osteolysis.*

Who are the best candidates for this procedure? (Indications)

- *Young patients with advanced OA + good bone stock with the following:*

➢ *Proximal femur deformity making THA difficult.*

➢ *High risk of sepsis.*

➢ *Neuromuscular disorders*

- *The best outcome is seen in young male patients with good bone stock.*

What are the contraindications for resurfacing?

- ***Absolute:***

➢ *Proximal femoral bone insufficiency (cysts-notching..)*

➢ *Abnormal acetabular anatomy (small).*

- ***Relative:***

➢ *LLD. (resurfacing doesn't allow for LLD correction*

➢ *Coxa vara. Associated with increased risk of fracture*

➢ *Metal hypersensitivity.*

➢ *Female (controversial)*

what are the pros and cons compared with THA?

- **Pros**:

➢ Preservation of the femoral bone stock that may be advantageous in revision surgery.

➢ better restoration of hip biomechanics.

➢ Rapid recovery.

➢ Decreased dislocation rate.

➢ Ability to engage in high demand activities.

- **Cons**:

➢ higher revision rate in hip resurfacing compared with conventional THA.

➢ Femoral neck fracture (the most common cause of revision).

➢ Higher incidence of HO due to larger exposure.

➢ High metal ions level. (wear rate is the same)

What are the outcomes of hip resurfacing compared with conventional THA?

- *Several recent studies report identical Harris hip scores but a greater percentage of patients with resurfacing involved in high demand activities.*
- *There is a higher revision rate with hip resurfacing when compared to conventional THA.*

What factors are associated with higher revision rates for hip resurfacing procedures?

- *AVN.*
- *hip dysplasia.*
- *Coxa vara*
- *female sex.*
- *inflammatory arthritis.*
- *increased age.*
- *Bone deficiency and notching.*

Is resurfacing contraindicated in women of childbearing age?

- *Most hip surgeons would now avoid a resurfacing procedure in a female regardless of whether they were of childbearing age or not.*

what is the preferred size of components of resurfacing?

- *The size of the components of resurfacing may have an influence on the survival of the prosthesis. It has been reported that component of less than 44mm is associated with a five fold risk of revision*

Viva 5

72-year-old man reports persistent, progressively worsening pain in his hip after undergoing a total hip arthroplasty 15 months ago

- Describe the radiograph
- How are you going to proceed with this patient?
- How are blood tests going to help you?
- Normal inflammatory markers. What are you going to do next?
- Are you aware of any diagnostic criteria used for diagnosis of PJI?
- How do you classify periprosthetic hip infection?
- What are the treatment options for PJI?

describe the radiograph

- *This A/P radiograph of the Left hip, date & name are not displayed, shows THR, there are radiolucencies in Gruen zones 1,2,4,5,7. there is periosteal bone formation about the meta-diaphyseal region of the femur with scalloping resorption.*
- *The femoral stem orientation appears neutral. I would like to see immediate postoperative radiographs to confirm whether there has been a change in stem position from the time of the original surgery and would also like to see an up-to-date lateral radiograph of the hip.*
- *Radiographic features are highly suggestive of infection until proven otherwise.*

How are you going to proceed with this patient?

- *I would like to take a full history from this patient:*

➢ *What was the indication for THR? And what was his expectation from the surgery?*

➢ *How the postoperative course? Any perioperative complications?*

➢ *How was the wound condition postoperatively? Any wound healing problems?*

➢ *Was there any period of pain-free interval post* THR?

➢ *The nature of the pain should be carefully analysed, including its character, location, radiation, aggravating and relieving factors. (Pain from an infected prosthesis is typically non-mechanical and unrelated to physical activity and not relieved by rest)*

How are you going to proceed with this patient?

- *I would enquire if there was a history provocative event: bacteraemia from a UTI, chest infection or dental extraction – colonoscopy.*
- *Medical condition of the patient and fully assess to his fitness for anaesthesia and surgery.*
- *The wound should be inspected for any signs of infection (erythema, discharge, warmth, and tenderness)*
- *I would perform routine blood tests including CRP and ESR*

How are blood tests going to help you?

- *ESR (peaks 5-7 days after surgery returns to normal 90 days) and CRP (peaks 2-3days after surgery, returns to normal at 21 days) are the baseline screening test even when there is a low suspicion of infection.*
- *They have high sensitivity and low specificity as they are nonspecific markers of inflammation,*
- *When both ESR and CRP are negative, periprosthetic infection is unlikely, however when both tests are positive PJI must be considered. (Their combined use is a very good 'rule out' test)*
- *A full blood count including a white blood cell (WBC) count is part of the routine workout for patients with suspected PJI, however recent evidence suggests that serum WBC and differential carries a very low sensitivity (55% and 52% respectively) and specificity (66% and 75%) respectively.*

Normal inflammatory markers. What are you going to do next?

- *I would perform hip aspiration under fluoroscopic guidance*.
- *Various approaches have been described (medial-anterior-lateral)*
- *Informed consent should be obtained from the patient explaining all the risks & benefits from the procedure*, the patient is placed supine with the lower extremity in neutral or slight internal rotation to provide better visualization of the femoral neck, the skin is cleansed and draped using aseptic technique, *using anterior approach: the femoral artery pulse is palpated and marked on the skin. The skin entry is 2cm lateral to the femoral artery(midway between the pubic symphaysis and ASIS) and 2cm inferior to the inguinal ligament is marked on the skin. Local analgesia is achieved by infiltrating the skin, subcutaneous tissue and the deep tissue bed with lidocaine*. A 3.5-inch spinal needle is generally used.

Normal inflammatory markers. What are you going to do next?

- *needle placement along the medial aspect of the femoral neck is often preferred for aspiration procedures because the capsule tends to be more redundant at this location allowing for easier acquirement of joint fluid. The needle is advanced until it contacts the bone. Or use lateral approach: greater troch is palpated & needle inserted just anterior to its superior tip; needle is directed 45 deg cephalad, & parallel to table*
- *Aspirated fluid should be sent to culture and sensitivity, WBC count & Neutrophils percentage.*
- *A WBC count higher than 1100 cell/µl for knees and > 3000 cell/ µl for hips or a PMN percentage greater than 64% in knees and >80% in hips is highly suggestive of chronic PJI, however these values are not applicable when diagnosis acute PJI.*
- *in cases of inconclusive aspirate and peripheral lab data → repeat aspiration.*

Aspiration results came negative. What are you going to do next?

- *if infection is suspected, but cannot be confirmed by aspiration or blood work → Positron emission tomography (PET) which identifies areas of high metabolic activity using fluorinated glucose. 98% sensitivity and 98% specificity.*
- *Other imaging modalities, including imaging of labeled leukocytes and gallium imaging, have been recommended , but these recommendations are based on weak to moderate evidence.*

Are you aware of any diagnostic criteria used for diagnosis of PJI?

- ***Musculoskeletal Infection Society (MSIS) analysed the available evidence to propose a new definition for prosthetic joint infections***

❖ ***Major criteria (diagnosis can be made when [1] major criteria exist)***

➢ *sinus tract communicating with prosthesis, or*

➢ *pathogen isolated by culture from 2 separate tissue/fluid samples from the affected joint*

❖ ***Minor criteria (diagnosis can be made when [4/6] of the following minor criteria exist)***

➢ *elevated ESR (>30mm/h) or CRP (>10mg/L)*

➢ *elevated synovial WBC (>1,100cells/ul for knees, >3,000cells/ul for hips)*

➢ *elevated synovial PMN (>64% for knees, >80% for hips)*

➢ *purulence in affected joint*

➢ *pathogen isolation in 1 culture*

➢ *>5 PMN per hpf in 5 hpf at x400 magnification (intraoperative frozen section of periprostehtic)*

How do you classify periprosthetic hip infection?

Type of infection	Definition	Etiology
Acute postoperative infection	Infection within first month	Frequently caused by S. aureus, Streptococcus, Gram-negative
Late chronic infection	Occurs several months to 2 years after prosthesis implant	Caused by less-virulent organisms : coagulase-negative Staphylococcus, gram-negative
Hematogenous seeding	Acute onset of symptoms in a previously well-functioning joint within days after inciting event	Inciting events : skin infection, dental extraction, RTI, UTI

What are the treatment options for PJI?

- *The management depends on the following factors*

➢ *The duration of symptoms.*

➢ *Physiological status of the patient and the overall health characteristics.*

➢ *History of PJI in the current joint and all other joint.*

➢ *Characteristics of the infection organism*

What are the treatment options for PJI?

❖ ***Antibiotic suppression***

- *Medically unfit for major surgery.*
- *The infective organism is of low virulence.*

❖ ***Irrigation & debridement with exchange of the PE***

- Indicated in patients with acute onset of symptoms(<3 weeks after surgery or acute hematogenus infection with symptoms less than 48-72 hours), a well-fixed and aligned implant, an antibiotic-susceptible organism, and sufficient soft-tissue coverage.

What are the treatment options for PJI?

❖ ***SSRA vs TSRA***

- *Two-stage revision is regarded by many as the best treatment of chronic infection in joint arthroplasties*
- *Most of the studies that comparing single stage to two stage revision arthroplasty favored the two stage technique and showed failure rate and reinfection rate are higher in SSRA compared to TSRA*

What are the treatment options for PJI?

❖ ***Salvage procedures (Resection arthroplasty – Arthrodesis)***

- *poor bone and soft tissue quality*
- *recurrent infections with multi-drug resistant organisms*
- *medically unfit for multiple surgeries*
- *failure of multiple previous reimplantations*
- *elderly non-ambulatory patients*

What factors are involved in reducing the infection rate in THR surgery?

❖ ***Preoperative factors**:*

- ➢ *Separation of elective from trauma cases*
- ➢ *All septic lesions should be examined and treated (feet, urinary, dental)*
- ➢ *Shave in the anaesthetic room (not night before)*

What factors are involved in reducing the infection rate in THR surgery?

- ***Perioperative factors**:*
  - *Antibiotic prophylaxis: systemic antibiotics*
  - *Surgical technique: gentle handling of tissues, careful haemostasis, limitation of haematoma formation, length of surgery, wound lavage, etc.*
  - *Movement: avoid unnecessary theatre personnel movement during surgery*
  - *Face masks: BOA guidelines*
  - *Gowns: modern, weaved patterns*
  - *Gloves and hands: two pairs of gloves, changing the outer ones frequently*
  - *Head gear: no hair exposed*

What factors are involved in reducing the infection rate in THR surgery?

- ***Perioperative factors**:*
  - *Sterile drapes: disposable non-woven drapes*
  - *Ventilation system: laminar--flow, ultra-clean-air system*

Viva 6

- What can you see?
- What is Protrusio acetabuli?
- What are the types of Protrusio acetabuli?
- How do you grade protrusio?
- What is the difference between Coxa profunda and Protrusio acetabuli?
- What is the surgical treatment option in skeletally immature and young adult patients?
- What are the considerations in THA?

What can you see?

- *This is an A/P radiograph of the pelvis, both hips and proximal femur of a woman, taken on X date, shows bilateral protrusio acetabuli which are noted by: sunken acetabulum, there is medial displacement of both the medial wall of the acetabulum and femoral heads, femoral heads are medial to ilio-ischial line, with obliteration of the tear drop bilaterally.*
- *There is increased lateral Centre edge angle of Wiberg.*

What is Protrusio acetabuli?

- *It is medial intrapelvic displacement of the medial wall of the acetabulum.*
- *Normally on an AP radiograph the medial wall of the acetabulum lies 2 mm lateral to the ilioischial line in a male and 1 mm medial to this line in a female.*
- *Protrusio is present if the medial wall of the acetabulum is 3 mm or more medial to the ilioischial line in a male or >6 mm in a female.*

What are the types of Protrusio acetabuli?

- ***Primary***

➢ *It is termed Otto's pelvis.*

➢ *More common in females 10:1 ratio.*

➢ *Idiopathic. Attributed to changes in triradiate cartilage ossification*

What are the types of Protrusio acetabuli?

- ***Secondary** (**due to softening of the bone**)*

- *Osteogenesis imperfecta*
- *Osteomalacia*
- *Rickets*
- *Rheumatoid arthritis*
- *Marfan's disease*
- *Ankylosing spondylitis*
- *Paget's disease.*
- *Infection. TB*
- *Trauma. Iatrogenic fracture during surgery*

How do you grade protrusio?

- ***<u>Hirst grade</u>*** *(based on the distance of the medial wall of the acetabulum to Kohler's line)*

➢ *grade I: mild. 5 – 10 mm*

➢ *Grade II: moderate. 10 – 15 mm*

➢ *Grade III: severe > 15 mm.*

What is the difference between Coxa profunda and Protrusio acetabuli?

- *Coxa profundal is the mildest form of the protrusion acetabuli, in which the medial wall of the acetabulum touches the ilio-ischial line or slightly medial to it*

What is the surgical treatment option in skeletally immature and young adult patients?

- Valgus intertrochanteric osteotomy VITO

What are the considerations in THA?

- *Because of the medial migration of the femur, the sciatic nerve is often nearer to the joint than normal and should be identified and protected.*
- *Dislocation of the hip is difficult, femoral neck should be cut and the head is removed from the acetabulum in a retrograde fashion.*
- *Avoid over reaming of the acetabulum, the medial wall is thin. Bone graft is needed for the medial wall*
- *The cup to be placed in more lateral position and fixed with acetabular screws to avoid medial migration.*
- *Femoral stem with increased offset reduces the risk of femoral – pelvic impingement especially if short neck is used to equalize leg length.*

Viva 7

- What is the diagnosis?
- What are the types of this condition?
- how do patients with this condition present?
- What are the radiographic abnormalities that can be found in this condition?
- Outline the objectives and options of treatment?

What is the diagnosis?

- *This A/P radiograph of the pelvis and both hips show features suggestive of femoroacetabular impingement (FAI) noted by loss of normal sphericity and normal contour of the femoral head & neck.*
- *FAI is now recognized as a common cause of hip dysfunction and secondary osteoarthritis.*

What are the types of this condition?

❖ ***Cam impingement***

- *femoral based disorder is usually in young athletic males*
- *Caused by an overgrowth of the anterior and anterosuperior femoral head-neck junction that results in repetitive abutment of the acetabular rim and femoral head-neck junction.*
- *Predisposing factors include:*
  - *aspherical femoral head.*
  - *reduced head neck offset.(alpha angle)*
  - *reduced head to neck ratio.*
- *It is recognized as a sequela of common pediatric hip conditions, such as Perthes and SUFE.*

What are the types of this condition?

❖ ***Pincer impingement***

- *acetabular based disorder usually in active middle-aged women*
- *Caused by over coverage of the femoral head by deep or retroverted acetabulum. This results in degeneration, ossification and tears of the anterosuperior portion of the labrum as well as a posteroinferior countercoup pattern of cartilage loss from the femoral head.*
- *Predisposing factors:*
  - *acetabular protrusion*
  - *acetabular retroversion*
  - *malunion of an acetabular fracture.*

What are the types of this condition?

❖ ***Combined***

- *The most common type*

how do patients with this condition present?

❖ ***History***

- *Activity related hip pain (anterior or lateral), that exacerbated by hip flexion activity*
- *Difficulty with prolonged sitting.*
- *Mechanical symptoms (catching) secondary to labral and articular cartilage disease*

how do patients with this condition present?

❖ ***Physical examination***

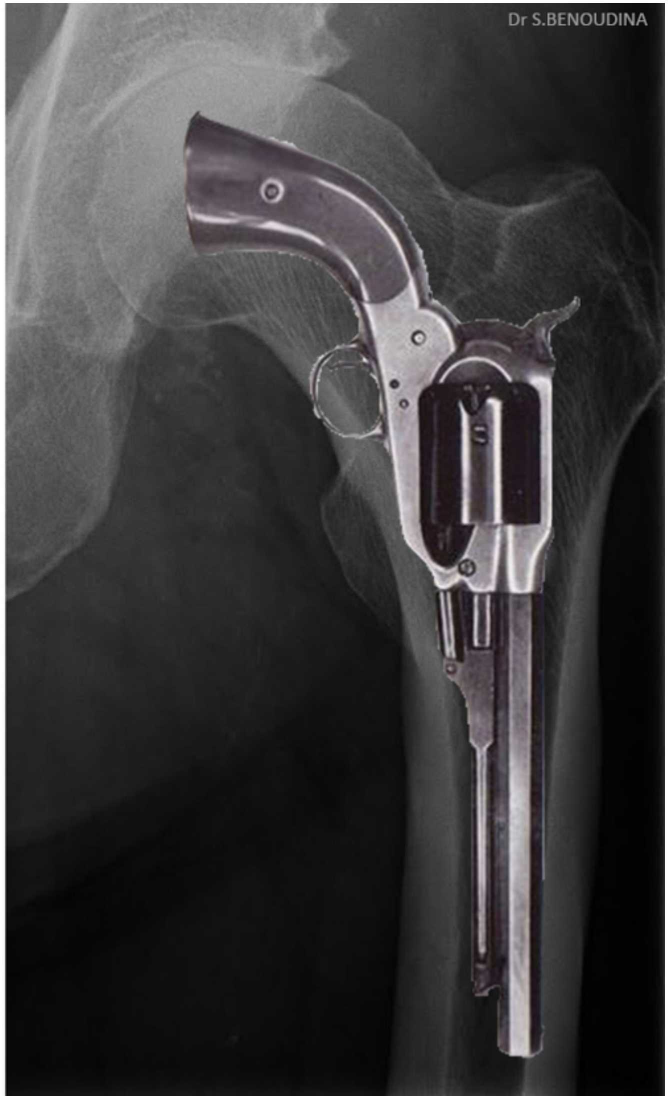
- *Painful hip ROM especially internal rotation*
- *Positive impingement test (flexion, adduction and internal rotation)*

What are the radiographic abnormalities that can be found in this condition?

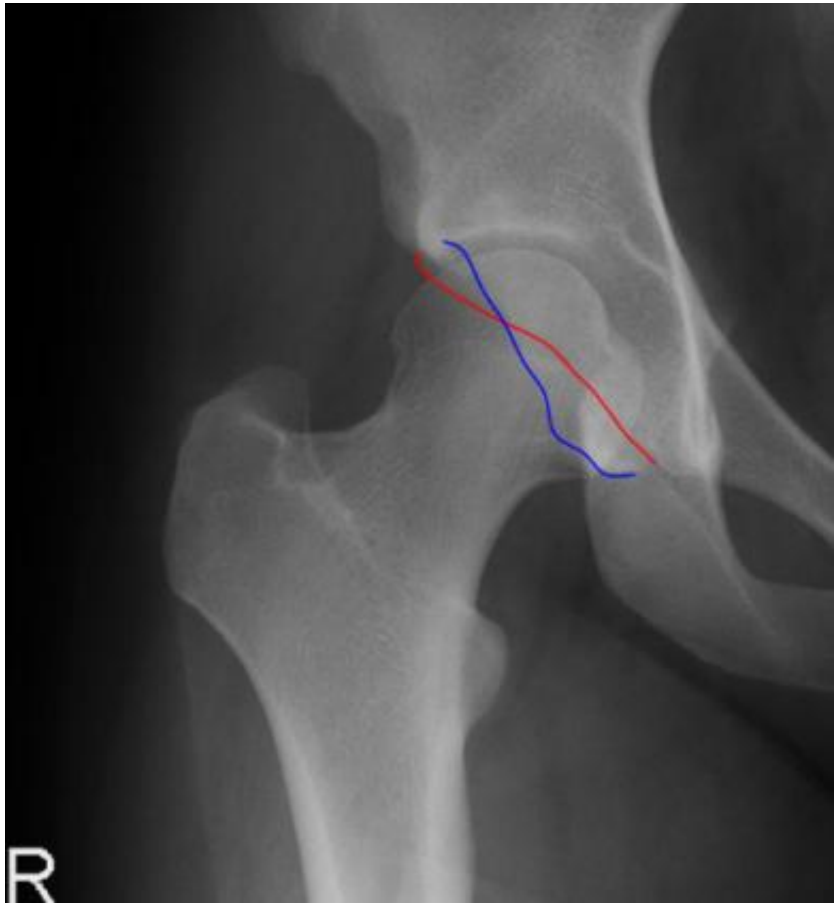
❖ ***A/P pelvis***

- *Aspherical femoral head*
- *Pistol grip deformity*
- *Cross over sing (indicates acetabular retroversion)*
- *Acetabular protrusio*

Pistol grip deformity




A



What are the radiographic abnormalities that can be found in this condition?

❖**Frog-leg lateral radiograph**

- *Alpha angle: first line is drawn connecting the centre of the femoral head and the centre of the femoral neck. Second line is drawn from the centre of the femoral head to the point on the anterolateral head-neck junction where prominence begins.*
- *values of >42° are suggestive of a head-neck offset deformity.*

Fig. 18

The technique for calculating the alpha angle on a frog-leg lateral radiograph. A line is drawn connecting the center of the femoral head and the center of the femoral neck. A second line is drawn from the center of the femoral head to the point on the anterolateral head-neck junction where the radius of the femoral head begins to increase beyond the radius found more centrally in the acetabulum where the head is more spherical (i.e., where a prominence starts). The intersection of these two lines forms the alpha angle, and values of >42° are suggestive of a head-neck offset deformity.

What are the radiographic abnormalities that can be found in this condition?

❖Cross table Lateral radiograph

- *Head-neck offset ratio: If the ratio is <0.17, a cam deformity is likely present*

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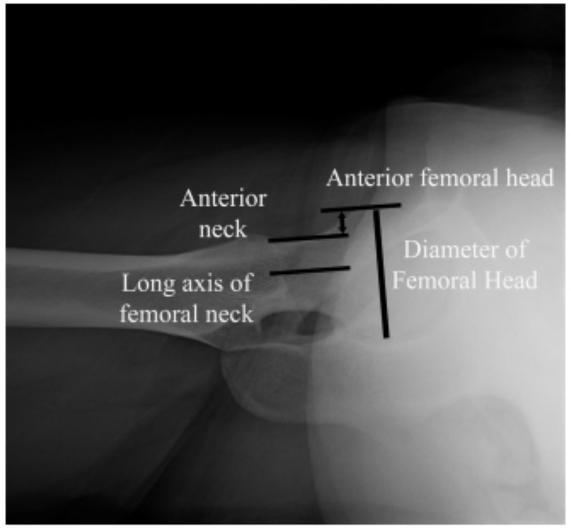


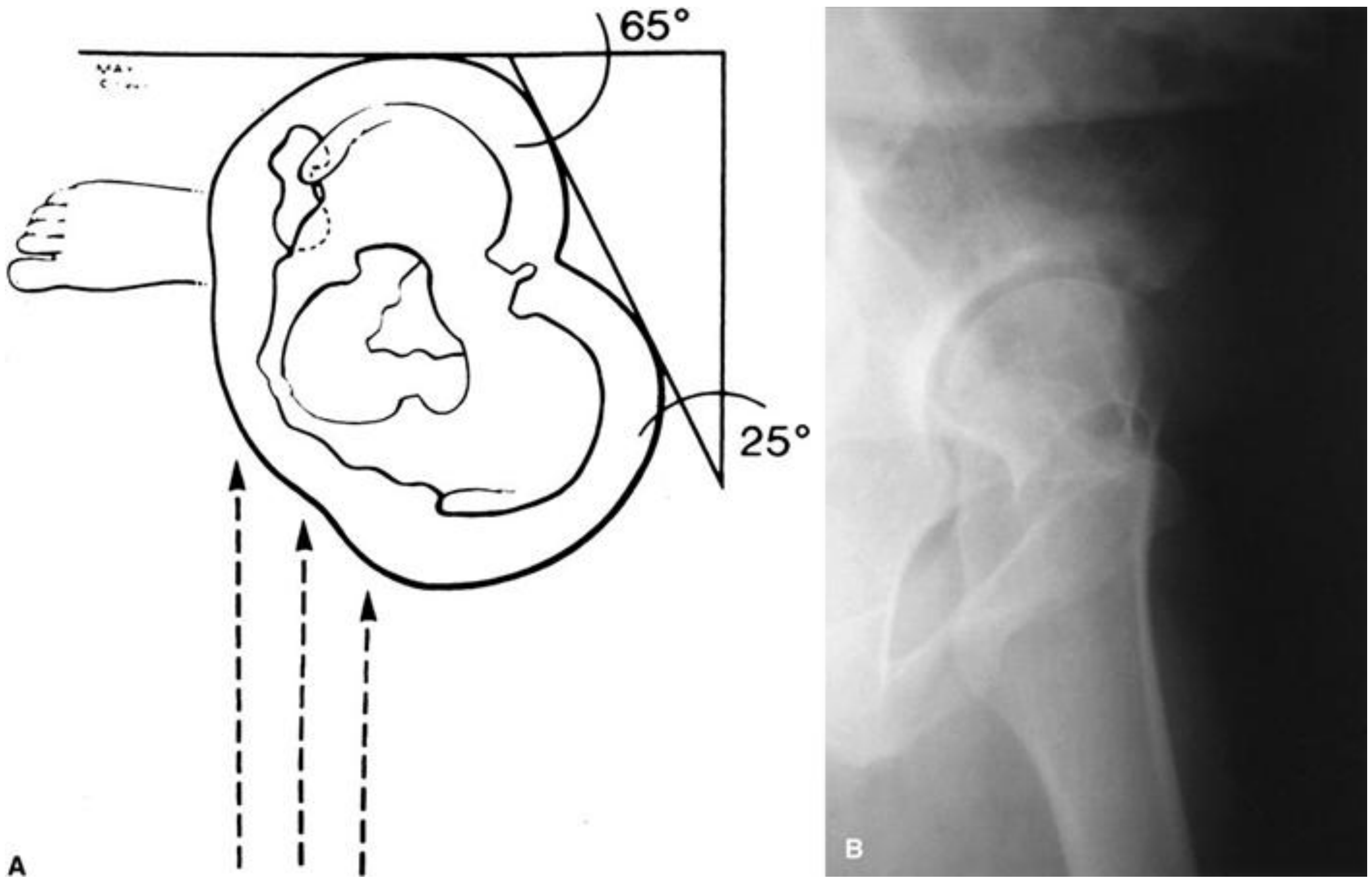
Fig. 19

The technique for calculating the head-neck offset ratio. Three parallel lines are drawn, with line 1 drawn through the center of the long axis of the femoral neck, line 2 drawn through the anteriormost aspect of the femoral neck, and line 3 drawn through the anteriormost aspect of the femoral head. The head-neck offset ratio is calculated by measuring the distance between lines 2 and 3 and dividing by the diameter of the femoral head[3]. If the ratio is <0.17, a cam deformity is likely present.

What are the radiographic abnormalities that can be found in this condition?

❖ False profile view

- *It is performed with the patient standing with the affected hip on the cassette, the ipsilateral foot parallel to the cassette and the pelvis rotated 65° from the plane of the cassette. It can be used to assess anterior coverage of the femoral head*


65°
25°
A
B

Outline the objectives and options of treatment?

❖ ***The objectives are to:***

- *Eliminate the contact between the proximal part of the femur and the acetabulum*
- *Address intraarticular labral and articular cartilage abnormalities.*

Outline the objectives and options of treatment?

❖ ***Non-operative treatment***

- *Indicated in minimally symptomatic patients with No mechanical symptoms*

Outline the objectives and options of treatment?

❖ ***Joint preserving surgery (Arthroscopy)***

- *Technique: trim femoral head/neck in Cam impingement- acetabular rim + labral debridement vs repair*

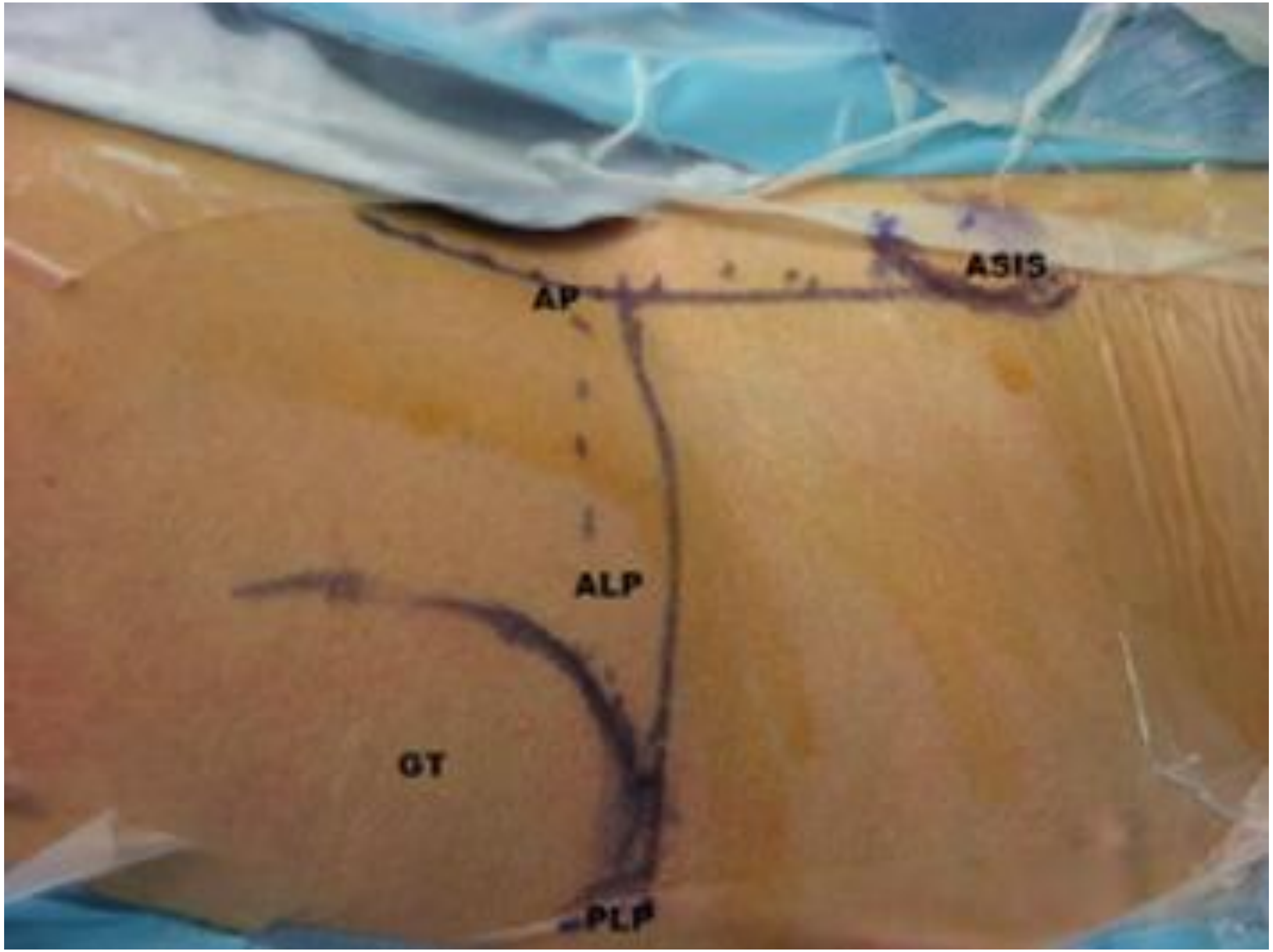
✓ *Position: supine*

✓ *Anterolateral portal: primary viewing portal – 2cm anterior and 2cm superior to anterosuperior border of GT. Superior gluteal nerve is at risk.*

✓ *Anterior portal: placed 2nd – give access to anterior joint – located at intersection between a line from GT tip with another line from ASIS – to be inserted with the hip in flexion and internal rotation to loosen the capsule after penetrating Sartorius and rectus femoris – LFCN & femoral nerve are at risk.*

✓ *Posterolateral: placed last – posterior hip access – 2cm posterior to GT tip with the hip in neutral and internal rotation to avoid injury to sciatic nerve.*

❖ ***Recent literature shows equivalent results to open hip surgery***



ASIS
AP
ALP
GT
PLP

Outline the objectives and options of treatment?

❖ ***Joint preserving surgery (Open surgical hip dislocation and osteoplasty)***

- *gold standard for management of FAI for patients with clinical signs and structural evidence of impingement and preserved articular cartilage, correctable deformity.*

Outline the objectives and options of treatment?

❖ ***Joint preserving surgery (Periacetabular osteotomy)***

- *Indicated in structural deformity of acetabulum with poor coverage of femoral head*

Outline the objectives and options of treatment?

❖ ***Total hip replacement***

- *Indicated in end stage arthritis*

Viva 8

68-year-old woman with 18-month history of left hip pain and difficulty walking.

- Differential diagnosis
- What is Paget's disease?
- What is the pathophysiology of this condition?
- What are the current theories regarding the etiology of Paget's disease?
- what are the complications of Paget's disease?
- What are the other radiographic features of Paget's disease?
- How do you assess disease activity?
- What are the indications for THA in Paget's disease? And what are the other causes of hip pain?
- What are the preoperative considerations and technical issues of performing THA in Paget's disease?
- What type of hip replacement would you use?

Differential diagnosis

- Pagets disease
- Mets
- MM
- lymphoma
- Renal osteodystrophy
- Hyperparathyroidism

What is Paget's disease?

- *Paget's disease is a metabolic bone disorder of unknown etiology characterized by an increase in osteoclastic activity leading to rapid bone resorption and compensatory accelerated disorganized osteoblastic new bone formation of a biomechanically weak bone and prone to deformity and fracture.*
- *The disease can be divided into three major phases, lytic, mixed lytic/sclerotic and sclerotic.*

What is the pathophysiology of this condition?

- *The primary abnormality of Paget's disease is an intense focal resorption of normal bone by abnormal osteoclasts.*
- *These osteoclasts are abnormal in size, activity and quantity. The abnormal osteoclasts make large resorption cavities in the bone.*
- *In response to the osteoclast resorption, osteoblasts are recruited, resulting in new bone formation. The osteoblast activity is rapid such that the newly formed bone is not organized and remains irregular and* ***woven*** *in nature, less resistant and more elastic than typical lamellar bone; prone to deformity and fracture.*

What are the current theories regarding the etiology of Paget's disease?

- *The etiology of Paget's disease is still unknown.*
- *Proposed theories include **viral**, genetic and environmental causes. Paramyxoviruses such as measles virus, RSV.(Electron microscopy has shown virus-like structures that resemble the paramyxovirus in osteoclast nuclei and cytoplasm of cells affected by Paget's disease. However, more recent studies have been unable to confirm the presence of specific viral antibodies in patients with Paget's disease).*
- ***Environmental** factors include high levels of **arsenic** and an uncertain association with **cats and dogs.***
- ***Genetically** 5–40% of patients have first-degree relatives with the disease as autosomal dominant inheritance.*

what are the complications of Paget's disease?

- *Complications of Paget's disease include: (spine, skull, heart, fractures, sarcoma)*

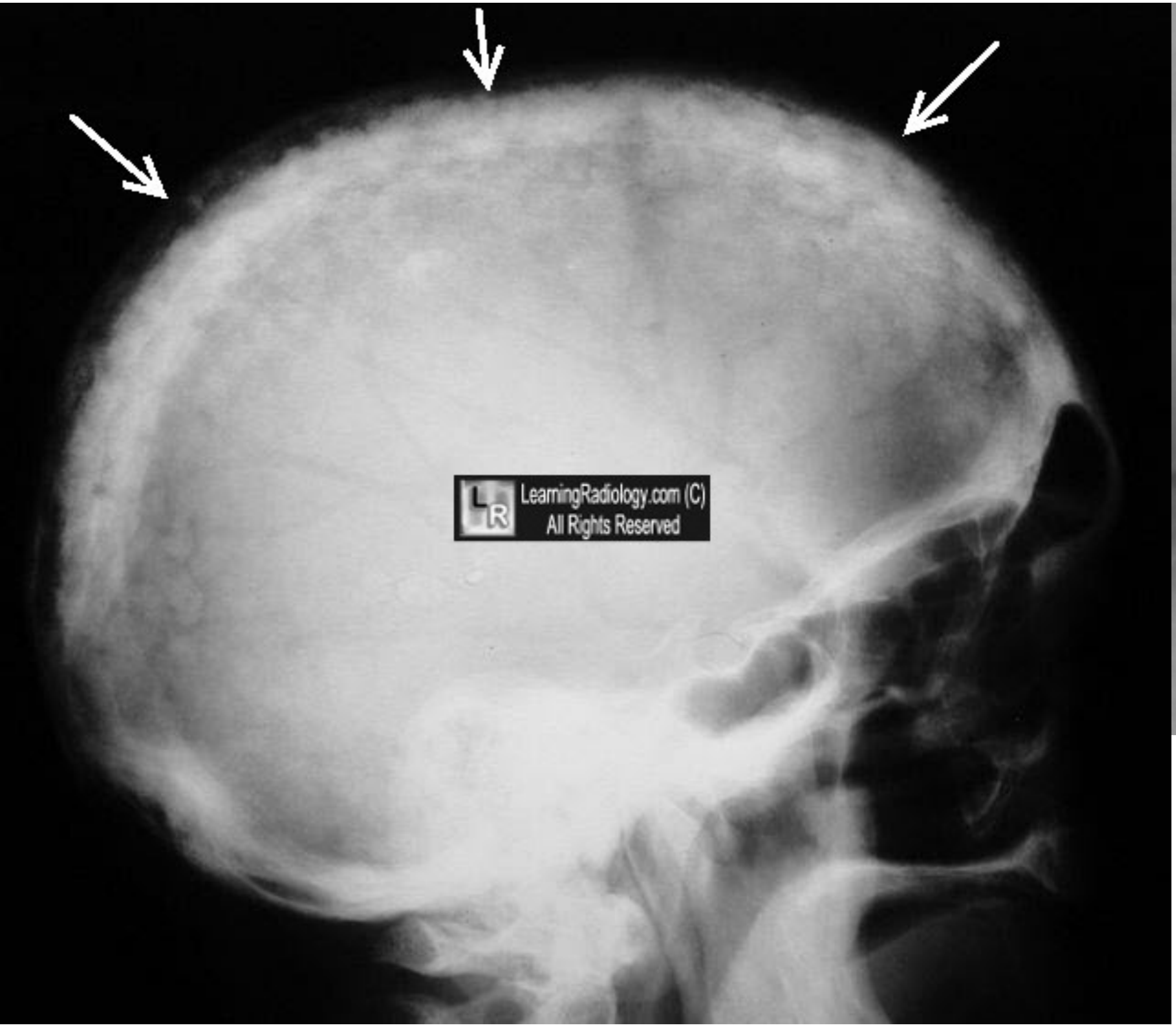
- *Compression fractures of the vertebral body (commonest complication of spinal Paget's).*
- *Pagetic spinal stenosis, defined as compression of the spinal cord, cauda equina or spinal nerves roots by expanded pagetic bony tissue of the spine. Most common in the lumbar region and typically single level.*
- *An enlarged and deformed skull can lead to increased intracranial pressure and hydrocephalus. Progressive closure of skull foramina can lea to cranial nerve deficits such as facial, hearing loss or blindness (pressure on optic nerve), headache, vertigo.*
- *High cardiac output secondary to increased bone vascularity (rare).*
- *Insufficiency fractures.*
- *Bowing deformities of long bones occurs due to softening. Sabre tibia (forward bowing of the tibia)*
- *Paget's sarcoma less than 1%: Osteosarcoma, chondrosarcoma, malignant fibrous histiocytoma and giant cell tumours all have been reported with Paget's disease, 5 years survival rate is <10%*

What are the radiographic features of Paget's disease?

- *Radiographic features of Paget's include:*
- ***long bones** is characterized by coarsened(harden) trabecula, bony sclerosis, bony enlargement and deformity.*
    - *A 'candle flame' or 'blade of grass' sign represents a wedge- or V-shaped pattern of advancing lysis in the diaphysis of long bones.*
    - *The femur develops a lateral curvature whilst the tibia develops an anterior curvature that may result in fracture.*
    - *(stress fractures) which resemble Looser zones but occur on the convex bone surface.*
- *Lateral radiographs of the **lumbar spine** demonstrate a 'picture-frame' vertebral body that is secondary to severe osteoporosis centrally and a thickened, sclerotic cortex or Ivory vertebra (increased density)*
- ***Protrusio acetabula***

What are the radiographic features of Paget's disease?

- *Radiographic features of Paget's include:*
- ***The skull** is involved in 29–65% of cases: diploic widening. Osteoporosis circumscripta is a well-defined lysis, most commonly involving the frontal bone, producing well-defined geographic lytic lesions in the skull. It is seen in the early or lytic phase. At a later stage a 'cotton wool appearance' represents mixed lytic and blastic pattern of thickened calvarium.*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CANDLE FLAME SIGN
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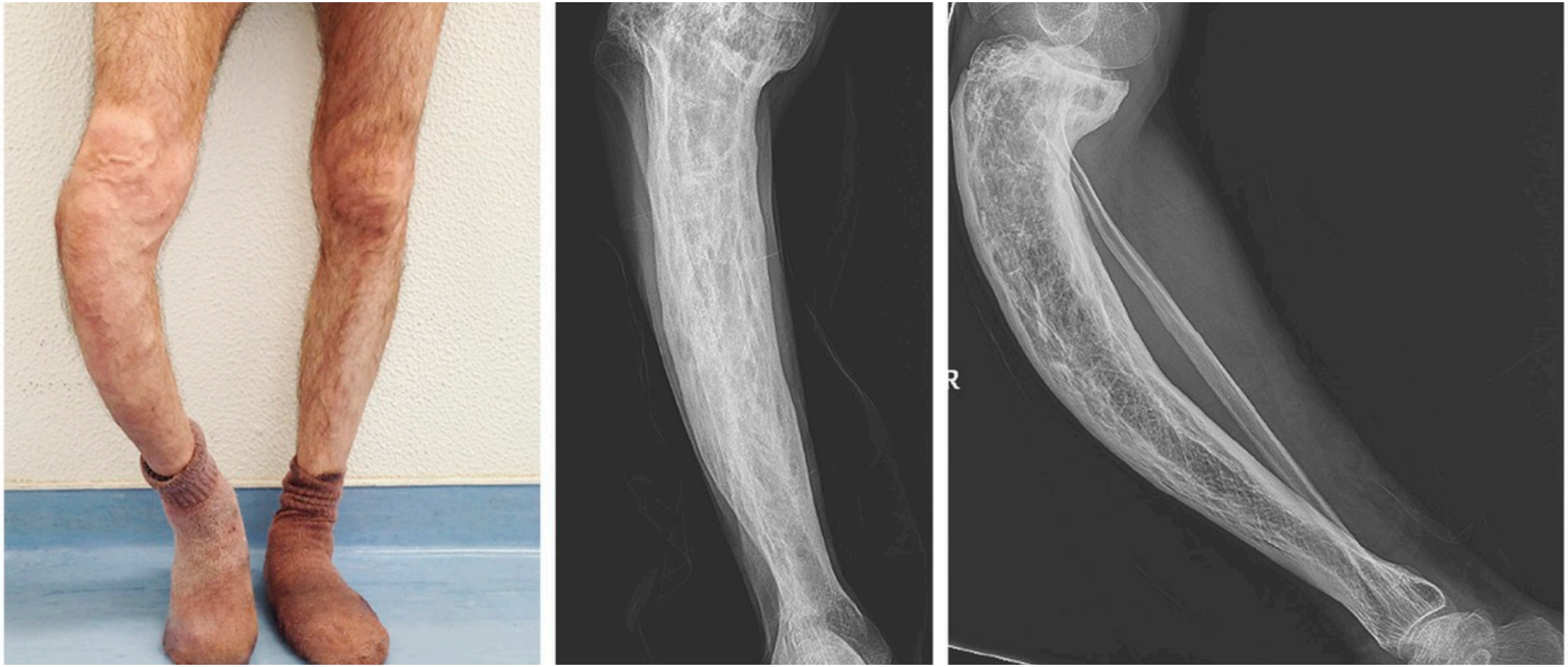
BLADE OF GRASS SIGN

Saber tibia



How do you assess disease activity?

- *Patients with active Paget's disease have a raised alkaline phosphatase (AlkPhos) and urine hydroxyproline(markers of collagen breakdown) values. The higher the level the more active the disease.*
- *Patients with very high AlkPhos levels are thought to be at higher risk of bleeding and heterotrophic ossification formation.*

What are the indications for THA in Paget's disease? And what are the other causes of hip pain?

- *The indications are similar to non-Pagetoid disease.*
  - *It is important to make sure that the pain is arising from the joint surface and not the bone. Bone pain with active Paget's is suggested by an increased alkaline phosphatase value.*
- *It is also important to **exclude** insufficiency fractures, neurological compression in the spine or Paget's sarcoma as a cause of pain.*

What are the preoperative considerations and technical issues of performing THA in Paget's disease?

- *1- There is increased risk of intraoperative bleeding from hyper-vascular and osteoporotic bone which may require additional cross – matching of blood.*

- *2- **Preoperative treatment with bisphosphonate or calcitonin has been used to reduce the incidence of intraoperative bleeding, HO and loosening**. (I would make a referral to one of my rheumatoid colleagues for a Pamidronate (Aredia) injection. This is a bisphosphonate, which is a potent inhibitor of osteoclastic activity, and hence bone resorption).*

- *3-There is increased risk of HO in this condition, therefore prophylaxis should be considered.*

What are the preoperative considerations and technical issues of performing THA in Paget's disease?

- *4- enlargement of the medullary canal which may require Proper preoperative templating and planning to determine the correct component size.*
- *5- broad spectrum of deformities which may require Trochanteric osteotomy for adequate exposure.*
- *6- If protrusio acetabulum exists: ream to expand the periphery without deepening the socket to avoid causing added protrusion – dislocation of the hip can be extremely difficult and the neck may need to be cut insitu.*

What are the preoperative considerations and technical issues of performing THA in Paget's disease?

- 7- *Marked deformity of the proximal femur with coxa vara or anterolateral bowing of the femoral shaft may require corrective osteotomy and the use of modular stems prior to THA.*
- 8- *The presence of dense sclerotic bone may make reaming and bone preparation difficult, sharp reamer will be needed to shape the femoral canal*. Burrs may be needed to enter the bone prior to reaming.
- 9- *As Paget's bone is **brittle** there is a higher risk of both intraoperative and postoperative **fracture**.*

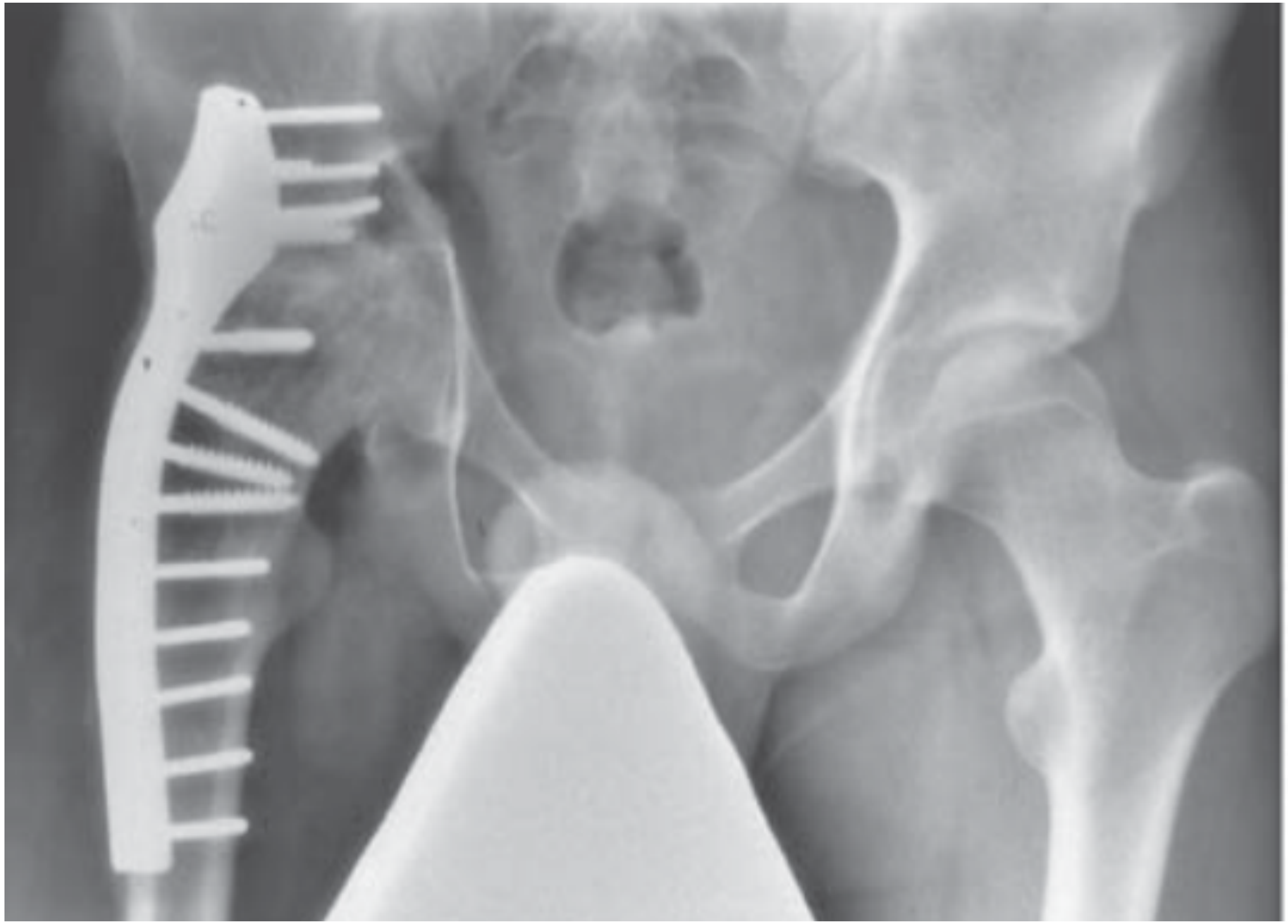
What type of hip replacement would you use?

- *I prefer cementless components especially when bone is very sclerotic or a concurrent osteotomy is done.*
- *Extremely sclerotic bleeding bone will make interdigitation of cement difficult and cement extravasation into the fracture gaps may occur after osteotomy. If using a cementless cup the use of adjuvant acetabular screws is recommended.*

➢ *Parvizi et al. reported on 21 cementless THA implanted against pagetoid bone; all were stable and demonstrated radiographic evidence of ingrowth at 7-year follow-up.*

Viva 9

- Describe the radiograph
- What are the indications for this procedure?
- What are the prerequisites for this procedure?
- In what position would you choose to arthrodese a hip?
- What are the methods of arthrodesis?
- What are the possible complications following this procedure?
- What are the long term outcomes?
- What are the indications and the preoperative and technical considerations in revision to THA?
- What effect does arthrodesis have on contralateral THR? And ipsilateral TKR?



What are the indications for this procedure?

- *The ideal candidate is a young adult with*

➢ *End stage unilateral hip disease who has contraindications for joint replacement or joint preserving procedure.*

What are the prerequisites for this procedure?

- *Normal contralateral hip*
- *Normal ipsilateral knee*
- *Normal lumbar spine*
- *No significant cardiovascular disease.*
  - *The altered gait produced following arthrodesis has been shown to increase oxygen consumption by 32 % — this may cause problems in patients with cardiovascular disease.*

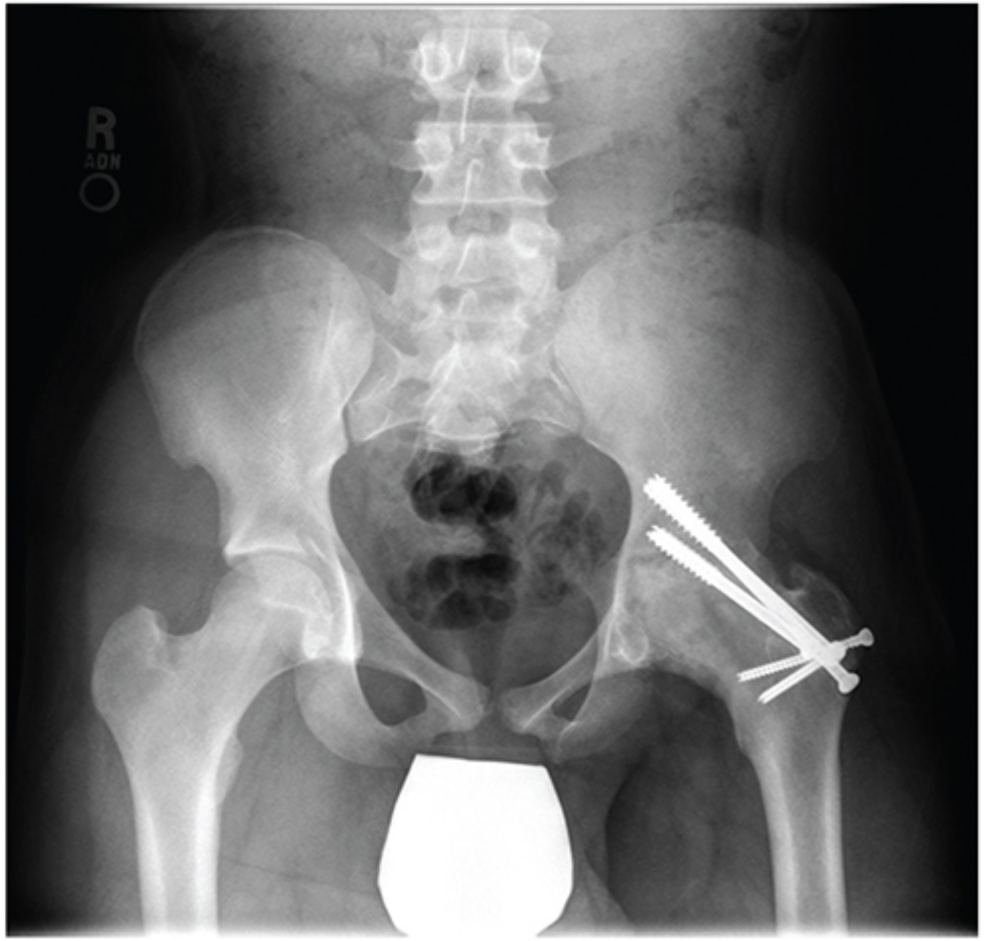
In what position would you choose to arthrodese a hip?

- *0 - 5° adduction. Abduction creates pelvis obliquity.*
- *5° - 10° external rotation*
- *20° - 30° flexion.*
    - *Insufficient flexion makes sitting extremely difficult and excessive flexion may lead to LLD and lumbar lordosis.*

What are the methods of arthrodesis?

- *Approach: lateral approach with trochanteric osteotomy is preferred.*

- *AO Cobra plate (need to perform a trochanteric osteotomy).*
  - *It is a stable fixation but disrupts hip abductors (as it needs to perform a trochanteric osteotomy) .*
- *Trans-articular sliding hip screw.*
  - *The lag screw is inserted across the joint superior to the dome of the acetabulum. Less stable fixation*
- *Extraarticular fusion*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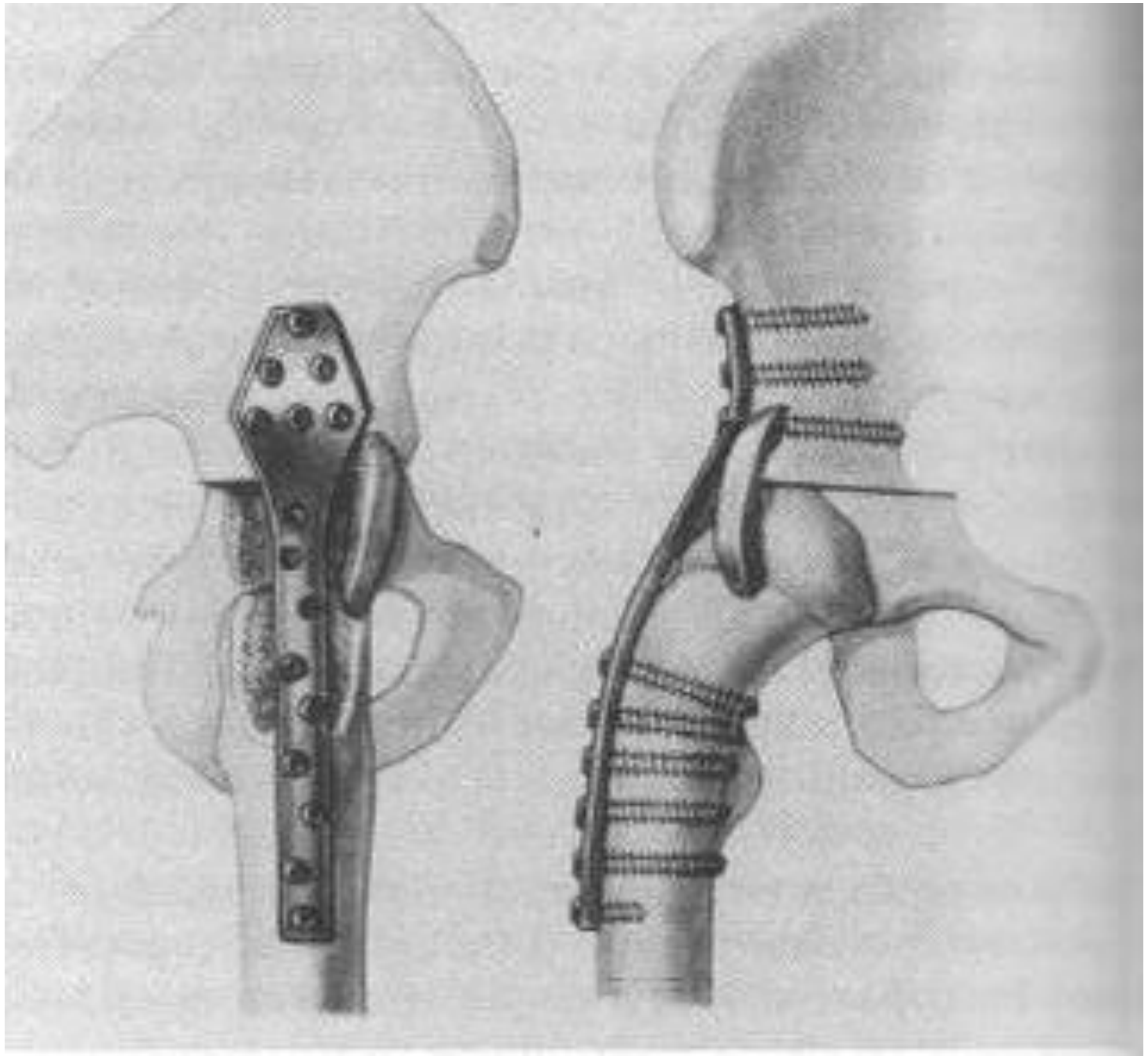



SHARMA

What are the possible complications following this procedure?

- *Neurovascular injury*
- *Femoral fracture*
- *Failure of internal fixation*
- *Non-union (pseudoarthrosis 15 – 25 %)*
- *Malunion*
- *OA of the contralateral hip, both knees, spine.*

What are the long term outcomes?

- *Advantages:*

- *provide long-term pain relief and stability to the joint.*

- *Provide good amount of mobility and return to an active lifestyle if performed correctly.*

- *It allows conversion to a THA at a later date.*

What are the long term outcomes?

- *Disadvantages:*

➢ *Long-term follow-up studies following hip arthrodesis have shown that the majority of patients develop LBP and ipsilateral knee pain 20 years or more after the fusion*

➢ *LLD*

➢ *The altered gait produced following arthrodesis has been shown to increase oxygen consumption by 32 % — this may cause problems in patients with cardiovascular pathology.*

What are the indications and the preoperative and technical considerations in revision to THA?

- *Indication:*
  - ✓ *Increasing lower back pain (make sure that the pain is not caused by other pathology HNP).*
  - ✓ *Increasing ipsilateral knee pain*
  - ✓ *Contralateral hip disease*
  - ✓ *Painful pseudoarthrosis of the hip*
- *Technically demanding procedure due to disturbed anatomy. Pre op work up includes: (for conversion of hip arthrodesis to THR)*
  - ✓ *Radiographs to assess bone stock and determine what metalwork (if any) needs to be removed*
  - ✓ *CT scan can be helpful for identifying bone stock.*
  - ✓ *MRI to determine(asses) the abductor muscle mass*
  - ✓ *The potential for reactivation of dormant infection must be considered and appropriate biopsies taken pre- or intra-operatively*

What effect does arthrodesis have on contralateral THR? And ipsilateral TKR?

- *Contralateral THR*
  - ✓ *Mechanical loosening occurs at a slightly higher rates when opposite hip has been fused*
- *Ipsilateral TKR*
  - ✓ *Studies have reported high complication rates with unpredictable outcomes. (stiffness – overstress – early failure)*

Viva 10

- What is the diagnosis?
- What is the pathogenesis and pathology of this condition?
- What are the clinical features of this condition?
- What are the radiographic features?
- How would you manage this condition?

What is the diagnosis?

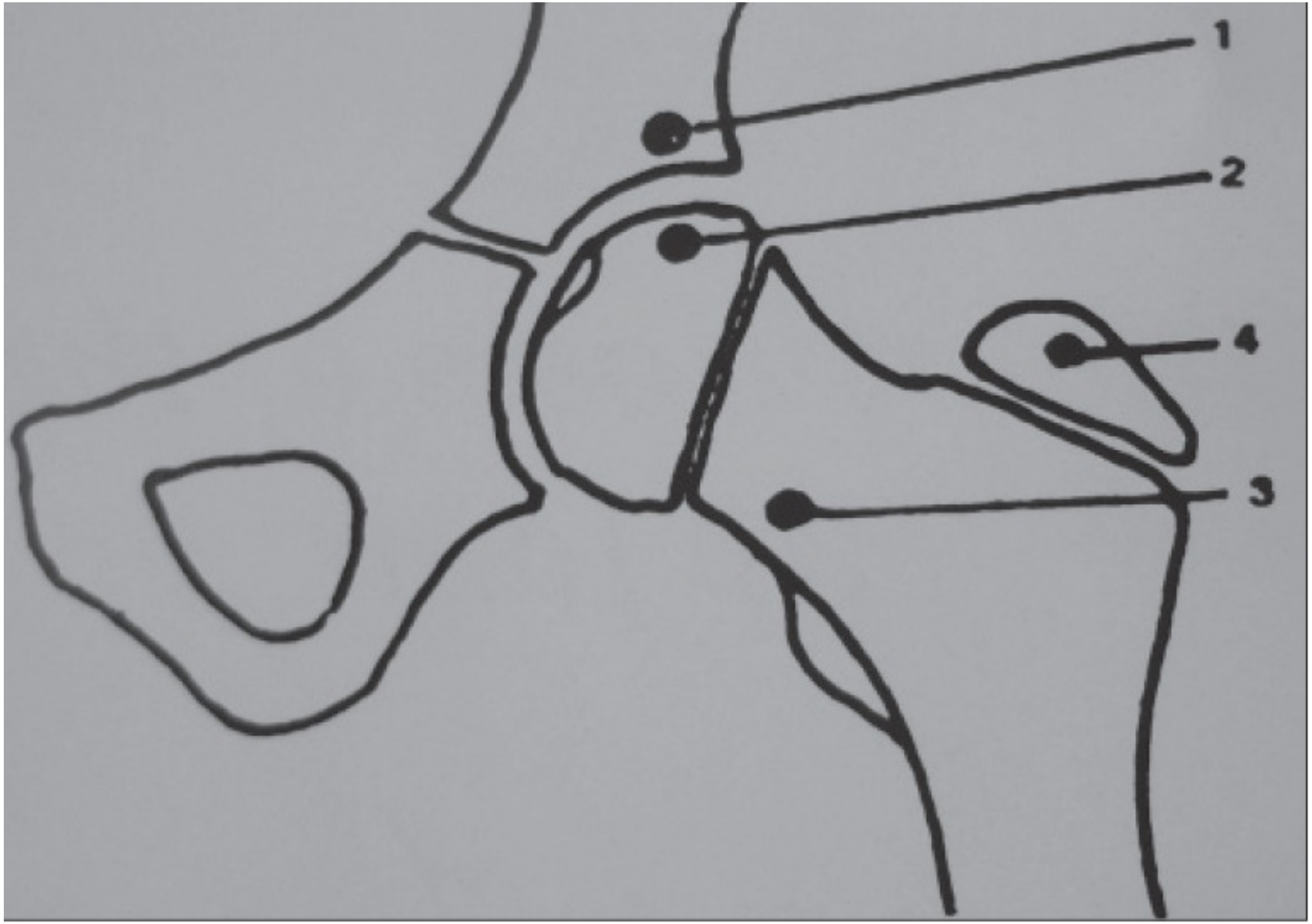
- *A/P radiograph of the pelvis and both hips that is showing a travelling or wondering right hip, suggestive of tuberculosis of right hip.*
- *The hip is the most commonly affected joint accounts for 15% of all cases of osteoarticular tuberculosis.*

What is the pathogenesis and pathology of this condition?

- *The causative organism is mycobacterium tuberculosis, which is Gm+ AFB*
- *Osteoarticular TB is secondary to primary pathology in lungs, lymph nodes or any of the viscera. Through the hematogenous route, the bacteria reach either to synovium or bone.*

➢ *When it lodges first in synovium, the synovial membrane becomes swollen and congested. The granulation tissue from the synovium extends over the bone resulting in necrosis of sub chondral bone, sequetra and may be kissing lesion on either side of joint. It progress fast to involve the joint*

➢ *The bacteria may also lodge first in the epiphyseal or metaphyseal region of the adjoining bones like head or neck of femur, greater trochanter or acetabulum to start the destructive process. It progress slower.*



Diagrammatic representation of the location of osseous origin of tuberculosis of left hip joint; (1) acetabulum (2) femoral he
femoral neck/metaphysic (4) greater trochanter (reprinted with permission from Tuli[1])

What are the clinical features of this condition?

- *Disease usually starts during first three decades but no age is immune*
- *Insidious onset with pain in the groin – thigh with limp*
- *Later the pain becomes more severe and cause sleep disturbance.*
- *All the hip movements are grossly limited by pain*
- *Deformity depending on the stage of the disease*
- *LLD*
- *Unlike pyogenic infections, proteolytic enzymes are not produced in tubercular infection; articular cartilage survives for a long time thus preserving mobility in many patients*

What are the radiographic features?

- *Periarticular osteopenia → early sign*
- *Irregular and hazy joint margins with rarefaction in Babcock's triangle (inferior aspect of femoral neck) → early sign*
- *Increased join space → early sign*
- *erosions*
- *destruction of bone on either side of joint*
- *reduced joint space*
- *Migration of the acetabulum (travelling)*
- *Advanced arthritis.*

What are the radiographic features?

Clinicoradiological classification of tuberculosis of the hip

Staging	Clinical findings	Radiologic features
I Stage of synovitis	Flexion, abduction, external rotation, apparent lengthening	Haziness, rarefaction
II Stage of early arthritis	Flexion, adduction, internal rotation, apparent shortening	Rarefaction, osteopenia, bony lesion in femoral head, acetabulum or both. No reduction in joint space
III Stage of arthritis	Flexion, adduction, internal rotation, shortening	All of the above and destruction of articular surface, reduction in joint space
IV Stage of advanced arthritis	Flexion, adduction, internal rotation with gross shortening	Complete destruction, no joint space, wandering acetabulum

Plain X-ray showing “stage of arthritis;” pathology involving articular surface. Irregular and hazy joint margins with diminished joint space on left side

X-ray left hip joint anteroposterior view showing the “wandering acetabulum”

How would you manage this condition?

- *Treatment depends on the :*

➢ *Stage of the disease*

➢ *Age of the patient*

➢ *Health status of the patient*

How would you manage this condition?

- *To establish the diagnosis, synovial effusion can be aspirated and subjected for cytology, AFB smear and PCR examination. If necessary, biopsy can be taken from diseased tissue to establish the diagnosis.*
- *Early diagnosis and effective chemotherapy are vital to save the joint*
- *The standard chemotherapy as accepted universally with four anti tubercular drugs to start with in all the stages of presentation*
- *In addition to medical treatment, traction preferably skeletal is recommended to all patients particularly in early stage. It provides rest of the affected part – relieves muscle spasm – maintains joint space – prevents and corrects deformity – minimizes the chances of development of migration of acetabulum*

How would you manage this condition?

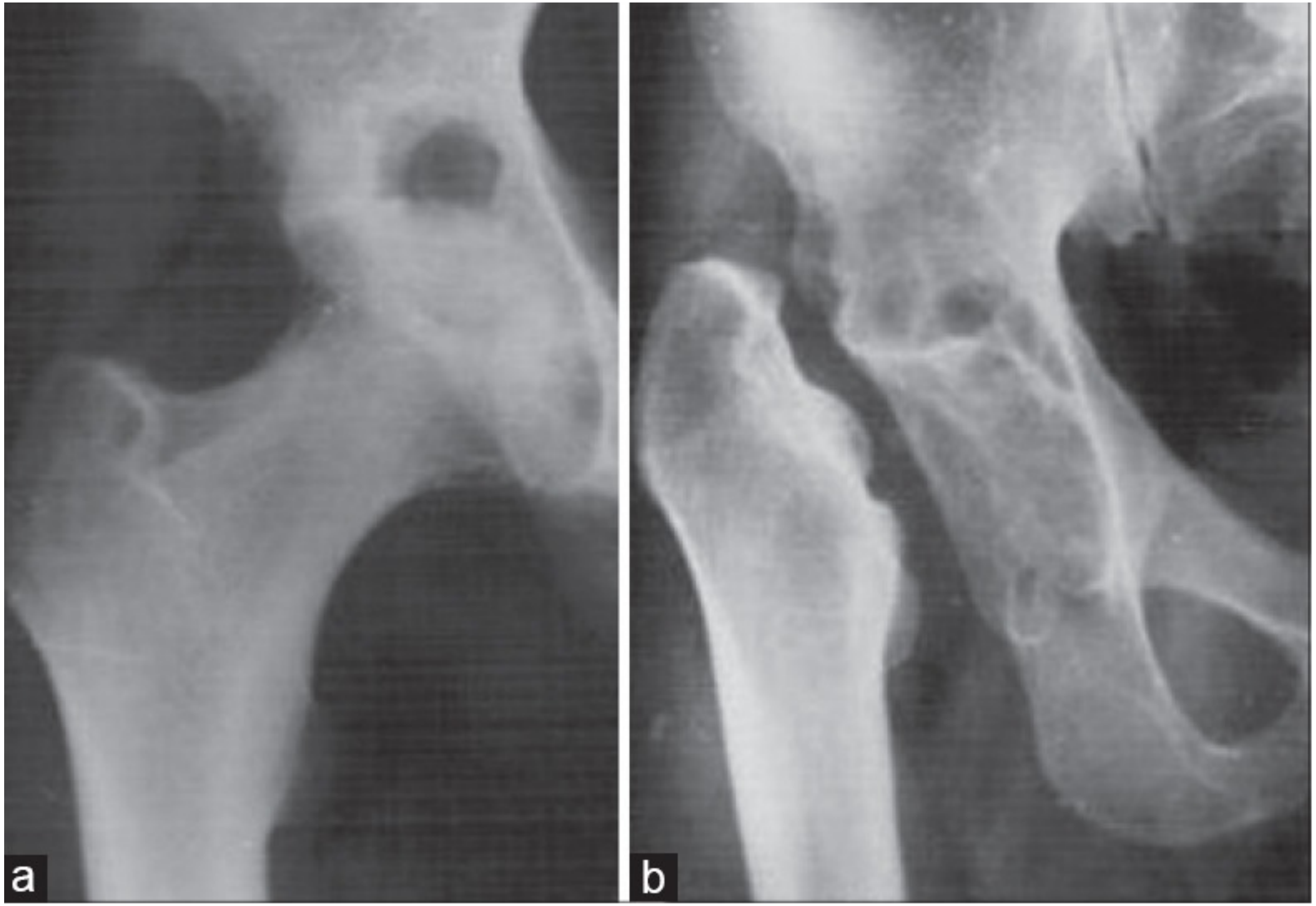
- *Options of surgical treatment*

- ➢ *Synovectomy and joint debridement*

- ➢ *Excision arthroplasty: can be safely carried out in healed or active disease after the completion of growth potential of bones of the hip joint, This procedure provides a mobile, painless hip joint with control of infection and correction of deformity. However, some degree of shortening and instability is unavoidable. The patient should bear weight with support by holding stick in opposite hand*

- ➢ *Arthrodesis: relieves the pain, and corrects the deformity. However it is at the cost of loss of movements. Ankylosis of the joint may occur spontaneously, and it may be unnecessary to perform arthrodesis.*

- ➢ *Joint arthroplasty: not performed in the active stage. Conversion of arthrodesis should be covered by antituberculosis treatment for 3 months before surgery and 9 months postoperatively.*



X-ray of right hip joint anteroposterior view showing (a) active tubercular arthritis of right hip. (b) After Girdlestone excision a

Viva 11

What are the Indications for THA?

- *End stage hip disease with disabling pain, severely affecting the patient's quality of life which is refractory to conservative treatment in a medically fit patient for surgery in the absence of active infections.*

Contraindications

- ***Absolute***
  - *Active infection*
- ***Relative***
  - *Neuropathic joint*
  - *Progressive neurological disease*
  - *Significant co-morbidity factors*
  - *Non ambulators*
  - *Abductor muscle loss*

What are the goals of THR?

- ***Surgical goals:***
  - *Relieve pain*
  - *Improve function*
- ***Technical goals:***
  - *Restore centre of rotation. ?? What do you mean by centre of the rotation?*
  - *Restore leg length.*
  - *Maintain offset and abductor tension.*
  - *Correct component position.*

How would you consent a patient for THA?

- *I would discuss the surgical and technical goals of THA with the patient as well as the reported success rate.*
- *I would inform the patient of possible complications related to THA:*

How would you consent a patient for THA?

- **Common (2-5%)**
  - *DVT*
  - *Dislocation*
  - *Aseptic loosening*
- **Less common(1-2%)**
  - *Infection*
- **Rare (<1%)**
  - *Leg length discrepancy*
  - *Sciatic nerve injury*
  - *PE and death*
  - *Periprosthetic fracture*

What are the Approaches of THA?

❖ ***Standard approaches***

- *direct anterior*
- *anterolateral*
- *direct lateral*
- *Posterior approach*
- *Extensile approaches: trochanteric osteotomy*

What are the Approaches of THA?

❖***Surgical approach may be dictated by***

- *surgeon preference*
- *prior incisions*
- *Obesity*
- *degree of deformity*
- *risk for dislocation*
- *implant selection*

Approaches

❖ Direct anterior (Smith-Peterson)

- ***Incision:*** *along the anterior half of iliac crest to the ASIS and then curved down towards the lateral side of the patella*
- ***Description:*** *uses inter-nervous plane between tensor fascia lata (superior glueteal nerve) and sartorious (femoral nerve). Deep, the plane is between the rectus femoris (femoral nerve) and gluteus medius (superior gluteal nerve).*
- ***Advantages:*** *decreased dislocation rate when compared to posterior approach in numerous studies-abductor mechanism not violated (compared to anterolateral exposure).*
- ***Disadvantages:*** *femoral exposure is difficult - risk to LFCN & ascending branch of lateral femoral circumflex artery-surgical site infection rates increased in obese patients with large abdominal panni*

Approaches

❖**Anterolateral (Watson-Jones)**

- *Incision: 2cm distal and lateral to the ASIS and continues to the posterior border of the GT*
- *Description: uses interval between tensor fascia lata and gluteus medius. less commonly used approach for arthroplasty secondary to violation of abductor mechanism and post-operative limp*
- *Advantages: Lower rates of dislocation and sciatic nerve injury compared with the posterior approach- easy to learn.*
- *Disadvantages: violates abductor mechanism-postoperative limp- superior gluteal nerve injury if the gluteus medius division is extended >5 cm above the greater trochanter*

Approaches

❖Direct (Hardinge)

- *Incision: longitudinal incision centred over the GT*
- *Description: no true interval, splits gluteus medius and vastus lateralis. less commonly used approach for arthroplasty secondary to violation of abductor mechanism and post-operative limp*
- *Advantages: Lower rates of dislocation and sciatic nerve injury compared with the posterior approach- easy to learn.*
- *Disadvantages: violates abductor mechanism-postoperative limp- superior gluteal nerve injury if the gluteus medius division is extended >5 cm above the greater trochanter- Heteropic ossification is common.*

Approaches

- ***Posterior***

- *Description: no true interval, the gluteus maximus is split bluntly in line with its fibres, the short external rotators are released from their insertion site and then a posterior capsulotomy is performed. The sciatic nerve should be identified and protected*
- *Advantages: abductor mechanism not violated-excellent exposure of both femur and acetabulum.*
- *Disadvantages: dislocation rates may be higher than anterior exposures-risk to sciatic nerve injury.*

What approach would you use to the hip?

- *I would prefer to use the posterior approach to the hip, I'm familiar with this approach, abductor mechanism not violated- gives excellent exposure of both femur and acetabulum.*

What are the methods of implant fixation in THA?

- There are two ways:

➢ Cemented fixation .

➢ Biological fixation.

What are the indications for cemented femoral component THA?

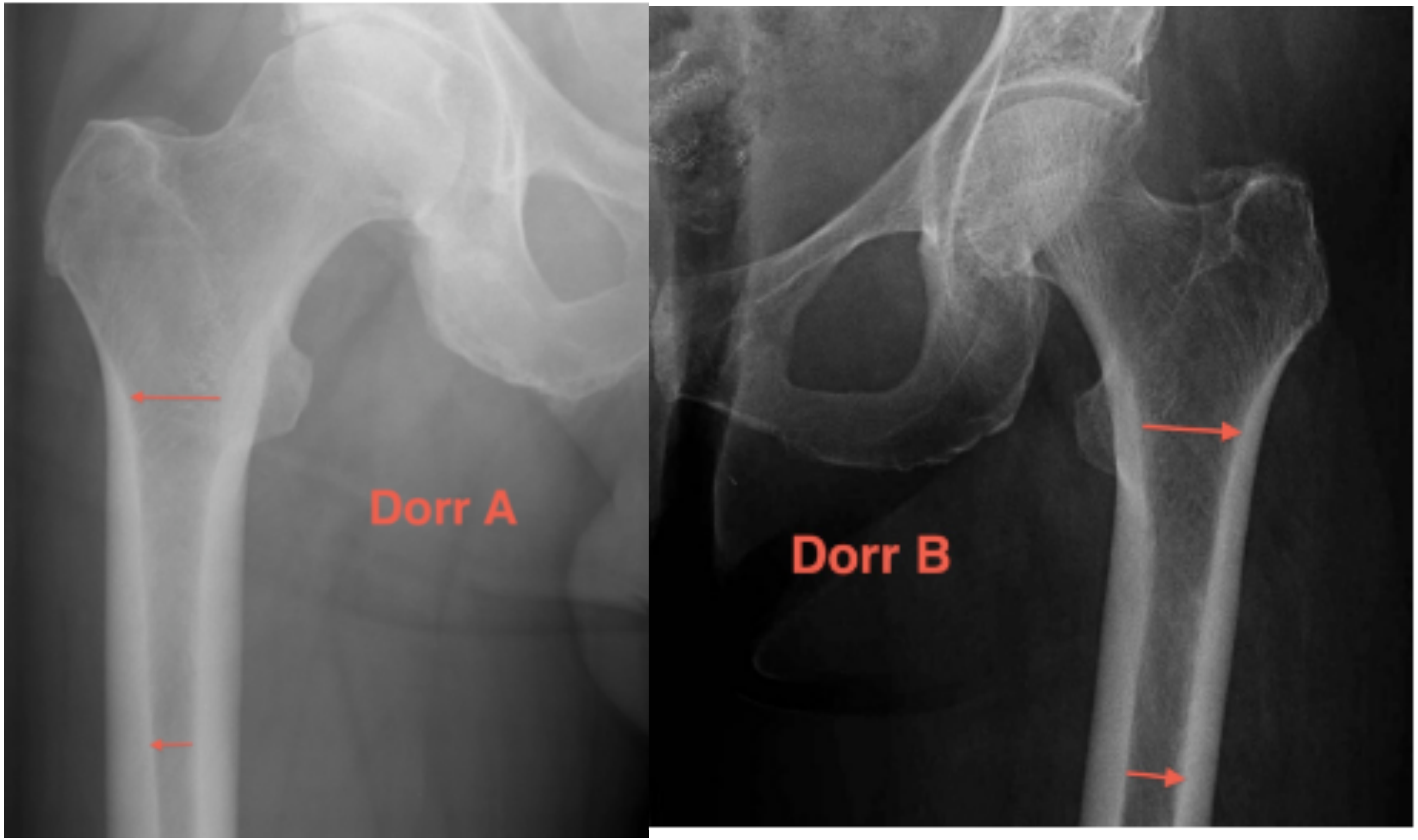
❖ **Cemented femoral component**

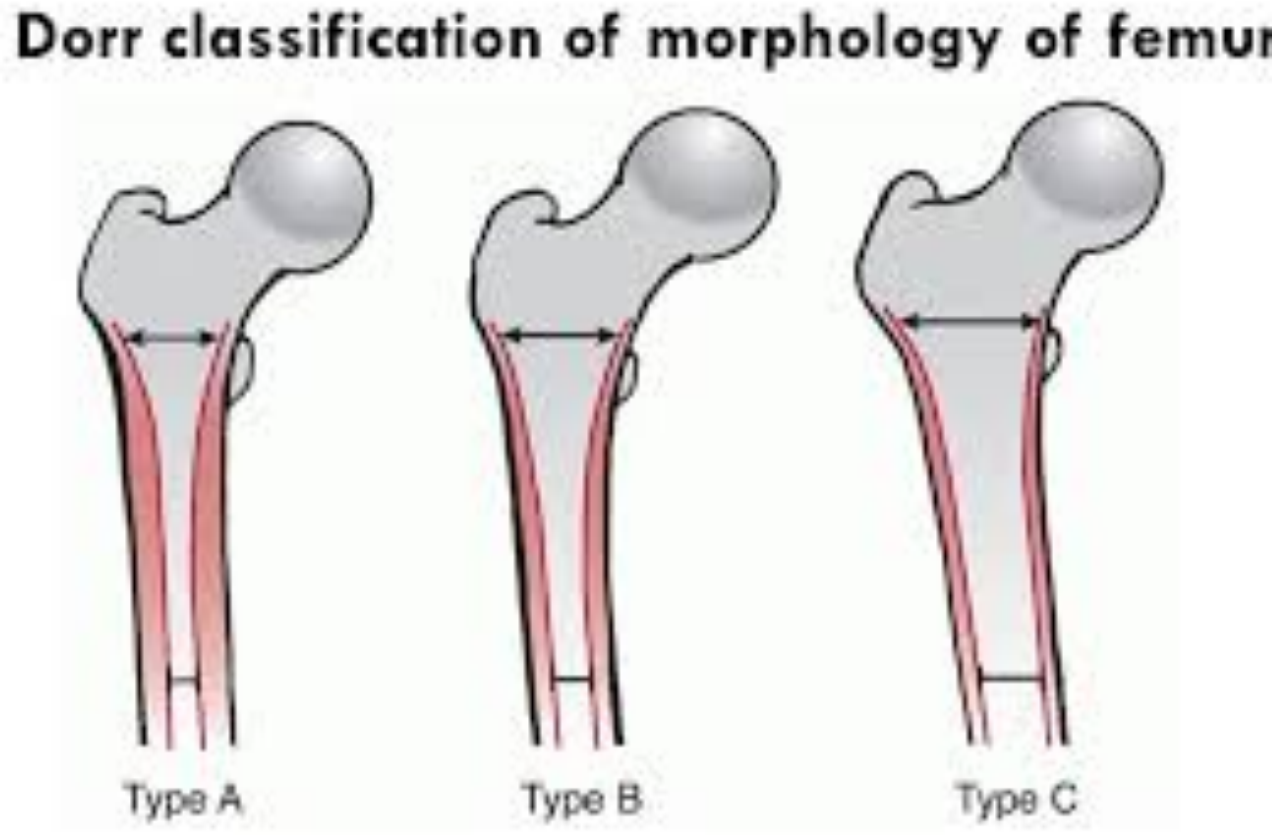
Indicated in:

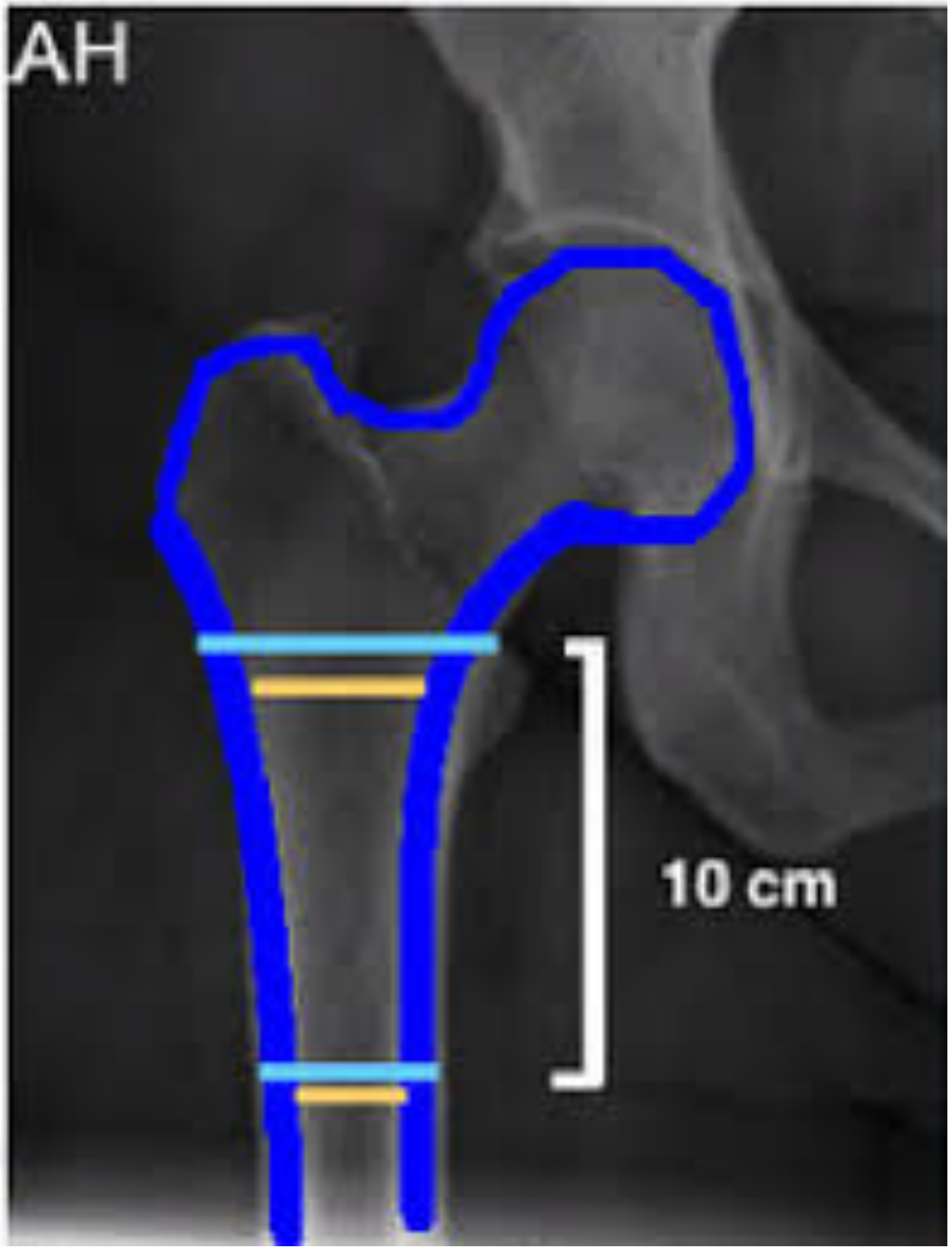
➢ Elderly patients: the increased porosity seen in osteopenia helps to create a bone-cement interface >> increased mechanical integrity >> increased fracture resistance.

➢ Irradiated bone.

➢ Dorr C femur: measure the inner diameter at Lesser Trochanter and divided by the inner diameter 10 cm distal. Type A<0.5 Type B between 0.5 and 0.75 type C (stove pipe)> 0.75. type A & B amenable for uncemented.


Dorr A
Dorr B


Dorr classification of morphology of femur
Type A
Type B
Type C


AH
10 cm

Describe the cementing technique

❖ **1st generation (Original technique of Charnley)**

- *Hand mixing of the cement*
- *Finger packing of cement*
- *No cement restrictor(femoral canal plug)*
- *No cement gun and (no reduction in porosity).*
- *No femoral canal preparation*

Describe the cementing technique

❖ **2nd generation**

➢ *Use of cement gun to allow retrograde filling.*

➢ *Femoral canal* ***plug****.*

➢ *Femoral canal preparation (brush & dry).*

Describe the cementing technique

- **3rd generation**

- *Use of* ***vacuum mixing*** *to reduce cement porosity and increase the strength of the cement.*
- ***Pressurization of cement*** *after insertion, improves cement strength by reducing voids in the cement. Plugging of the femoral canal allows for increased pressurization and the guarantee of a uniform cement mantle distal to the prosthetic tip.*
- *Distal stem centralizer.*
- *Femoral canal preparation (pulsatile lavage), Inclusions such as air, blood or tissue debris result in poor cement penetration into trabecular bone.*

Describe the cementing technique

- **4th generation**
  - *Not widely adopted*
  - *Involves using implant centralisation both proximally and distally to ensure uniform cement mantle.*

What are the methods of cement fixation optimization?

- <u>Humidity</u>: Increased humidity increases the setting time.
- <u>Temperature</u>: Increases in room temperature decrease both the dough and setting times by 5%/ degree centigrade.
- <u>Powder/liquid ratio</u>: normally 2:1. decreased ratio increases the setting time.
- <u>Antibiotics</u>: reduce mechanical properties by 4%).
- <u>Reduce porosity of the cement</u>: vacuum mixing is the best method.
- <u>Femoral canal preparation</u>: Inclusions such as air, blood or tissue debris result in poor cement penetration into trabecular bone.

What are the methods of cement fixation optimization?

- Pressurization of the cement: improves cement strength by reducing voids in the cement.
- Stem Centralization: avoid malpositioning of stem to decrease stress on cement mantle, varus or valgus stem positioning increases stress on cement mantle
- Use Stiff Femoral Stem: flexible stems place stress on cement mantle

What are the stem philosophies of cemented femoral component?

- There are two types of stem philosophies:

➢ **Loaded (polished)taper**: summarized by the Exeter implant. The stem is tapered in two or three planes, the stem is allowed to subside initially because of the cement creep, radial compressive forces are created in the cement sealing the stem-cement interface and transferred to the bone as hoop stress. A distal centralized is used to facilitate subsidence of the stem to a stable position.

➢ **Composite beam**: the stem needs to be rigidly bound to the cement since subsidence may result in damage to the cement with generation of cement and metal debris.

What are the types of biologic fixation?

- There are two types of biologic fixation:

➢ **Ingrowth**: bone grows into porous structure of the implant.

➢ **On-growth**: bone grows on the grit blasted surface.

What are the indications for cementless ?

- Femoral component:
  - ➢Young active patients.
  - ➢Older patients with good bone stock.
  - ➢Revision arthroplasties.
- Acetabular component
  - ➢All situations except poor acetabular bone stock-irradiated bone

What are methods of fixation technique of the cementless component?

- Press fit technique:

➢ Slightly larger implant than what was reamed is wedged into a position (1 or 2 mm)

- Line to line technique

➢ The size of the implant is the same as what was reamed. You may need to use screws

What are the methods of biological fixation optimization?

- Pore size (50 to 300 micron)
- Porosity < 40% (increased porosity may lead to shearing of the metal)
- Gap < 50 micron(space between the bone and prosthesis).
- Micromotion < 150
- Maximal contact with cortical bone. Cancellous bone is not weight bearing area.

What are types of uncemented acetabular cup?

- 1st generation: purely mechanical, relies on screws fixation, no biological fixation.
- 2nd generation: aimed for mechanical and biological fixation.
- 3rd generation: component has high porosity, high coefficient of friction. Tantlam. Used in revision cases.

- Component micromotion should be < 28 micrometre
- Screws showed greater amount of bone ingrowth than pegs and spikes (Cook et al)
- Biomechanical analysis showed that screws help to convert torsional forces to compressive forces which increase the bone-implant contact area.

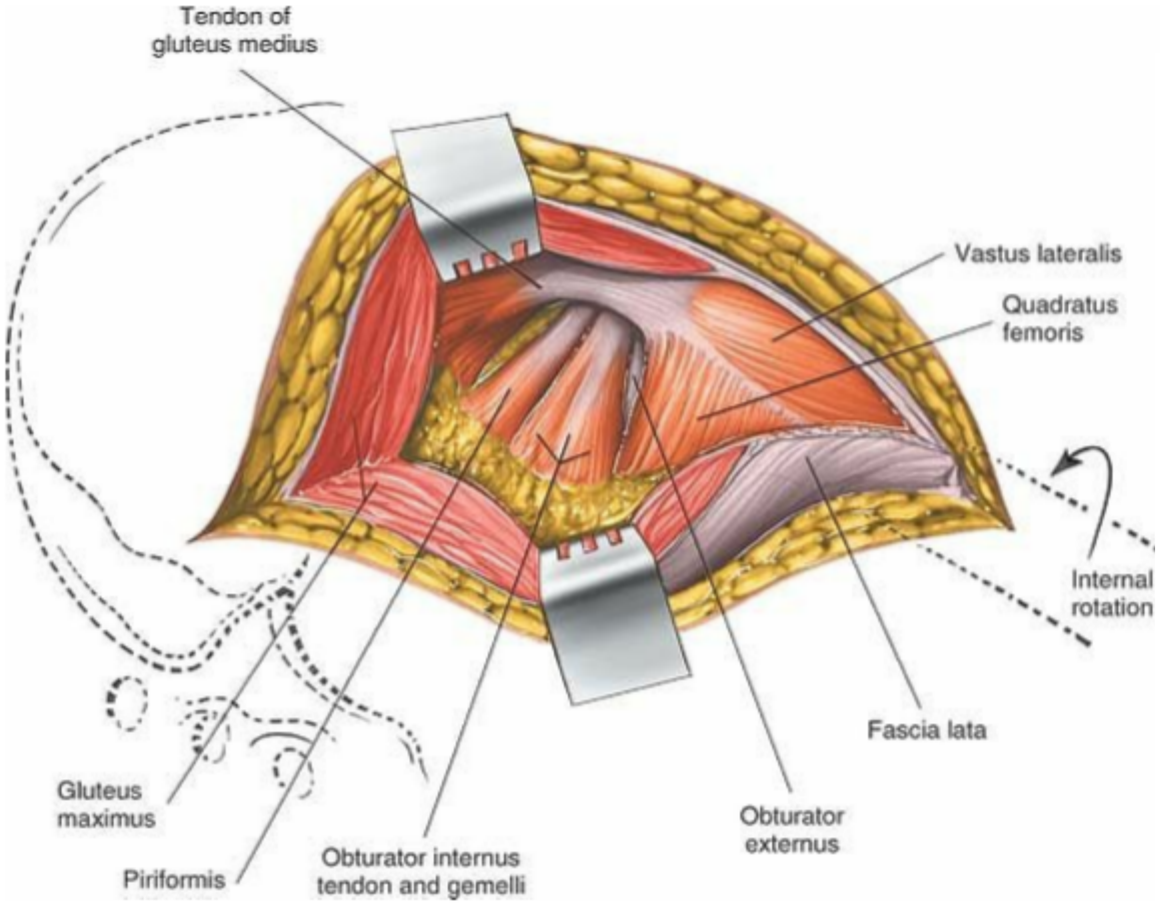
THR technique

- *Assuming full informed consent has been obtained, all relevant case notes and radiographs have been obtained.*

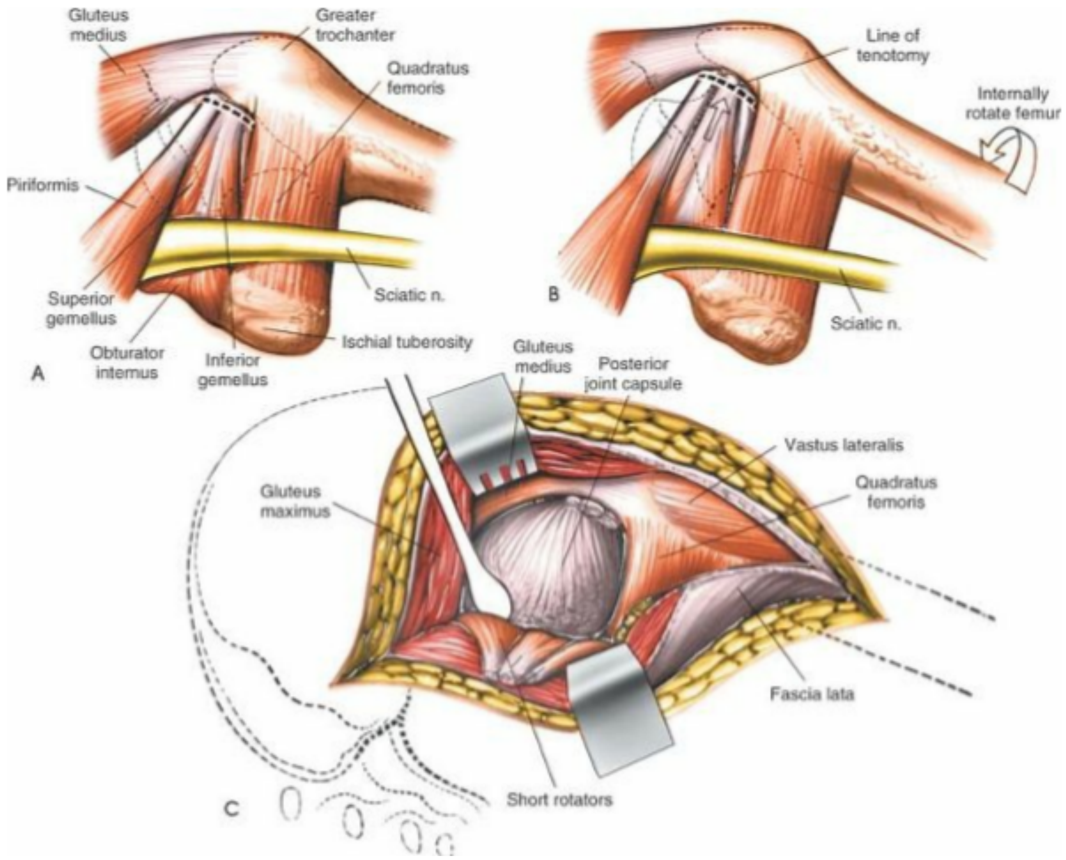
- *Nerve injury: 1 %*
- *Infection: 1–2 % in osteoarthritis, 5 % in rheumatoid arthritis.*
- *Limb length discrepancy: 15 %*
- *Dislocation: 3 %*
- *Heterotopic ossification: 10 %*
- *DVT : 2 %*
- *Pulmonary embolism: 1%*
- *Loosening: revision surgery is required for loosening in up to 10 % at 15 years*
- *Component failure: stem fracture, locking mechanism failure in uncemented cups and other failures of components are rare, but recognized, complications*
- *Mortality: 0.3 %*

THR technique

- *the leg has been marked and patient has been suitably anaesthetized I would position the patient laterally, affected leg uppermost, with hip supports.*
- *I would then prepare and drip the patient and make a longitudinal incision (with the hip flexed 90°) centred over the posterior half of greater trochanter (curve incision over the posterior aspect of GT when the leg is straightened), approximately 15cm in length. I would cut through the skin, subcutaneous tissue, and open up the fascia lata distally, splitting the gluteus maximus along the line of muscle fibres, and then put the leg in internal rotation to stretch the external rotators. I will insert stay sutures into the piriformis and obturator internus tendons just before they insert into the greater trochanter and detach the muscles close to their femoral insertion and reflect them backward*



Tendon of gluteus medius
Vastus lateralis
Quadratus femoris
Internal rotation
Fascia lata
Gluteus maximus
Piriformis
Obturator internus tendon and gemelli
Obturator externus



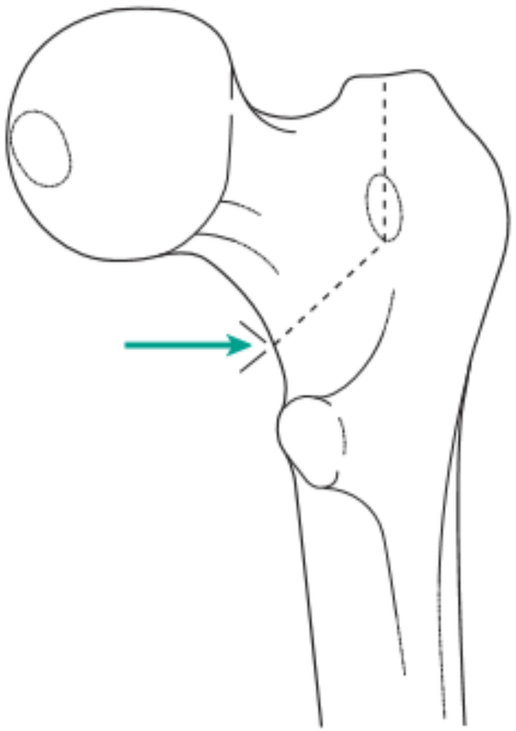
Gluteus medius
Greater trochanter
Quadratus femoris
Piriformis
Superior gemellus
Obturator internus
Inferior gemellus
Ischial tuberosity
Sciatic n.
A
Line of tenotomy
Internally rotate femur
B
Sciatic n.
Gluteus medius
Posterior joint capsule
Vastus lateralis
Quadratus femoris
Gluteus maximus
Fascia lata
Short rotators
C

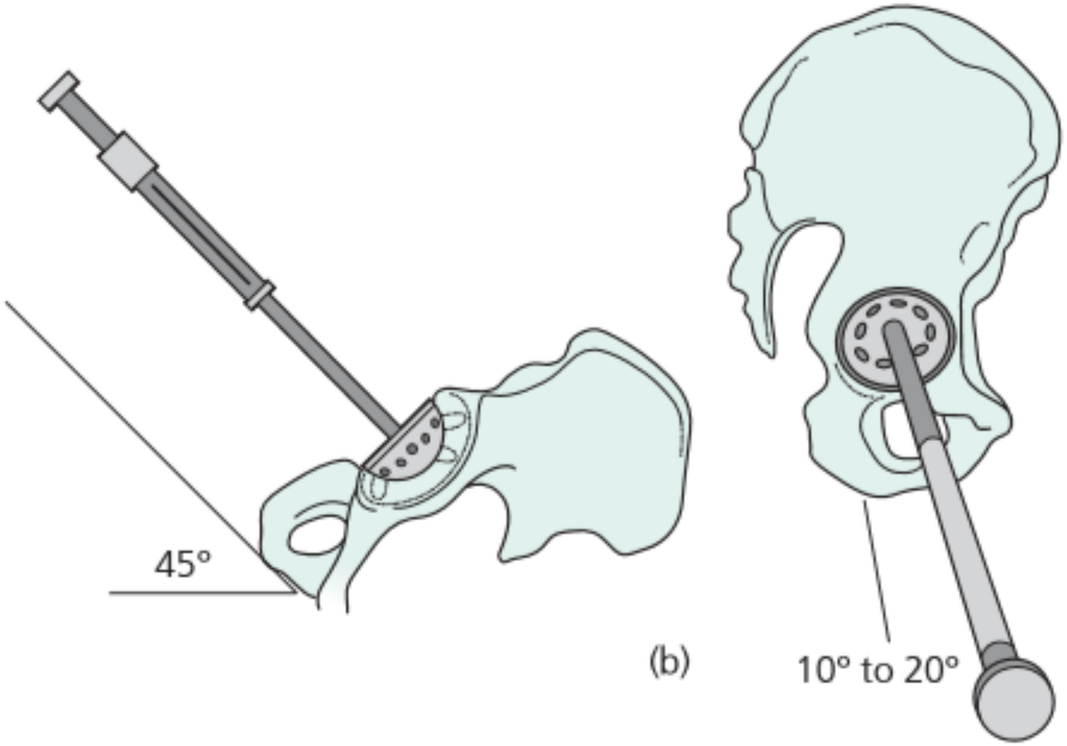
THR technique

- *Finally, I would perform a capsulectomy (T-shaped) and then dislocate the hip. I would protect the sciatic nerve being aware of its position and avoid dissecting too near to it. Dislocation of the hip is achieved by internal rotation after capsulotomy.*
- *Hohmann retractors are inserted around the superior and inferior aspects of the femoral neck. I will mark the planned femoral osteotomy site which is about fingerbreadth above the lesser trochanter. An oscillating saw is used to perform the osteotomy, with the Hohmann retractors protecting the surrounding soft tissues. The femoral head is removed.*

THR technique

- *Acetabular preparation:*
- *I will remove all overhanging soft tissues including the labrum, ligamentum teres and ? Transverse acetabular ligament.*
- *Hohmann retractors are placed over the anterior wall, to lever the femur anteriorly.*
- *I will remove any remaining soft tissue to identify the medial wall. Then I will start reaming medially up to the medial wall, then increase the size of the reamer (not the depth, just the width) with appropriate alignment 45° from the horizontal and 15–20° of anteversion. A trial is inserted at the correct angle to assess the coverage and stability. If stability is questionable, I will insert screws in the safe zone*

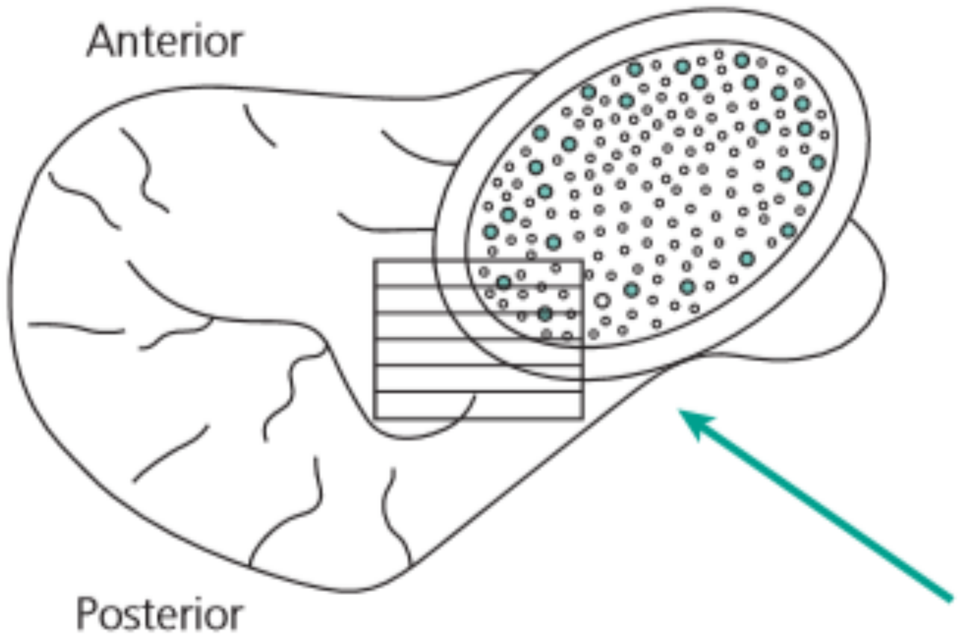




(a) (b)

THR technique

- *Femoral preparation:*
- *Entry point is created with a box chisel and then canal finder to allow insertion of the femur (posterior & lateral) for the anterior bow in the femur and to prevent varus malposition*
- *Broach up sizes from small to large in adequate alignment 10 – 15 anteversion*


Anterior
Posterior

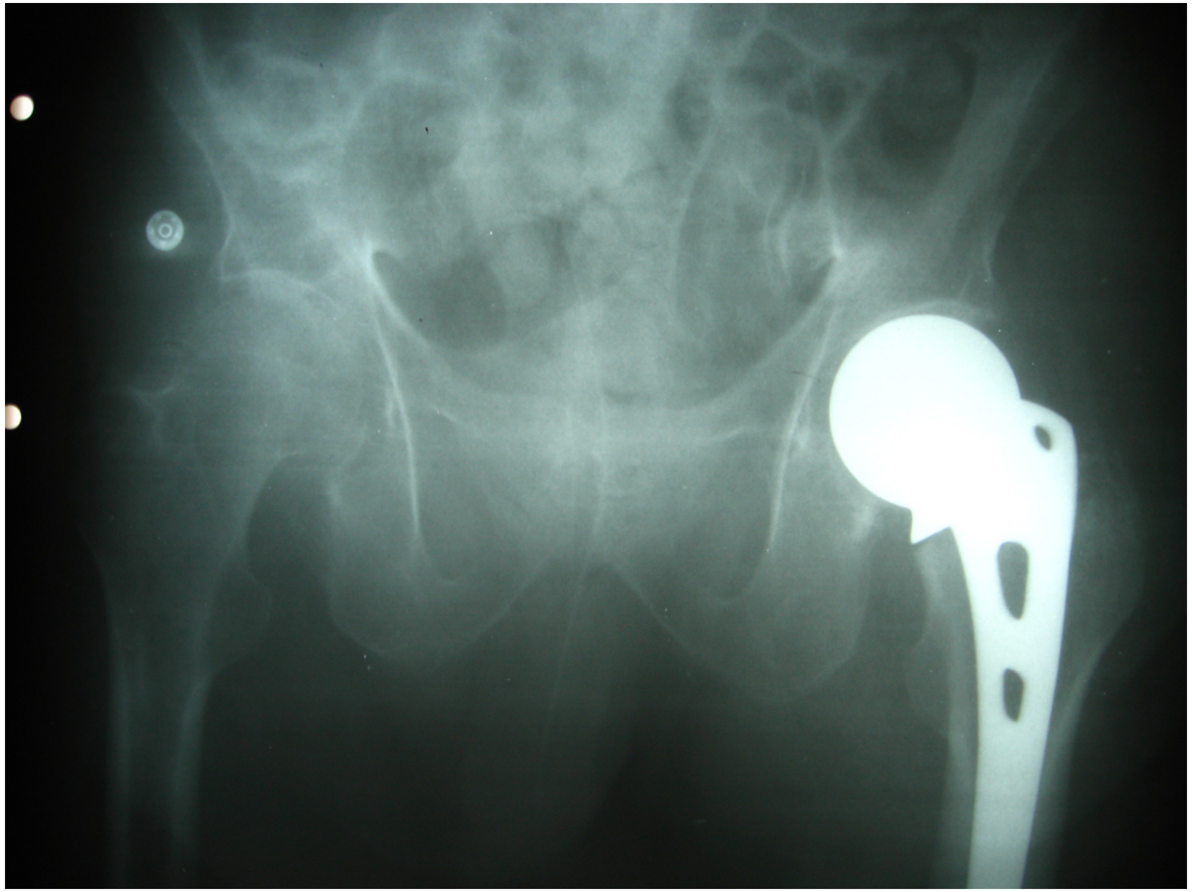
What type of implant fixation and bearing surfaces will you use and why?

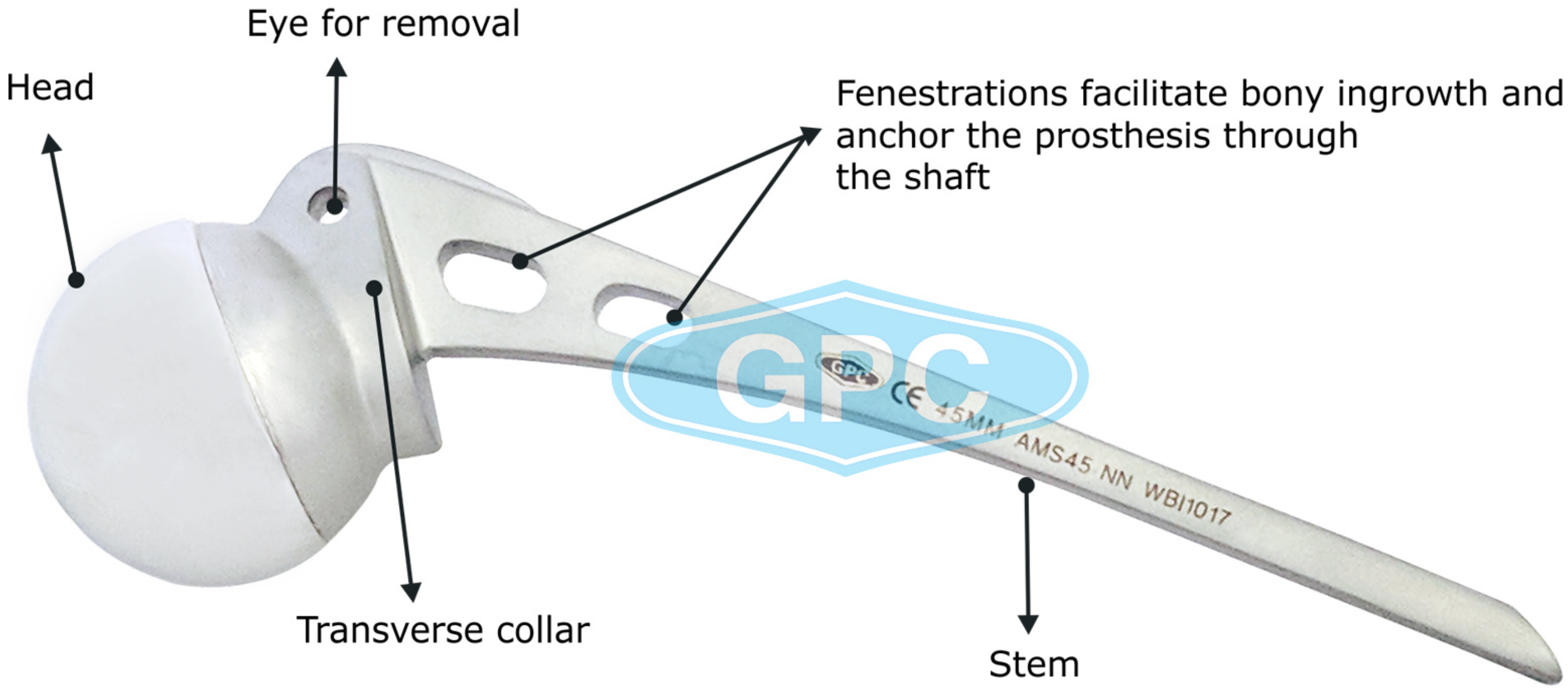
- Uncemented THR. NJR: 8.94% revision rate.
- Cemented THR. NJR: 4.88% revision rate.
- Hybrid. NJR: 5.38%
- National joint registry

Viva 12

History

- *1891: Dr. Gluck performs first reported attempt at a hip replacement with ivory used to replace the femoral head.*
- *Austin Moore describe the first metallic hip replacement surgery in 1940. The patient had a proximal femoral resection for a giant cell tumor. The original prosthesis he designed was a proximal femoral replacement, with a large fixed head, made of the Cobalt-Chrome alloy Vitallium.*
- *A later version, the so-called Austin Moore Prosthesis which introduced in 1952. The Austin-Moore prosthesis (Unipolar uncemented hemiarthroplasty) was a large, uncemented femoral stem that didn't use polyethylene, had fenestrations for self-locking & bone ingrowth (never cement an AT Moore prosthesis, since it will be impossible to remove w/o severely damaging the femur).*




Eye for removal
Head
Fenestrations facilitate bony ingrowth and anchor the prosthesis through the shaft
Transverse collar
Stem
CE 45MM
AMS45 NN WBI1017

History

- *1954: Thompson prosthesis, (Unipolar cemented hemiarthroplasty) has a more vertical neck angle that allow sinking of the prosthesis and is better indicated for the patient with a low or distal neck fracture*
- *1960s: Charnley introduces concept of low friction arthroplasty, termed "low friction" as a small femoral head was used to reduce wear. <u>Components >> cemented metal femoral stem-cemented polyethylene acetabular component</u>*

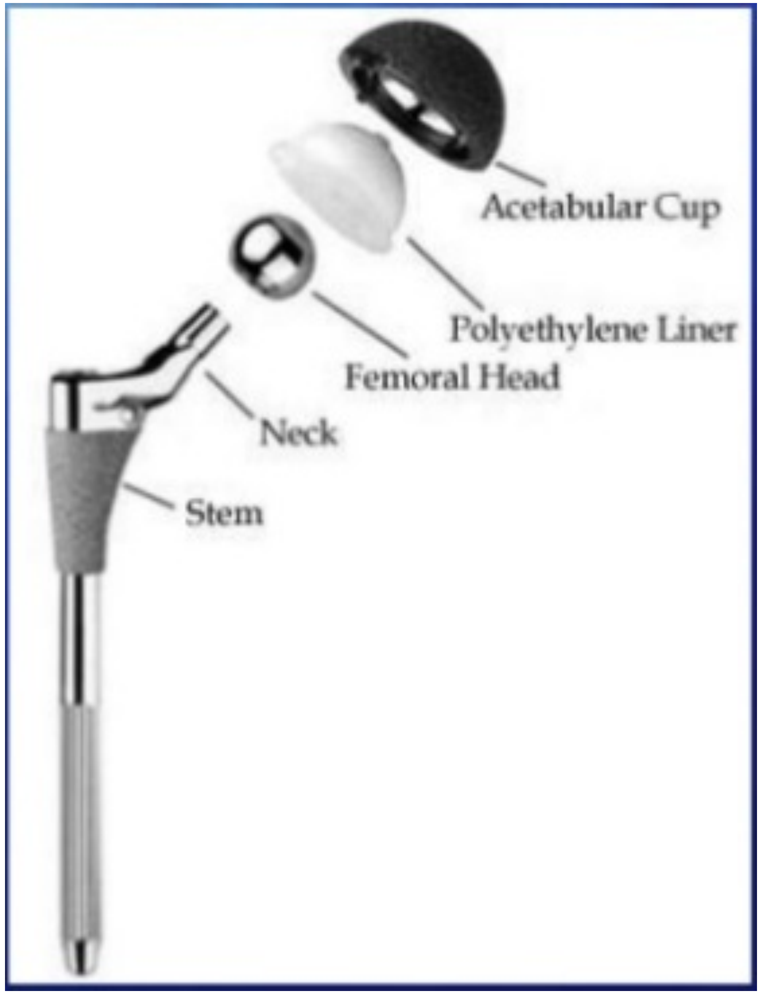

History

Evolution of the Charnley stem. From left to right: Original 1st generation Charnley flatback, 2nd generation round back stem, 3rd generation flanged copra stem, latest triple taper stem.

-When Charnley changed his stem from the flatback to the Cobra design, the biomechanical characteristics were changed from a tapered polished (force-closed) to a shape-closed or composite beam bio-mechanical design

- the flatback stem had a higher incidence of stem fractures, the possibility for aseptic loosening was greater with the flanged stem

THA components



Femoral component design

- ***Cross-section of the stem***

- *The cross sectional shape influences(affect)*
  - *distribution of the cement within the canal*
  - *the rotational stability of the implant*
  - *stress distribution within the cement mantle.*
- *Stems with oval cross-section have better fit within the femoral canal than the rectangular cross sections (Exeter) which are limited in size by their contact against the inner cortex of the femoral canal.*

Femoral component design

❖ ***Stem shape***

➢ *Straight (curved only in the coronal and not sagittal plane) or curved (anatomical) designed to fit the sagittal intramedullary anatomy.*

➢ *Anatomically shaped components allow better centralization of the stem and a more thickness of the cement mantle.*

➢ *A tapered geometry from proximal to distal is designed to allow controlled subsidence of the stem within the cement mantle, permitted by the tensile stress relaxation of the cement, to a new position of stability. A polished(soft) surface finish is important in the success of these taper slip stems*

Femoral component design

- ***Collar or collarless***

- *The collar is designed to*
  - *prevent subsidence of the stem*
  - *facilitate vertical load transfer from the stem to the medial femoral neck.*
  - *reduces tensile stresses in the stem*
  - *reduces the overall migration by minimizing the micromotion between the prosthesis cemet interface.*

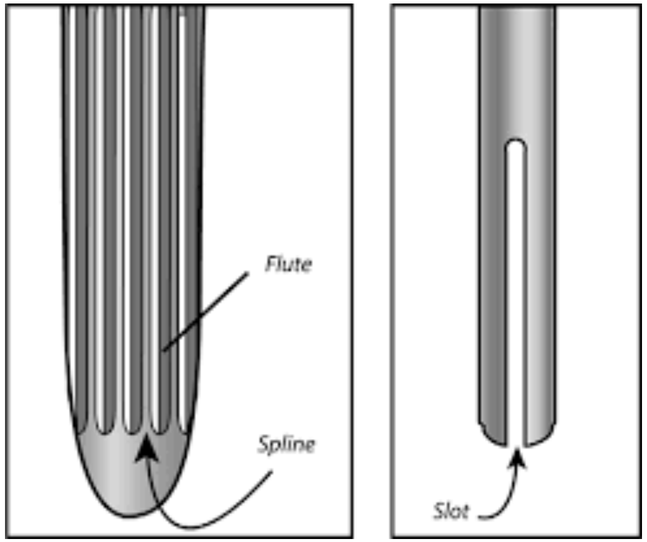
Femoral component design

❖ ***Longitudinal slots/grooves***

➢ *improve the rotational stability of the stem within the cement mantle*.

➢ *Decreases stress shielding,*

➢ *increases the interlock between the stem and the cement.*


Flute
Spline
Slot

Femoral component design

- ***Surface finish***
  - *roughened stems have been shown to fail earlier than polished stems of the same implant.*

Femoral component design

❖ ***Neck length***

➢ *measured from the centre of the head to the base of the collar.*

❖ ***Modularity (non-modular, modular)***

➢ *modular heads allow for adjustment in neck lengths.*

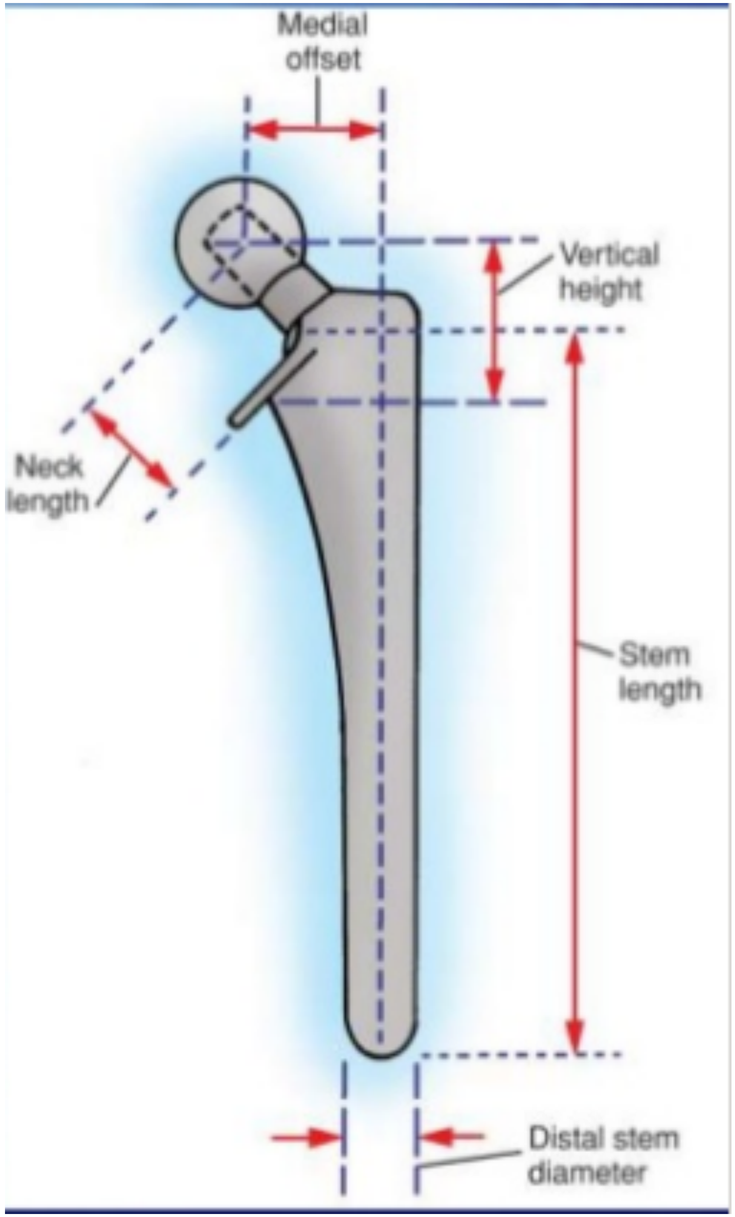
❖ ***Medial (head stem) offset or femoral offset***

➢ *perpendicular distance between the centre of the femoral head and the long axis of the distal part of the stem. Inadequate restoration leads to increased joint reaction force, bony impingement and dislocation while excessive offset can lead to stem fracture or loosening.*

Femoral component design

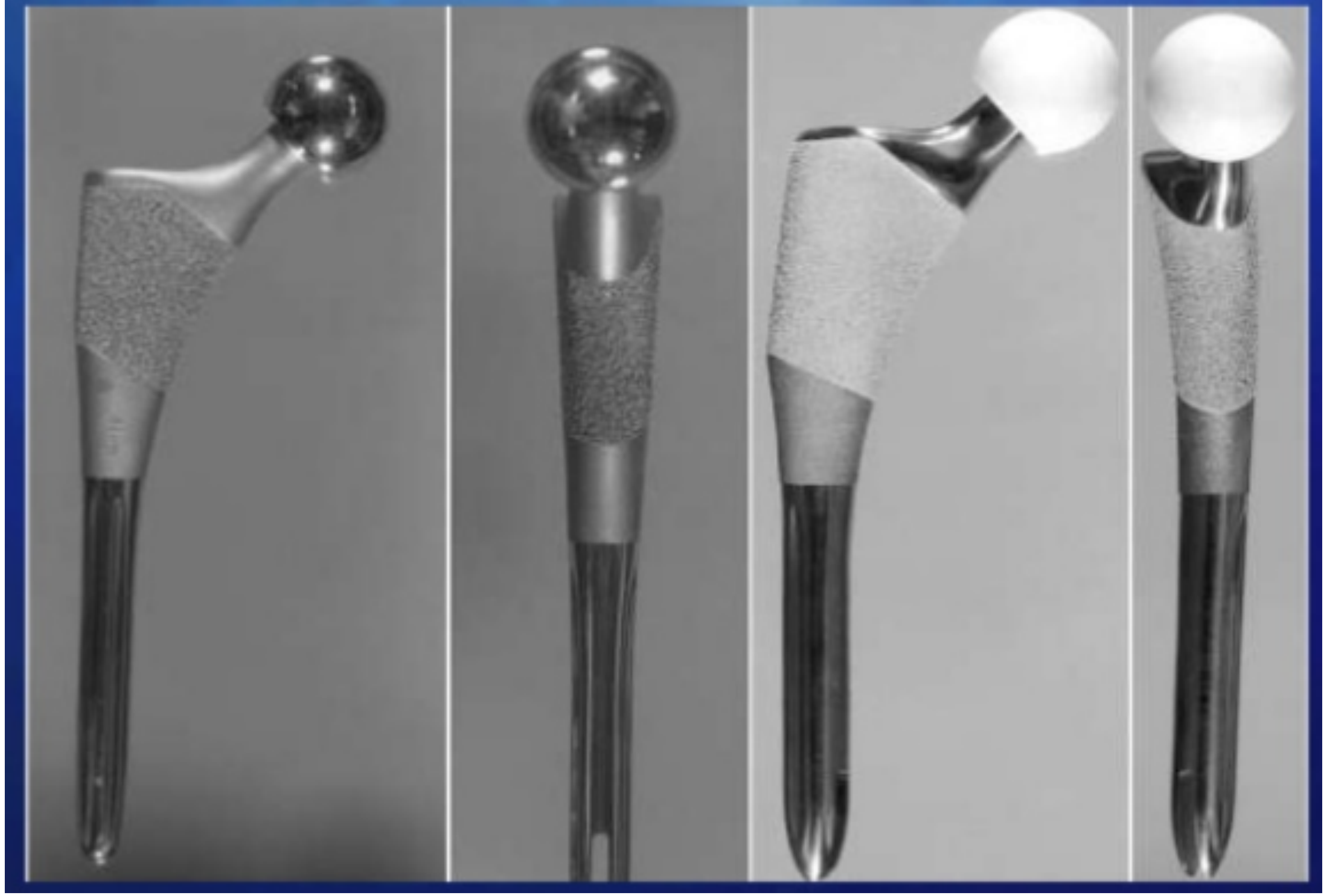
❖ ***Ratio of femoral head diameter to the femoral neck diameter***

➢ *if this is increased there is a greater primary arc of motion.*


Medial offset
Vertical height
Neck length
Stem length
Distal stem diameter


FEMORAL COMPONENTS USED WITH CEMENT

CEMENTLESS STEMS WITH POROUS SURFACES



What are the features of ideal implant?

- *Biocompatibility: inert, non-immunogenic, nontoxic, non-carcinogenic*
- *Strength: sufficient tensile, compressive and torsional strength, stiffness and fatigue resistance*
- *easy to manufacture and implant*
- *Inexpensive*
- *No effect on radiological imaging*
- *Corrosion: free*

This is a photograph of two types of femoral stem used in a total hip replacement

- ***What are they called?***

- *The stem on the left is an Exeter. The stem on the right is a Charnley.*

- ***What are the characteristic features of both the stems?***

- *The Exeter stem is a collarless, highly-polished, double-taper stem. The Charnley stem is a matt finished (rough surface), monobloc, round back stem, with collar to prevent subsidence, with a 22.225 mm femoral head.*

- ***Which material are they composed of and why?***

- *Both femoral stems are manufactured from a stainless steel alloy. This has high strength with ductility and a high corrosion resistance.*

❖ ***What biomechanical principles are they supposed to work?***

➢ *The Exeter works by utilizing a taper slip design and controlled subsidence. It is implanted within a cement mantel and the highly polished nature and the taper allows controlled subsidence of the stem within the cement mantel (about 1.6mm/ year). This taper means that the hoop stresses which are perpendicular to the long axis of the implant remain applied to the bone as the hip subsides. By contrast the Charnley works in a composite beam manner, relies on friction to maintain the position of the stem within the cement mantle. A rough surface finish (typically greater than 2 Ra) and design features, such as a collar or flange are intended to minimize micromotion at the prosthesis–cement interface. It is not designed to subside.*

❖ *How do they fail?*

- *Composite beam stems fail when movement occurs at the prosthesis–cement interface. A rough surface finish will scrap the cement mantle once micromovement is established. This probably leads to gap formation, which in turn further increases micromovement and also allows the circulation of wear debris. Polished, tapered stems are inherently stable devices and their mechanism of failure is not well understood. RSA and retrieval studies suggest that these devices fail when they rotate in the axial plane.*

Viva 13

Radiographic evaluation of hip replacements

Checklist for reading radiographs

- ***The radiograph*** *(view – site – date – patient identity – quality)*
- ***The prosthesis*** *(type of fixation: cemented, uncemented or hybrid – design feature ??– cementing technique: old or new ??femoral canal plug)*
- ***The procedure*** *(femoral stem position: neutral, valgus, varus – acetabular component: inclination – anteversion (lateral view) – cement mantle: thickness, bone-cement and cement-bone interfaces)*
- ***The present status*** *(radiolucencies: Charnly & Gruen zones – subsidence and loosening – fracture – leg length)*

The radiograph

- Date.
- Patient identity
- Side
- Quality (note whether the whole prosthesis is included in the film and whether the pelvis or femur is properly rotated)-beam focused on the pubic symphysis with hips extension and internal rotation.

The patient

- Clues about pre-existing hip disease:

➢ radiological features of avascular necrosis, osteoarthritis (may present in the contralateral hip).

➢ Some features may also be present in the replaced hip, such as residual hardware after internal fixation of the acetabular or proximal femoral fractures, or holes indicative of previous internal fixation devices

➢ changes in the sacroiliac joints and the lumbosacral spine may be seen in the AP radiograph of the pelvis, and the obturator foramen morphology may be changed in ankylosing spondylitis.

Figure 1 A woman had bilateral cementless total hip arthroplasty (THA) [Anatomic Medullary Locking, AML; DePuy, Johnson and Johnson] done when she was 35 years old. There were multiple metallic clips over the right lower quadrant of the abdomen. She had a history of renal transplantation and the reason for THA was steroid-induced avascular necrosis of the femoral heads.

The prosthesis

❖ **Type of fixation**

➢ Cemented (cement is usually made radio-opaque by the addition of barium sulphate or zirconium dioxide, it may be radiolucent, especially if the THA was done a long time ago)

➢ Cementless

➢ Hybrid or reverse hybrid (usually a cementless socket and a cemented stem, as cemented acetabular components have a tendency to loosen over time).

The prosthesis

❖ **Design features**

➢ Shape of stem – straight/ curved.

➢ Tip- taper/blunt.

➢ Collar/collarless

➢ Surface finish – smooth/ rough.

➢ Modular(exeter)/monoblock(charnely)

The prosthesis

❖ **Design features**

➢ The socket may be all-polyethylene (mostly cemented) or have a metal shell (mostly cementless). For the allpolyethylene cemented sockets, there are metallic markers or wires to enable the surgeon to assess the alignment and wear.

- all-polyethylene

The prosthesis

❖ **Design features**

➢ For cemented stems, the presence of a collar should be noted. The collar is designed to prevent subsidence of the stem and to facilitate vertical load transfer from the stem to the femoral neck. The presence of a centraliser distally can also be looked out for, it is usually radiolucent and may be mistaken for bubbles or voids. The presence of cement restrictor also can be noted. One can tell whether a cemented stem was inserted with early or improved techniques by looking at the cement distally. With improved cementing techniques, there is usually an sharp cut off of the cement in the medullary canal because of the use of a distal plug

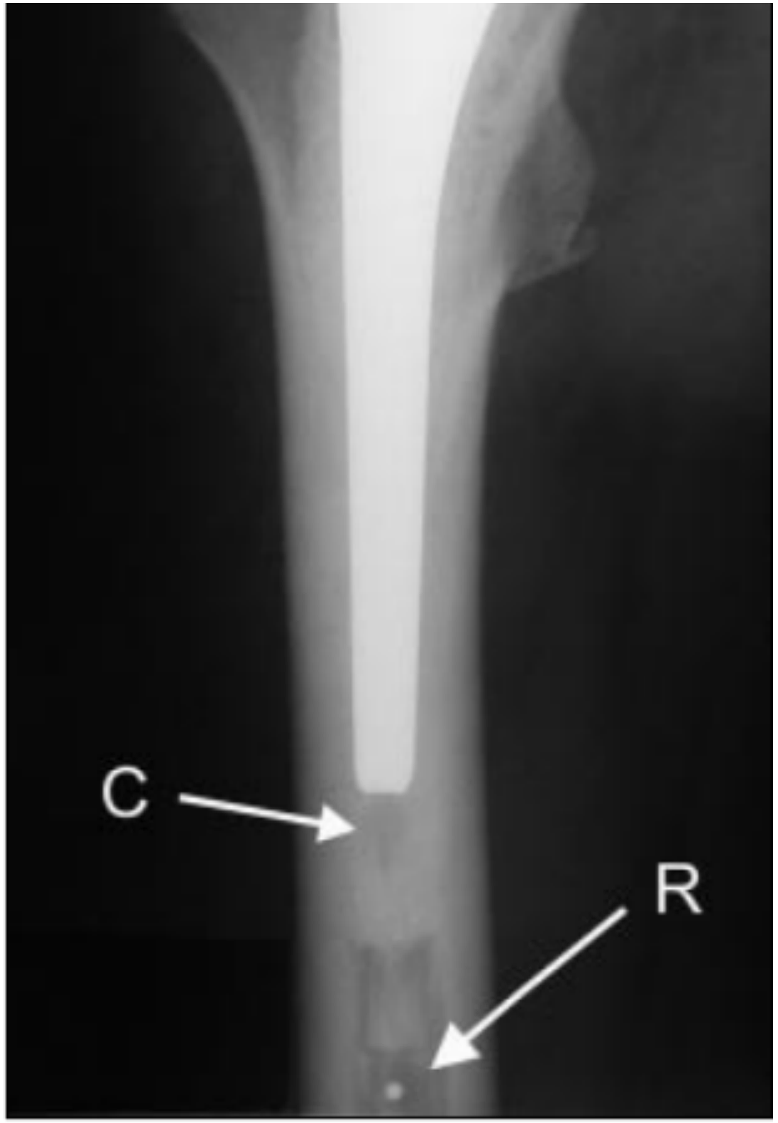


Figure 3 The cemented stem (Elite plus; DePuy, Johnson and Johnson) was inserted with improved cementing techniques. A cement restrictor (R) was used and the cement column was stopped abruptly. There was a centraliser (C) that appeared as a radiolucent bubble distal to the stem tip. The stem alignment was neutral. There was a complete cement mantle of >2 mm. Apart

The prosthesis

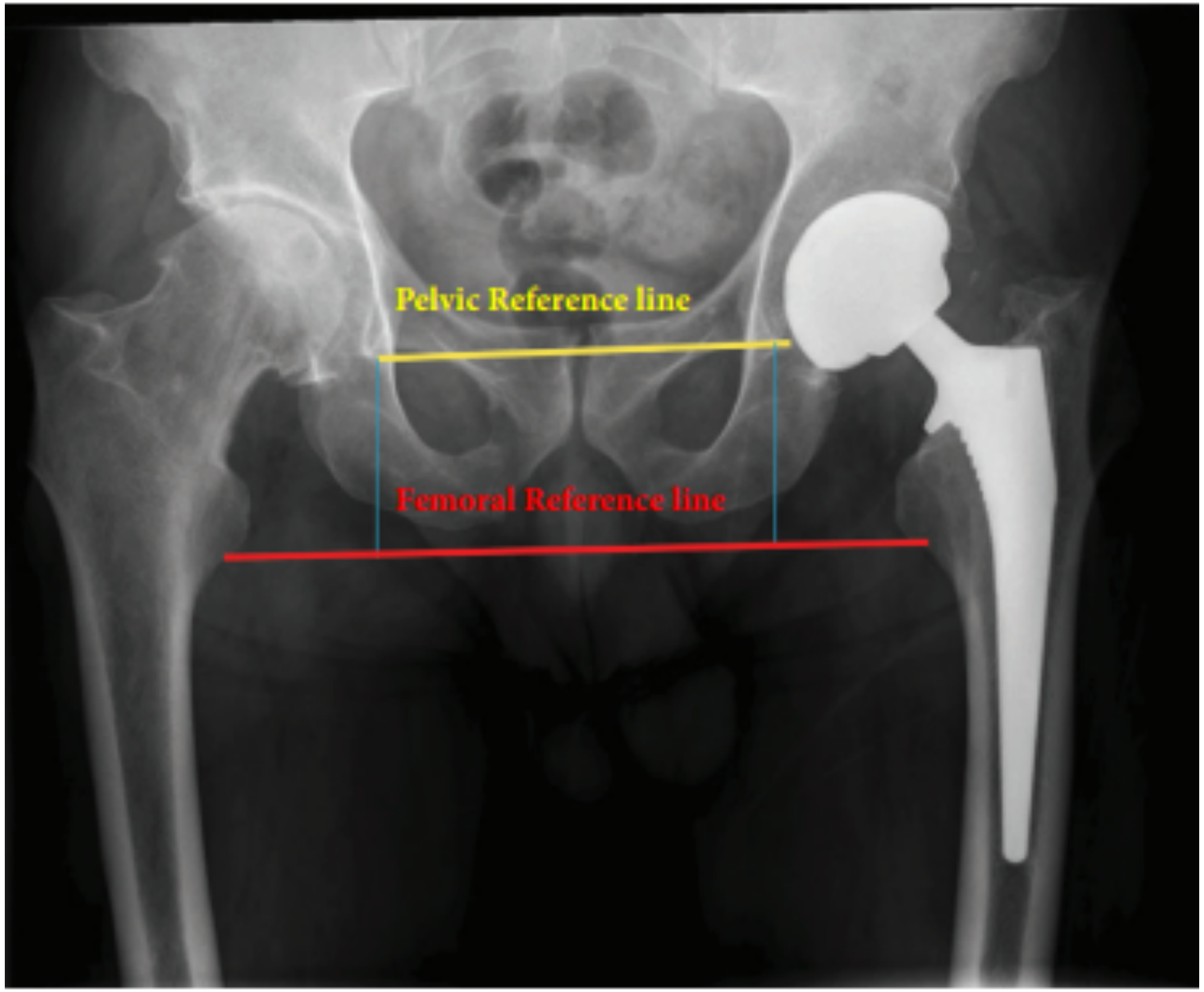
❖ **Design features**

➢ For cementless stems, comment on the shape, presence of a collar, extent of the coating, and length can be commented on. The stem may be curved and bowed so as to fit with the actual anatomy of the medullary canal, or it may be a straight stem design that makes use of the 3-point fixation principle. The distal part of the stem may be tapered or cylindrical. The use of a collar in cementless stems is controversial. For the extent of coating, it may be proximal (metaphyseal loading) or extensive or fully coated (distal loading). However, these coatings are not visible on radiographs. The actual length of the stem varies among different models

The procedure

❖**Leg length**

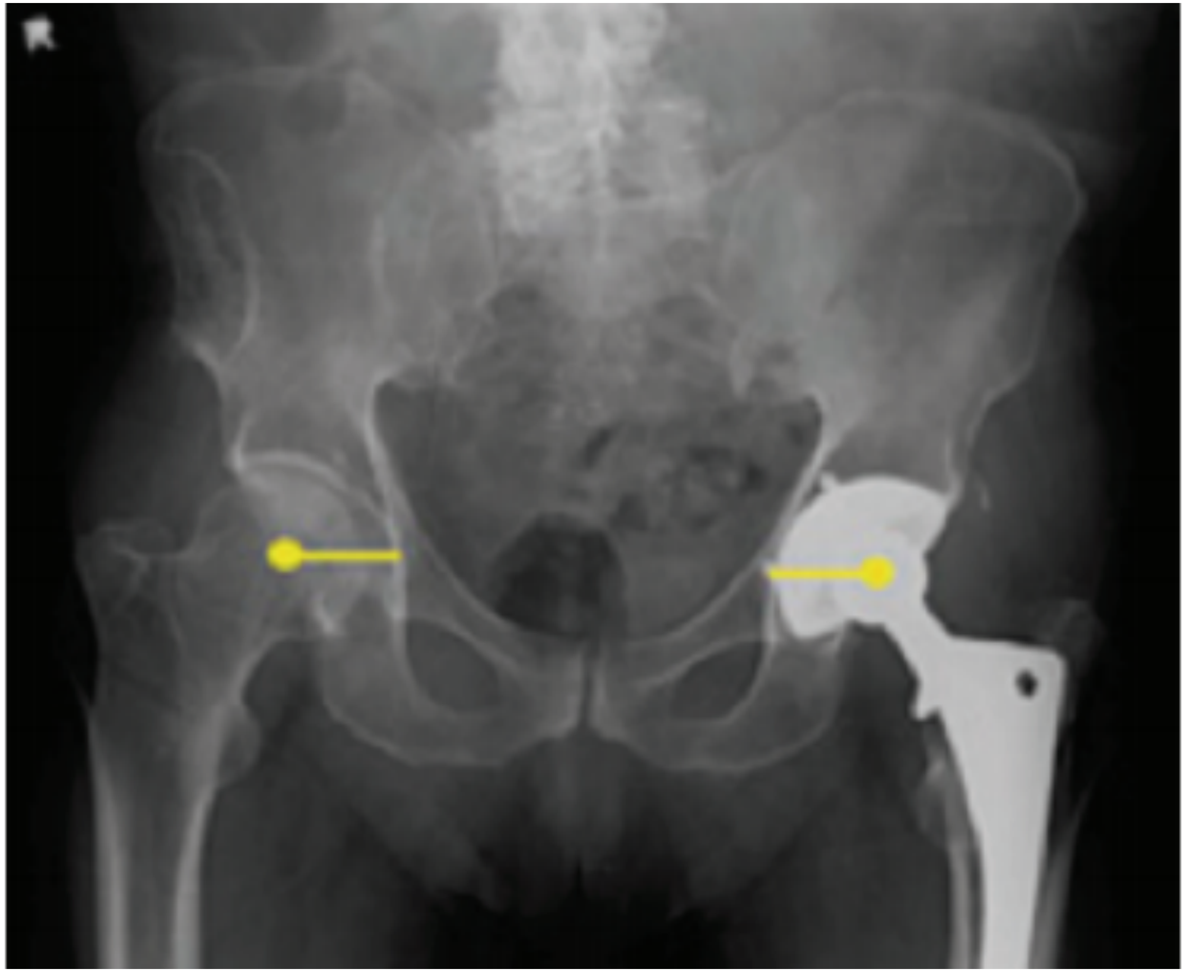
- ➢A pelvic reference line is drawn transversely connecting the inferior borders of the acetabular tear drops.
- ➢ The bi-ischial line has also been described as a pelvic reference
- ➢A femoral reference line is drawn transversely connecting the lesser trochanters.
- ➢A perpendicular line is then drawn from the femoral reference to the pelvic reference line and both sides are measured and compared.


Pelvic Reference line
Femoral Reference line

The procedure

❖ **Horizontal centre of rotation**

- assesses the acetabular component of the prosthesis.
- evaluated by measuring the distance from the centre of the femoral head to the acetabular teardrop.
- The distance from the centre of the femoral head to the teardrop should be equal bilaterally.
- Lateralizing the acetabular component >> increased lever arm of the body weight >> decreased lever arm of abduction >> increased JRF. ??



	Acetabulum COR medial to Femur COR	Acetabulum COR = Femoral COR	Acetabulum COR lateral to Femur COR
Acetabulum COR superior to Femoral COR	Leg shortened with decreased offset	Leg shortened	Leg shortened with increased offset
Acetabulum COR = to Femoral COR	Offset decreased	No change	Offset increased
Acetabulum COR inferior to Femoral COR	Leg lengthened with decreased offset	Leg lengthened	Leg lengthened with increased offset
	COR = Center of Rotation		

The procedure

❖ **ACETABULAR COMPONENT POSITION**

- **Acetabular inclination**

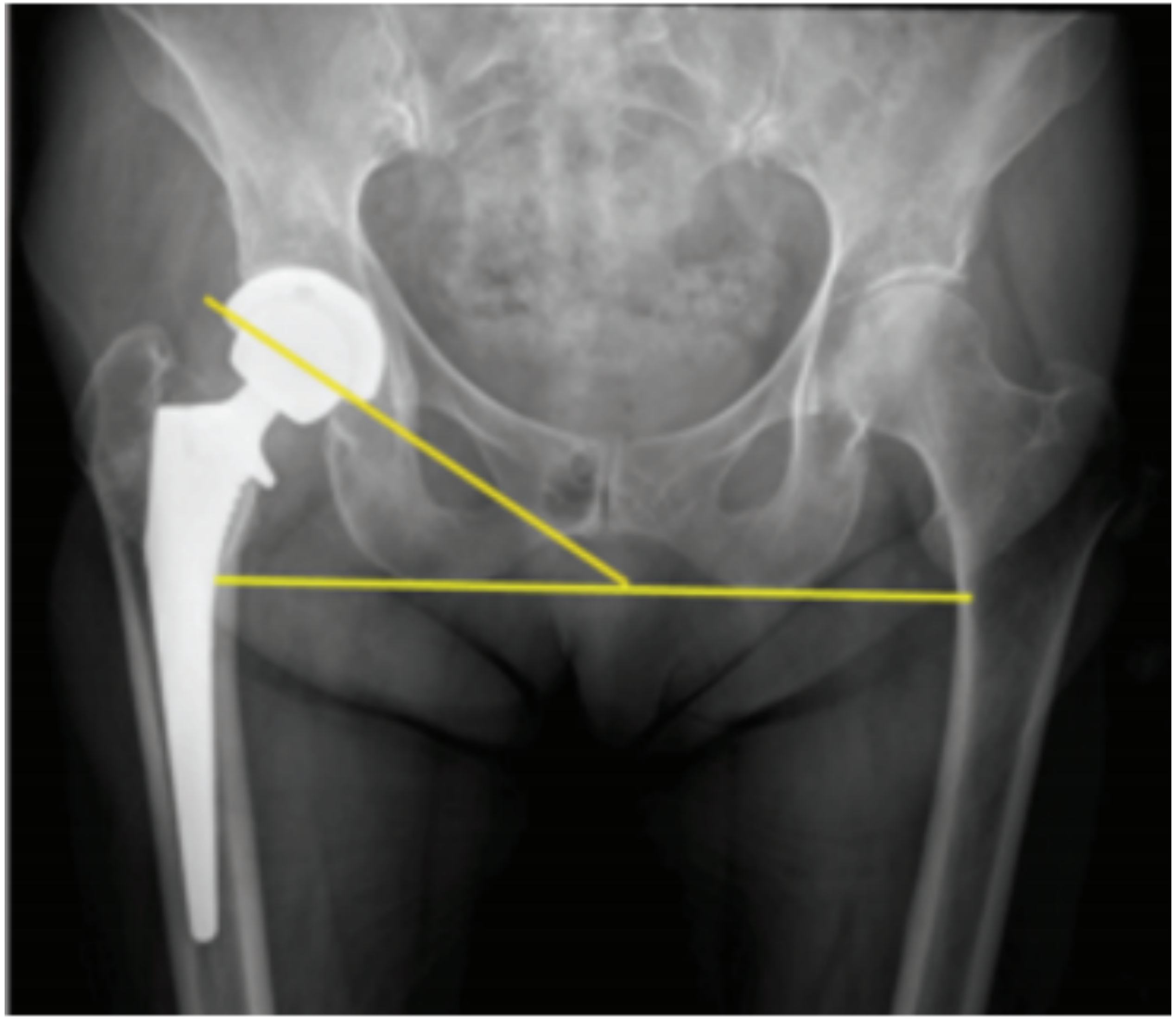
➢ It measures the angle between the face of the cup and the transverse axis.

➢ It is achieved by drawing a line through the medial and lateral margins of the acetabular cup with the transverse pelvic axis by using the bi-ischial pelvic reference line.

➢ The inclination should measure between 30–50°.

➢ Less angle results in a stable hip but limited abduction and impingement .

➢ Greater angulation substantially increases the patients risk of hip dislocation and may lead to eccentric PE wear.



The procedure

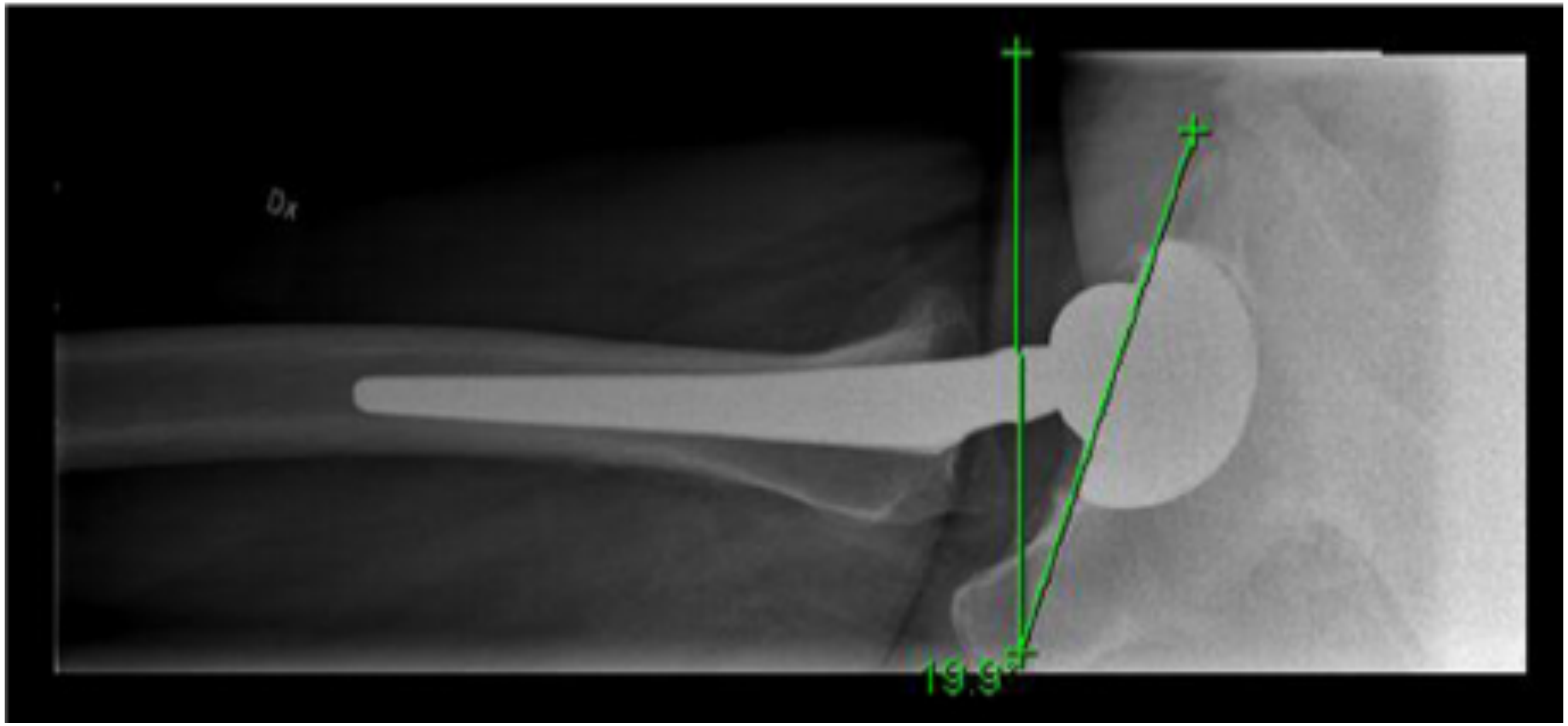
❖**ACETABULAR COMPONENT POSITION**

- **Acetabular anteversion**

➤It is defined as the angle between the acetabular axis and the coronal plane.

➤Measuring anteversion can be done using a true lateral radiograph, but as is often the case only an AP view is available.

➤Normal angle is 20°+/- 5


Dx
19.9°

The procedure

- **Femoral stem position**
- On an AP pelvic radiograph the prosthetic stem should appear to be in neutral alignment with the longitudinal axis of the shaft and the tip in the centre.
- Valgus positioning is generally not a significant problem but varus positioning puts the prosthesis at greater risk of loosening and fracture.

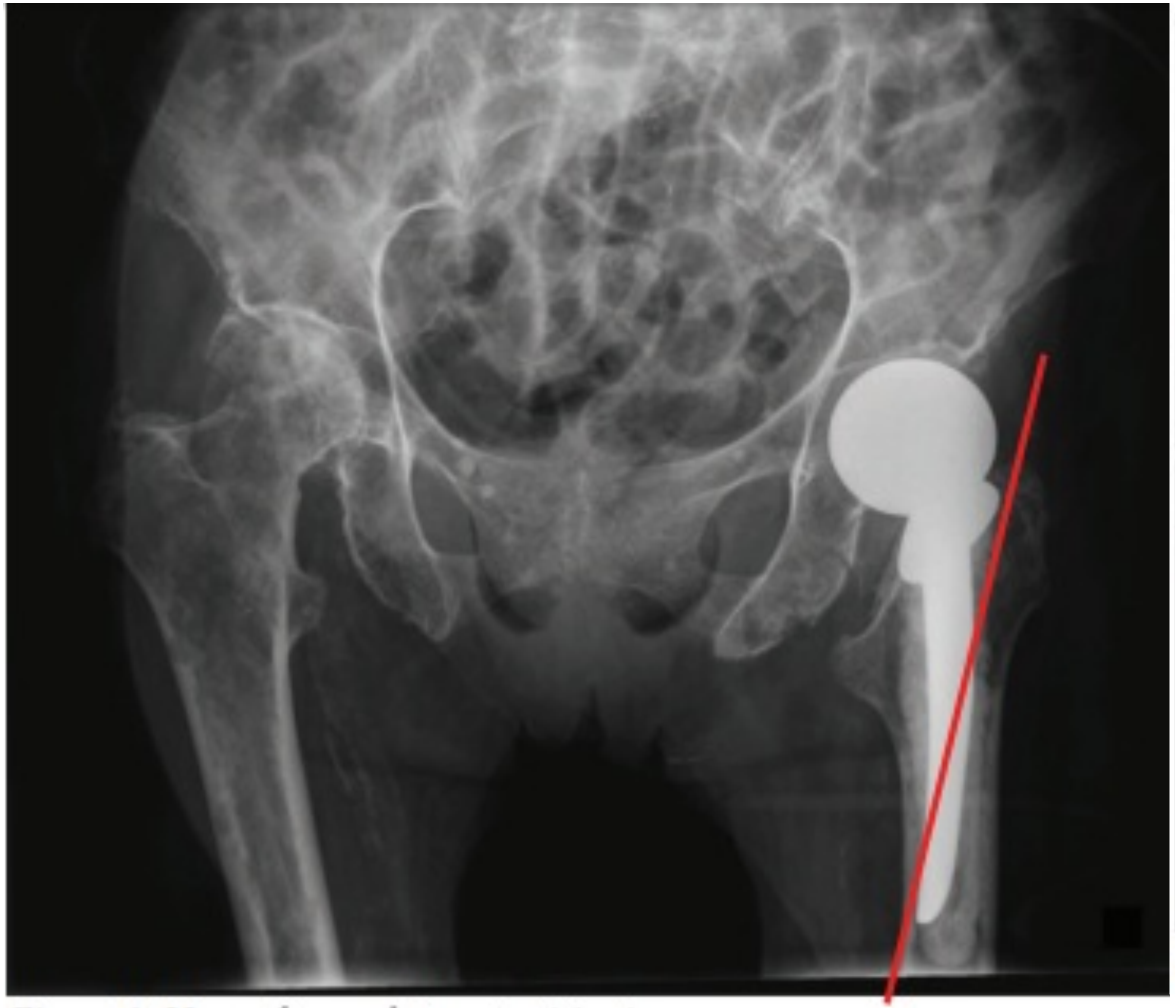


Figure 8: Varus femoral stem positioning

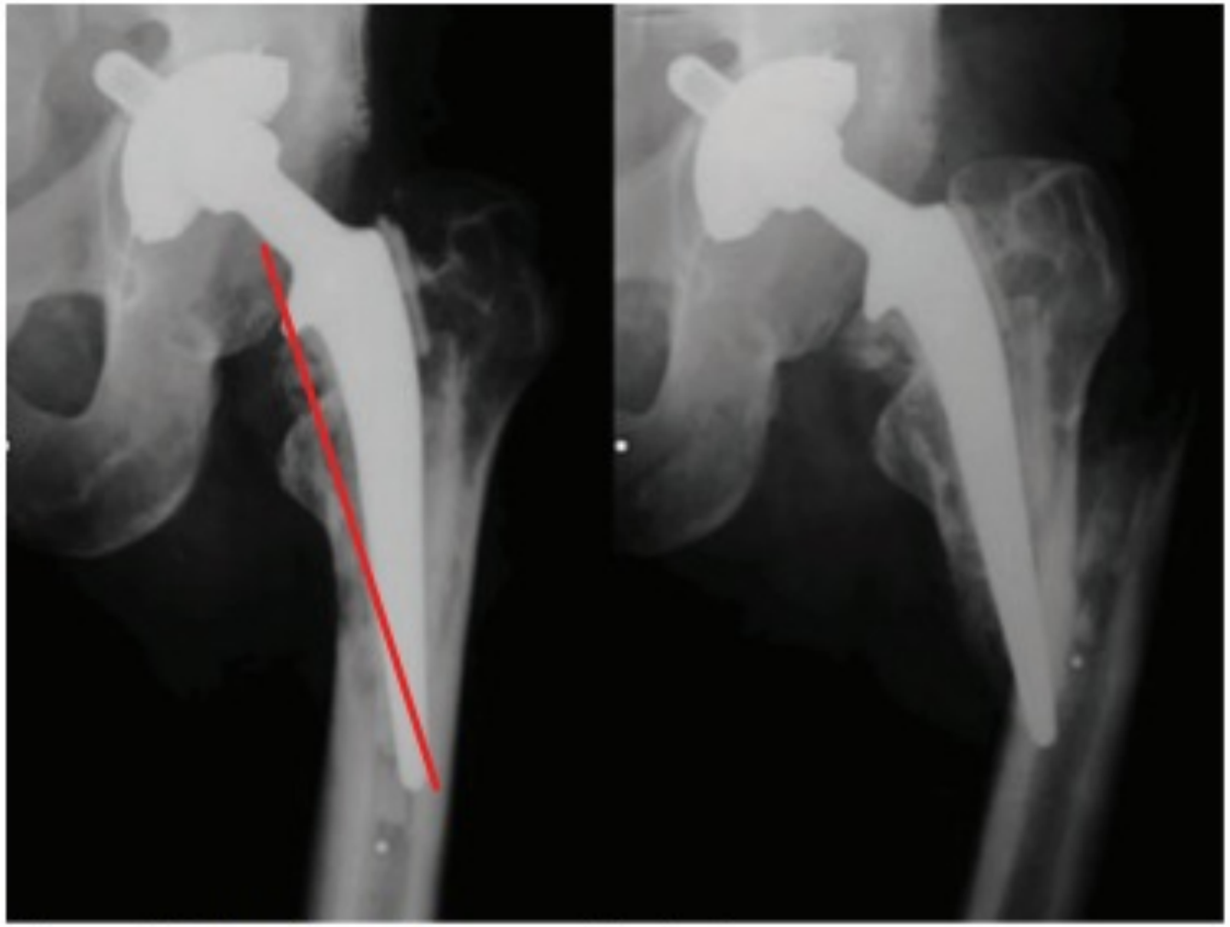


Figure 9: Valgus femoral stem positioning[6]

The procedure

❖**Femoral stem position**

➢On the lateral view anteversion can be assessed as well as the AP tilt of the stem.

➢The degree of femoral anteversion is suggested to be between 10 to15 degrees.

➢A combined anteversion angle (acetabular & formal) of 50° is suggested.

The procedure

❖**Cement mantle**

- It is important to consider both the cement-bone and the cement-prosthesis interfaces.
- In general, a radiolucent zone greater than 2 mm wide at either interface is indicative of probable loosening. (*Complete femoral cement mantles of 2-3 mm thickness have been shown to yield good long term radiographic and clinical outcome*).
- (aim to Adequate cement mantle thickness, no gaps or lucencies in both cement-bone and the cement-prosthesis interfaces).

The procedure

❖ **Cement mantle**

- Barrack & Harris grading system

➢ Grade A mantles, if there is complete filling of the medullary cavity by cement, or 'white-out' of the bone-cement interface.

➢ Grade B mantles, there is slight radiolucencies < 50%

➢ grade C mantles, the radiolucency occupies > 50%.

➢ Grade D mantles, gross defects in the cement mantle, and/or the distal cement does not extend beyond the stem tip

The present status

❖**Radiolucent lines RLL (for the cemented prosthesis)**

➢DeLee and Charnley described 3 types of cement-bone demarcations in cemented sockets. From lateral to medial.

➢Gruen described RLL for the stem

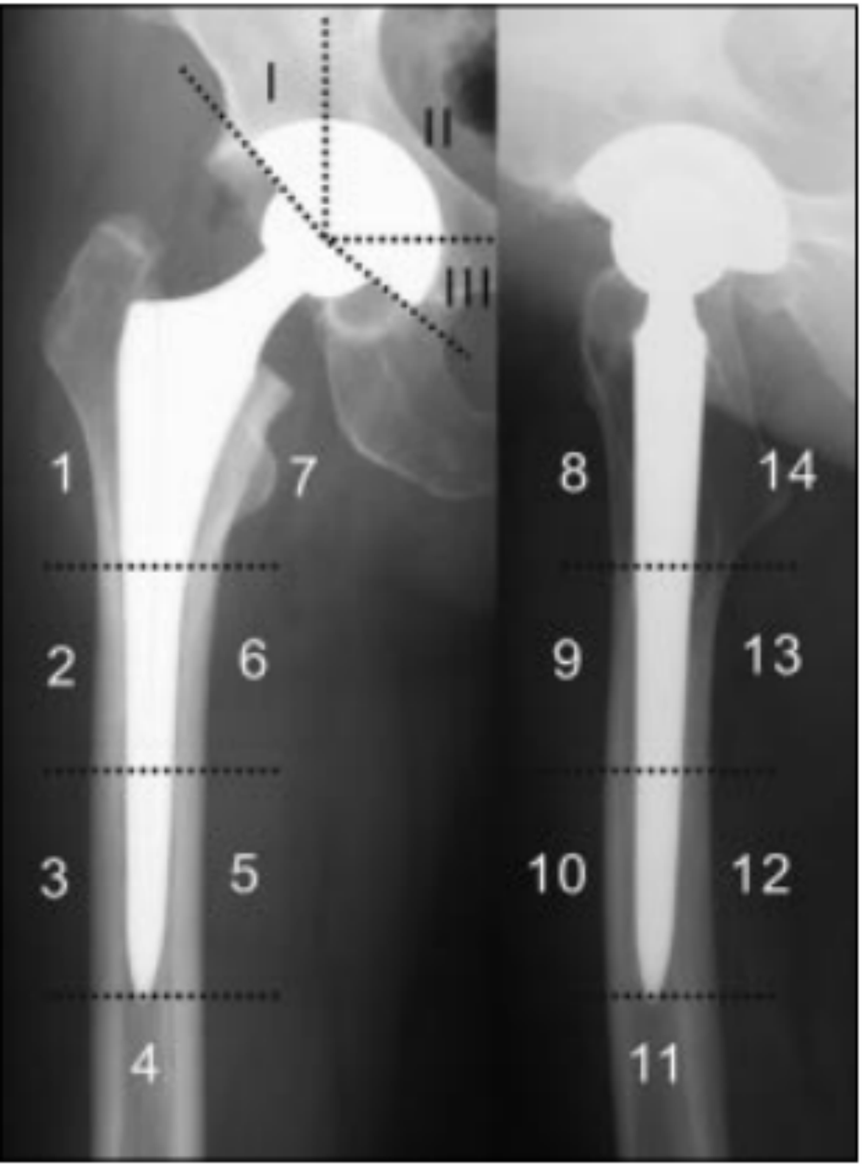
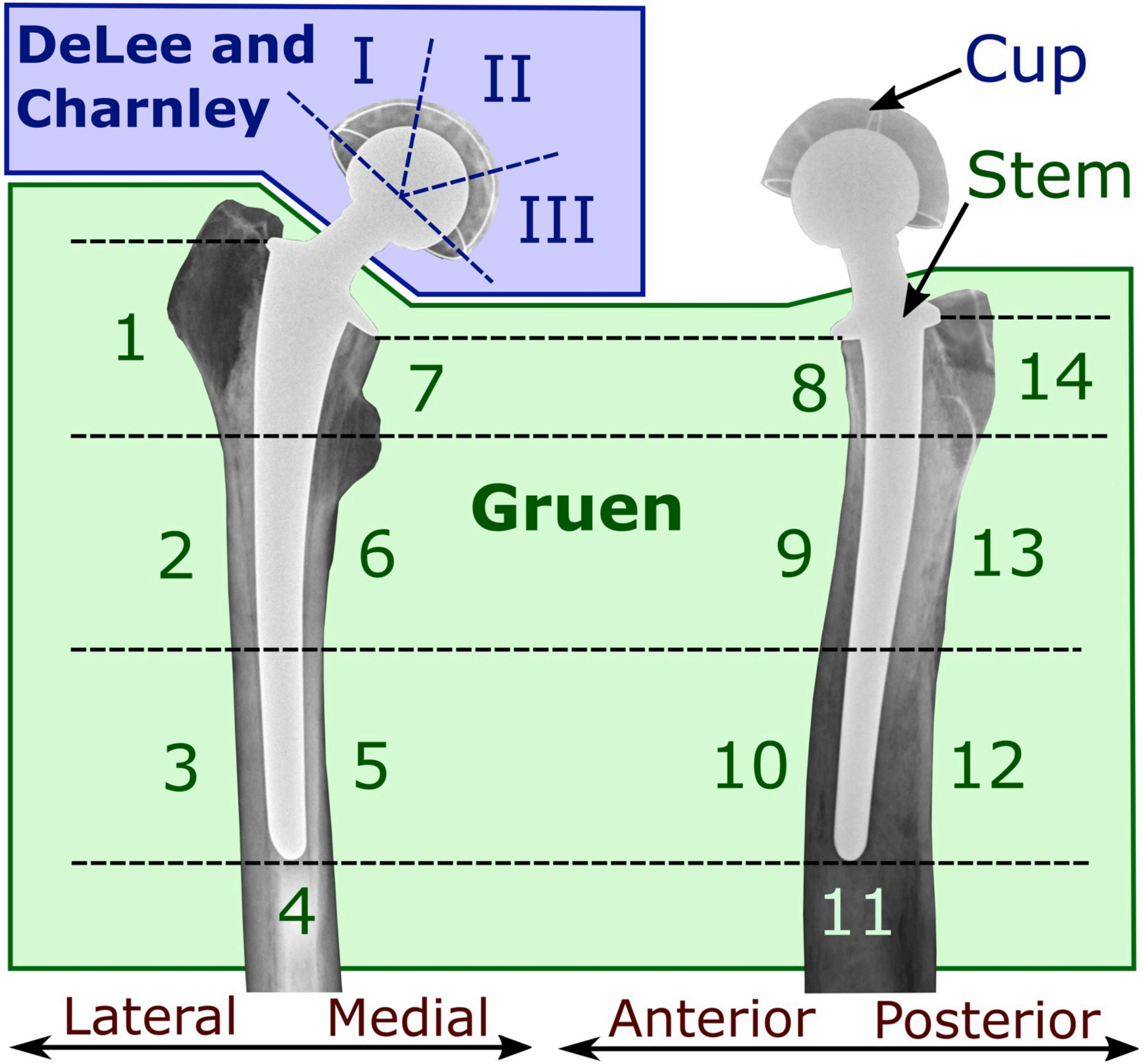


Figure 5 The surface of the socket is divided into 3 zones and that of the stem into 7 zones in the anteroposterior radiograph (left). There are 7 more zones around the stem in the lateral radiograph (right).

Hip prosthesis zones



The present status

❖ **For the cementless prosthesis**

- Fixation of cementless stem is classified as:

➢ bone ingrowth.

➢ stable fibrous.

➢ Unstable.

The present status

❖ **For the cementless prosthesis**

- Criteria for bone ingrowth:

➢ no subsidence.(equal to distal migration of the implant)

➢ no reactive line adjacent to the porous-coated portion.

➢ endosteal hypertrophy (spot welds) at the distal limit of the porous coating.

➢ variable amount of proximal bone resorption due to stress shielding??

➢ Stress shielding refers to the reduction in bone density (osteopenia) as a result of removal of typical stress from the bone by an implant.

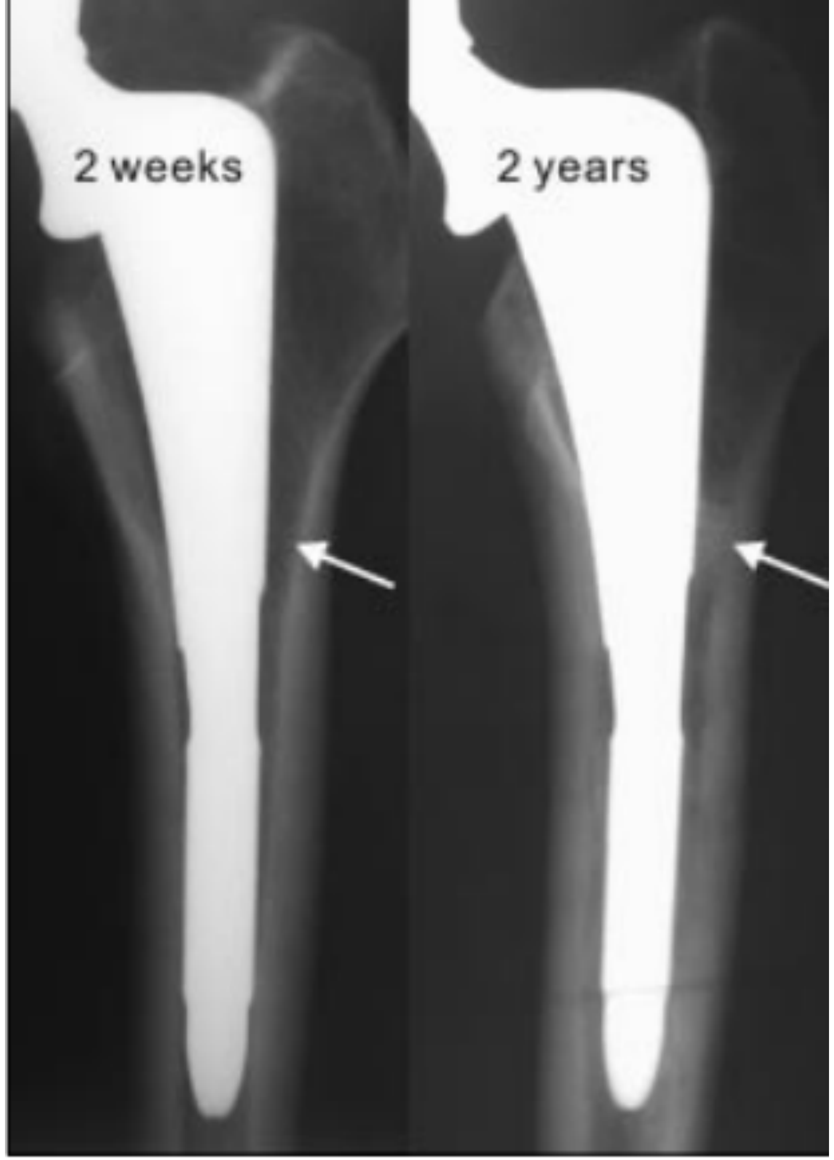


Figure 7 A total hip arthroplasty with a proximally porous-coated stem (Replica A; DePuy, Johnson and Johnson) was performed. On comparing the 2 radiographs, there is an obvious 'spot weld' at the lower part of the porous coating over the lateral side (white arrows). There is no reactive line over the porous-coated surface and no subsidence. Calcar resorption is also seen. The stem is bone ingrown.

The present status

❖**For the cementless prosthesis**

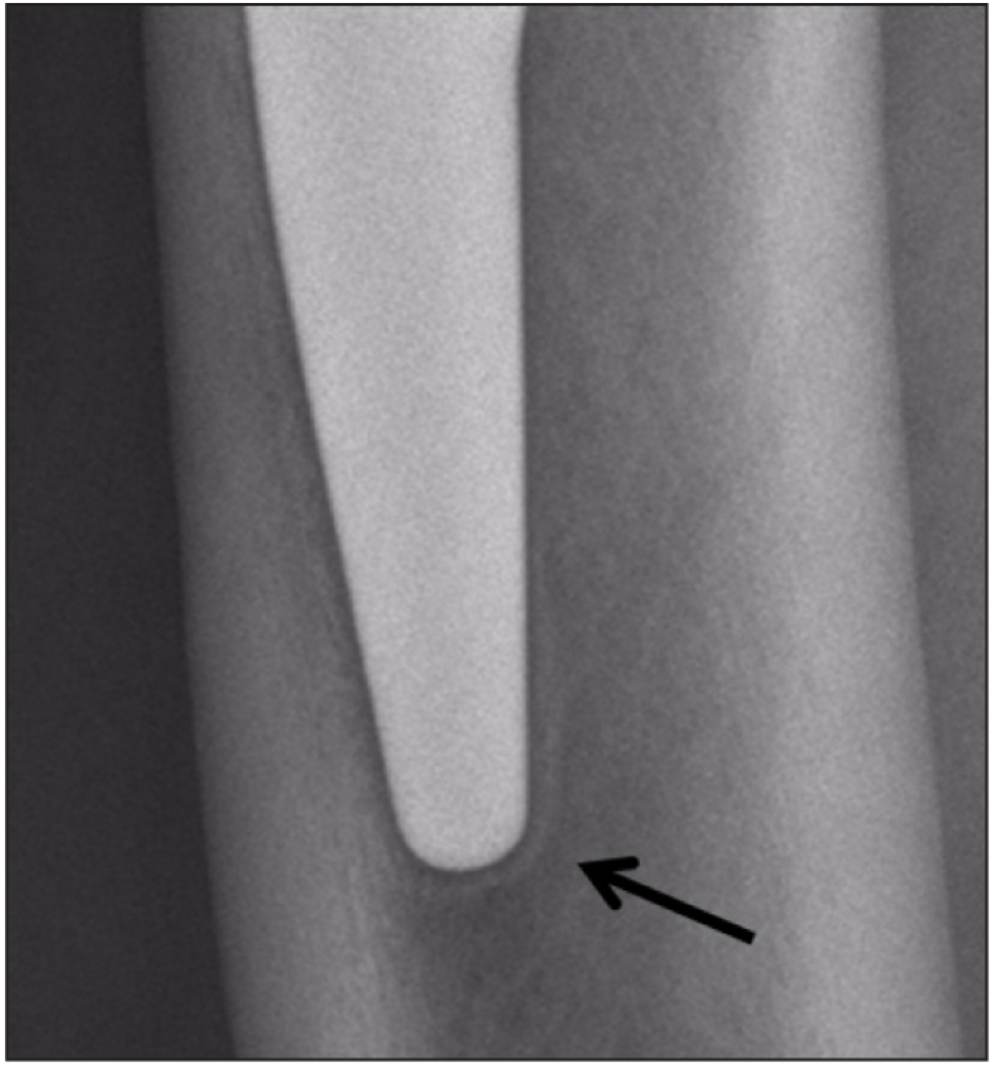
- Criteria for stable fibrous fixation:

➢no progressive implant migration.

➢no or minimal proximal atrophy.

➢no endosteal hypertrophy noted at the distal limit of the porous coating.

➢There may be a reactive line adjacent to the porous-coated portion, but it does not widen with time.



The present status

❖**For the cementless prosthesis**

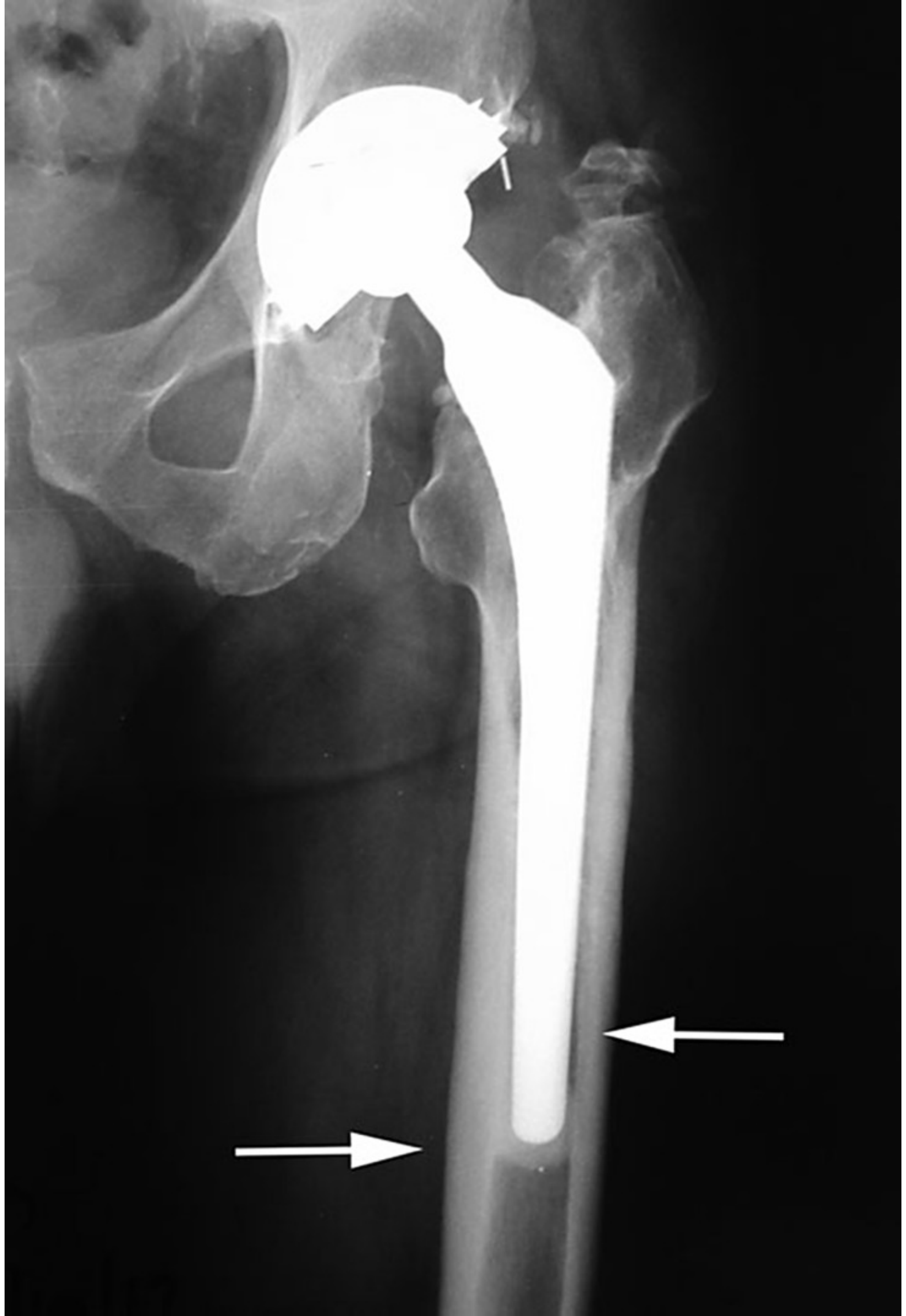
- Criteria for unstable cementless:

➢ progressive component migration.

➢ formation of a distal pedestal at the stem tip (is an endosteal new bone formation below the distal end of the stem and it usually extends over 50% of the canal).

➢ Calcar hypertrophy. (*Distal pedestal formation and calcar hypertrophy imply prosthesis-to-bone stress transfer away from the porous coating metaphyseal part of the implant and are associated with instability*)

➢ the presence of reactive lines that tend to diverge from the component surface and widen with time



The present status

- Stress shielding vs osteolysis

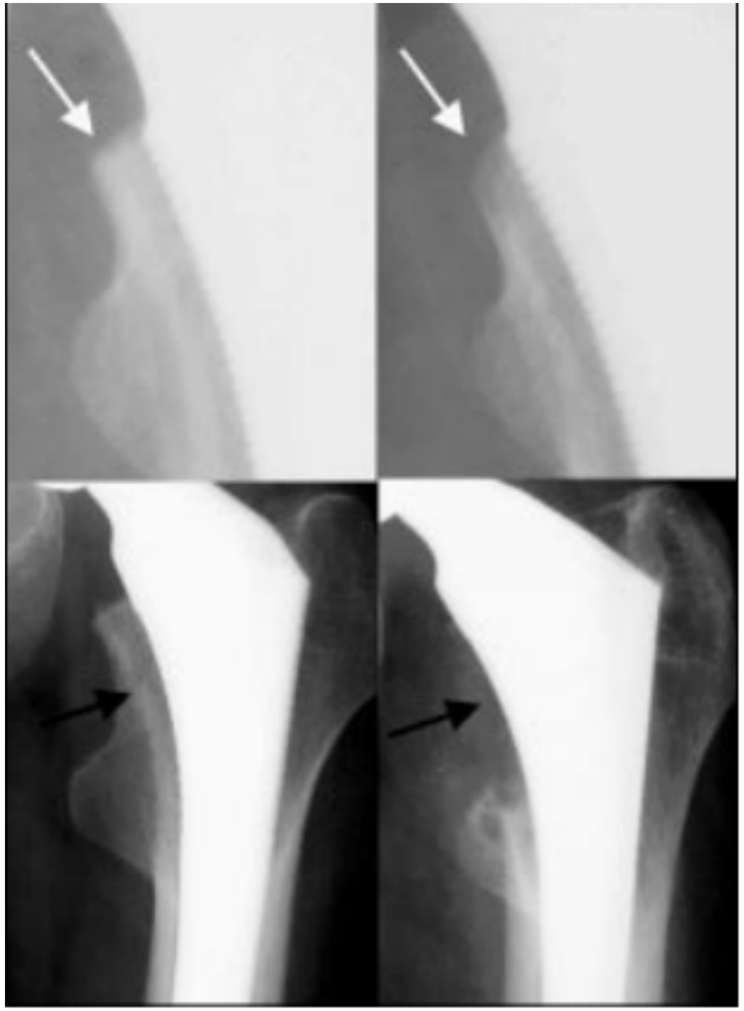


Figure 10 Differentiating between calcar resorption as a result of stress shielding and osteolysis affecting the calcar region due to particulate disease. Stress shielding usually stabilises after 2 to 3 years; there is round off of the femoral neck, and the density of the cortical bone in the calcar decreases and becomes cancellous-like (cortico-cancellisation) [top, white arrows]. Osteolysis begins to manifest usually after 5 to 7 years; it is a punched-out lesion, with a concave surface over the calcar (bottom, black arrows).

Viva 14

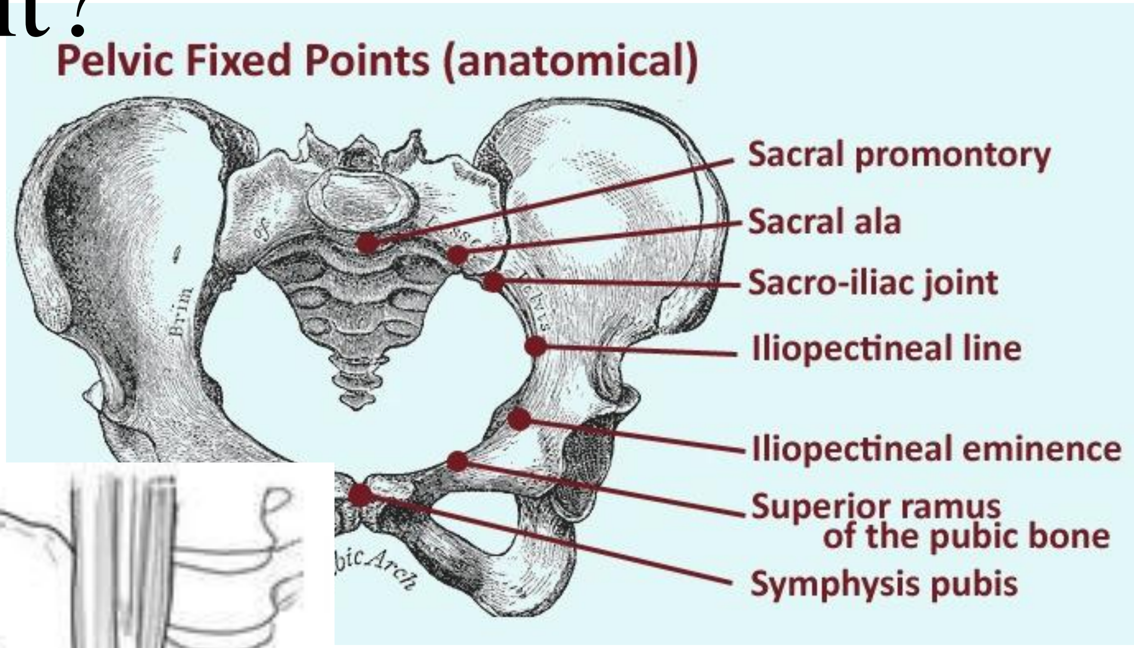
- Describe the radiograph
- What is the diagnosis?
- What would be the patient complaint? Any other causes?
- Treatment?

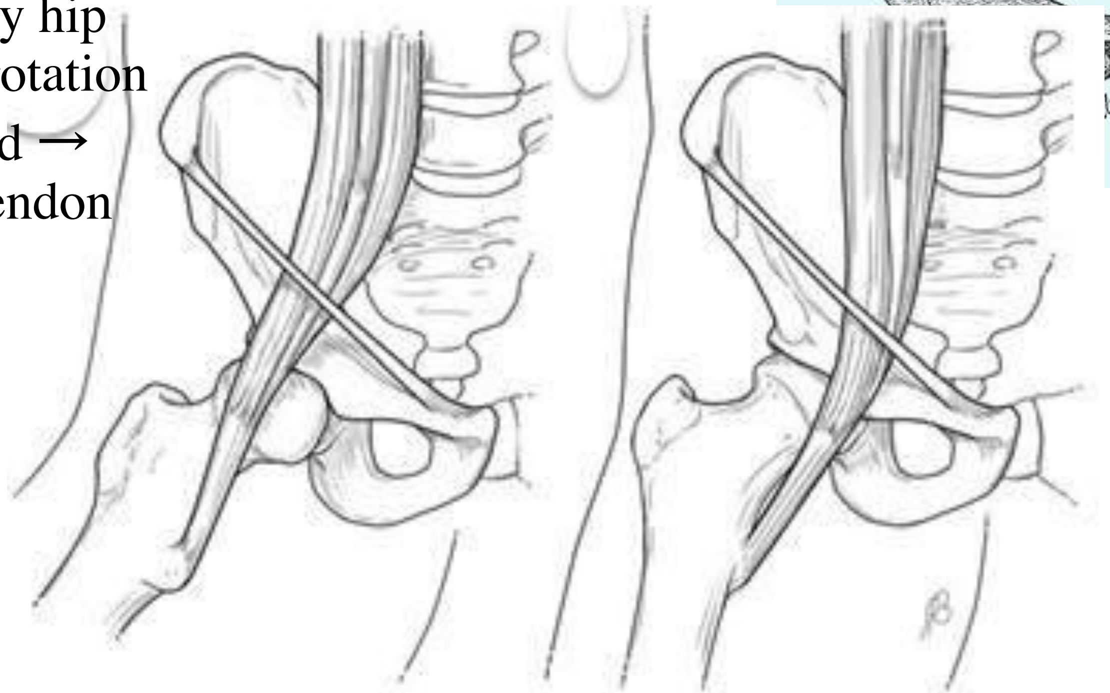
What would be the patient complain? Any other causes?

- Synovial chondromatosis is a proliferative disease of the synovium characterized by cartilage metaplasia of the synovial tissue.
- Can cause snapping hip syndrome (coxa saltans) due to intra-articular pathology.
- Clinical features:
  - Pain increased with activity
  - Slow progression of the disease
  - Multiple intra-articular loose body ➔ snapping hip

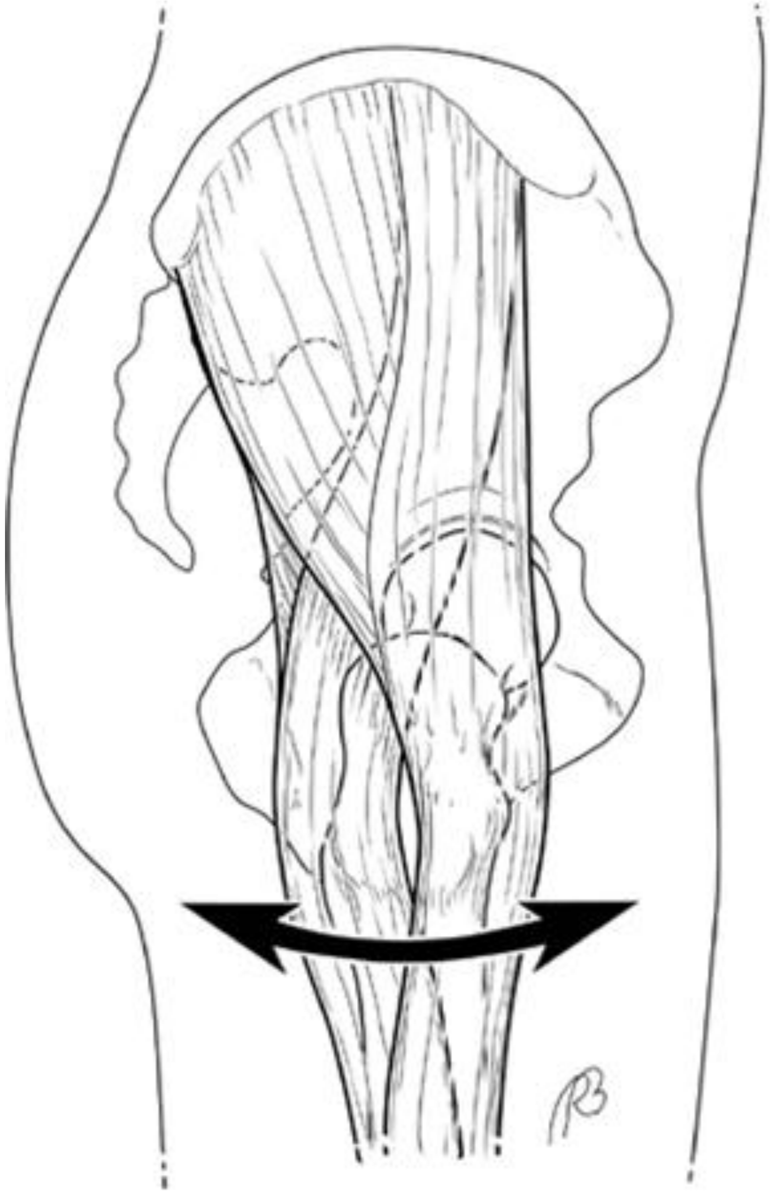
Others causes of snapping hip and its treatment?

- Internal snapping (MCC) (audible but not visible)
  - **Iliopsoas tendon** sliding over femoral head, iliopectineal ridge.
  - Snapping produced by hip flexion and external rotation
  - Rx➔ non-op, if failed → release of iliopsoas tendon





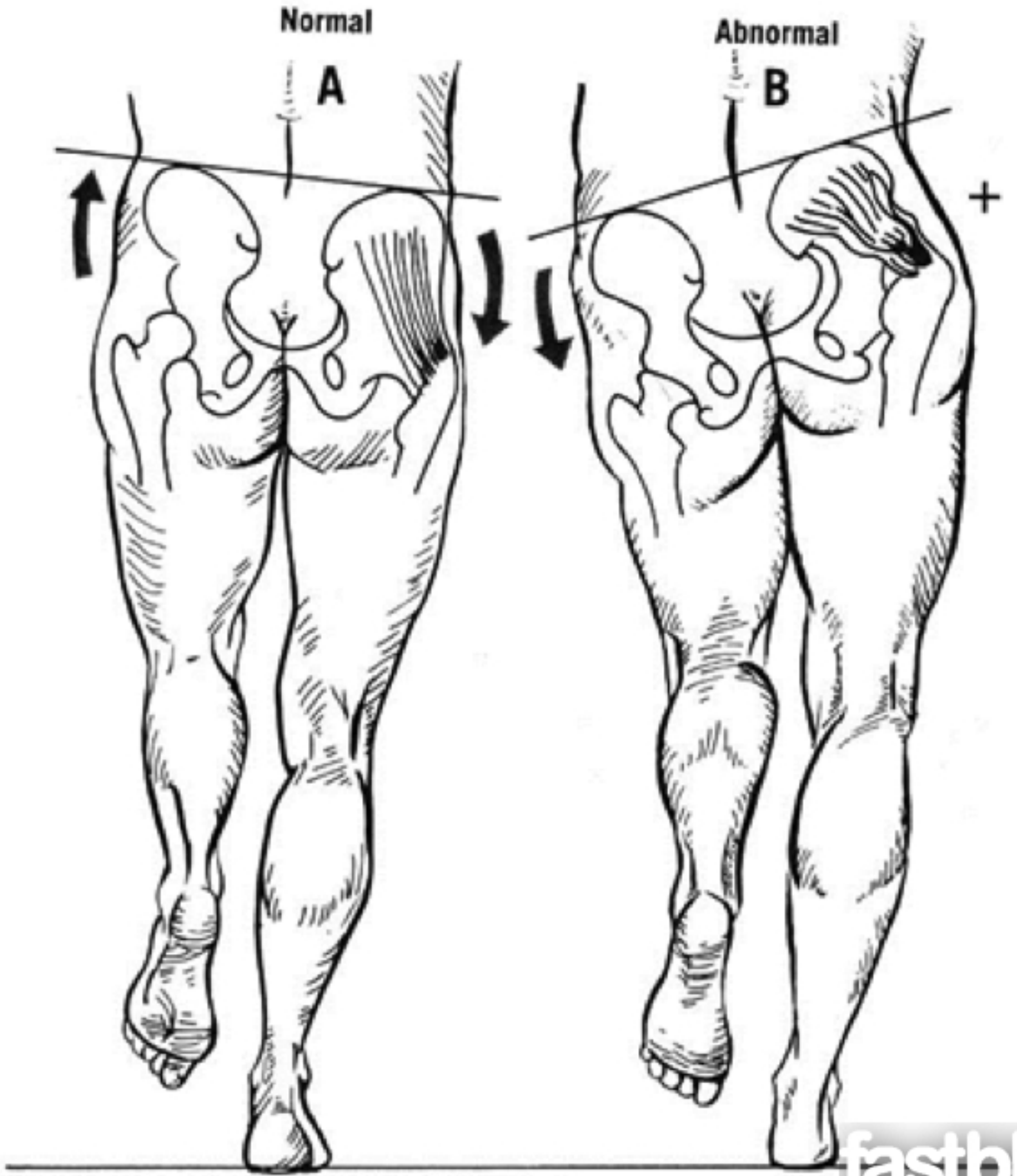
- External snapping: visible not audible
  - Snapping of ITB over greater troch
  - Obers test (abduction and extension of the hip)
  - Rx➔ Excision of GT bursa + ITB Z-plasty



- Intra-articular:
  - Multiple intra-articular loose bodies 2ry to synovial chondromatosis or labral tears
  - Rx➔ hip arthroscopic removal of loose body, synovectomy, or labral repair

Viva 15

- Describe the diagram
- What are the prerequisites for this test?
- What causes this abnormality?
- What is Trendelenburg lurch?
- What other abnormal gaits seen in hip patients?



Describe the diagram

- The diagram represents **Trendelenburg sign**, which is found in people with weak or paralyzed abductor muscles of the hip, namely gluteus medius and gluteus minimus. It is named after the German surgeon Friedrich **Trendelenburg**.
- The gluteus medius maintain both hips at the same level during the stance phase of the gait cycle.
- Trendelenburg test time: 30 sec to 1 minute.

Describe the diagram

- Test is positive if the pelvis on the raised side dips down indicating insufficiency of the abductor mechanism on the weight bearing side

What are the prerequisites for this test?

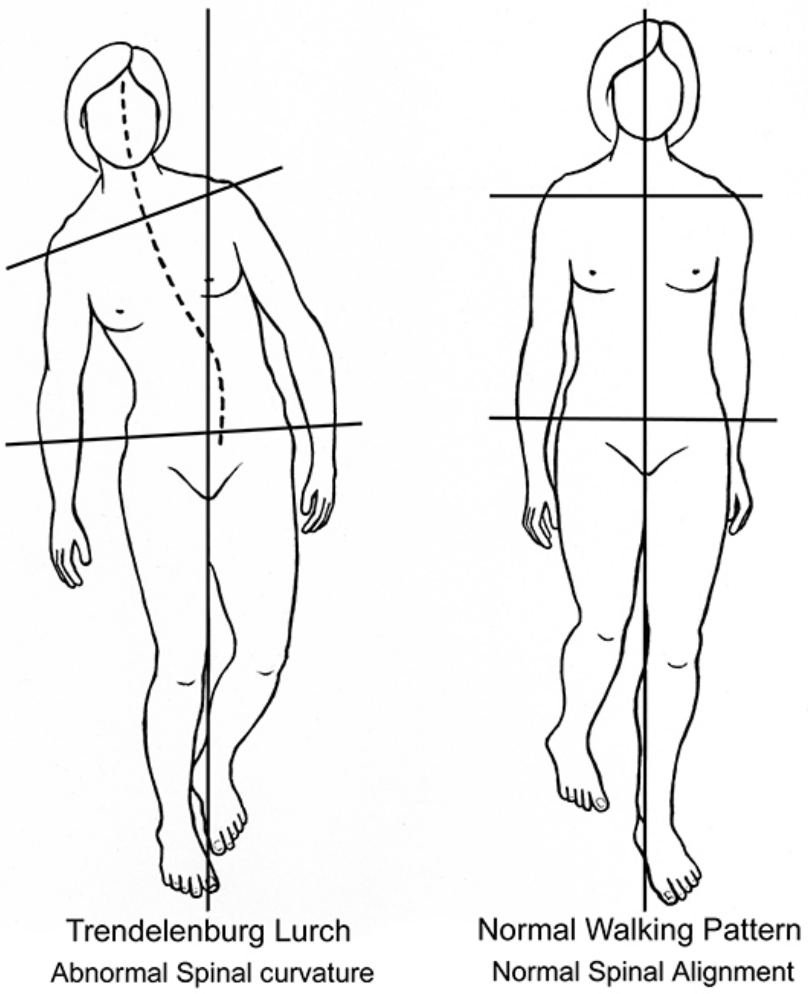
- Free abduction/ adduction of 20 deg
- Able to stand on affected limb for > 30 sec
- Age > 5 years

Causes of Trendelenburg sign

- Trendelenburg test can be positive for 2 main reasons:
- Neurological:
  - Generalized weakness eg. Myelomeningocele, SC lesions..
  - Local: superior gluteal nerve dysfunction
- Mechanical: conditions that affects abductor muscle lever arm➔ shortening of the abductors ➔ weakness
  - DDH
  - Coxa vara
  - Fractures
  - Advanced arthritis

Trendelenburg lurch

- Abnormal gait pattern in patients with weak abductors in which the patient pelvis will drop on the opposite side to the stance limb. (Trendelenburg gait)
- In order to maintain the Center of gravity the patient is leaning over the affected hip to shift the body center of gravity towards that side. (Lurch)



Other abnormal gait patterns in hip pts

- **Antalgic gait**: short stance gait
- **Short leg gait**: shift of center of gravity towards the short side with drop of the center of gravity. Stance is equal bilaterally.
- **Gluteus maximus gait:** due to hip extensor weakness.

  Forward thrust of the pelvis and backward thrust of the trunk➔ shifts center of gravity posterior to the hip, tenses iliofemoral ligaments and stabilizes the pelvis.
- **Foot drop gait** (slapping gait/ high steppage)
- **Tip toe gait** due to equines of the hindfoot and ankle
- **Intoeing gait** internal torsion of the tibia, excessive anteversion of the hip

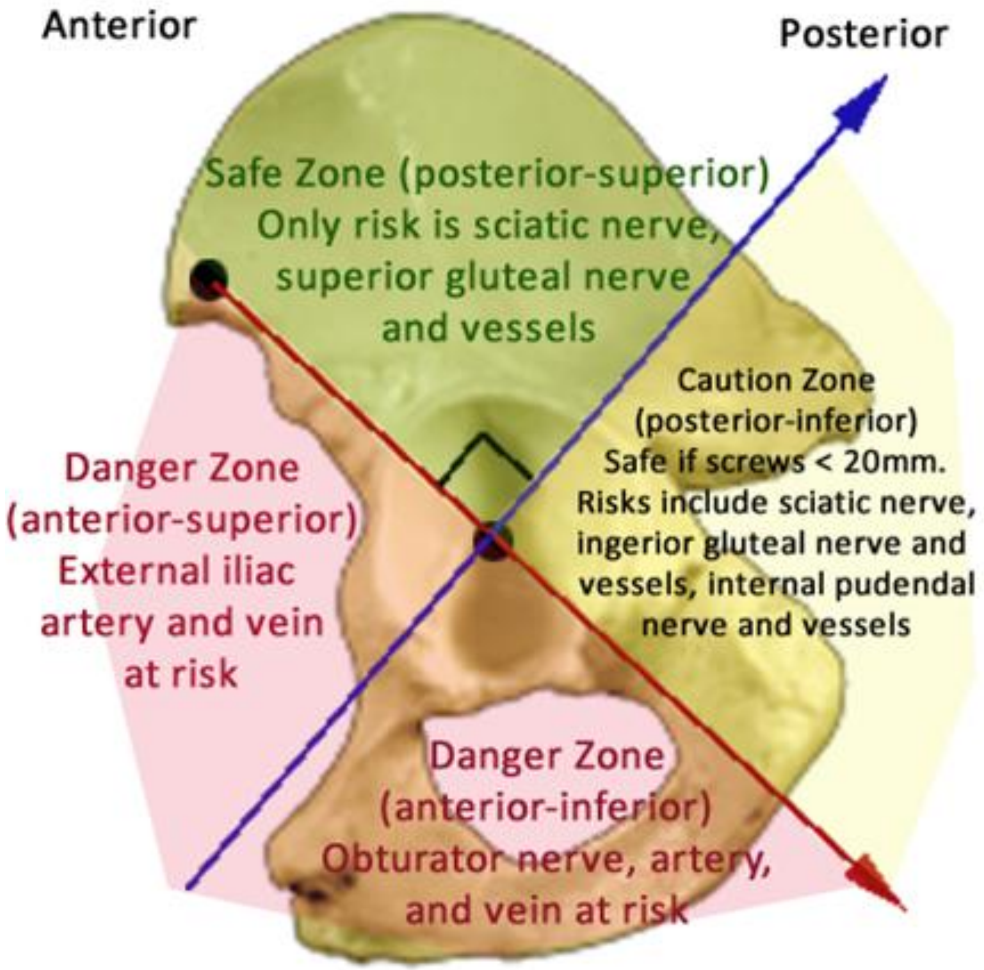
Viva 16

A 45-year-old female underwent a total hip replacement for significant end stage arthritis secondary to dysplasia. An anterolateral approach was used for the surgery with cemented implants in the femur and acetabulum. On the ward round the day after surgery she was noted to have a painless drop foot and loss of sensation in the lower leg.

1. What is the diagnosis and how common is this?
2. Is this patient at higher risk of the complication than a standard patient? What are the other risk factors?
3. What specific features should be looked for on the post-operative radiograph of the hip?
4. What other features should be examined for and what investigations should be considered?
5. When should exploratory surgery be undertaken?
6. Patients may present with a painful drop foot. Would your management differ in this instance?
7. What further investigations should be considered in the outpatient setting?

Describe the ideal location for placement of acetabular screws.

- First line drawn from the ASIS to the center of acetabulum
- Second line drawn perpendicular over the first line and passing in the center of the acetabulum



What is the diagnosis and how common is this?

- Sciatic nerve palsy.
  - This is likely to be a traction injury due to excessive lengthening rather than any direct trauma in this case (antero-lateral approach).
- Incidence of nerve palsy is 1% to 2% of primary total hip replacement, 3% to 4% after revision, and 5% to 6% in THR for congenitally dislocated hips.

Is this patient at higher risk of the complication than a standard patient? What are the other risk factors?

- Yes, the complication rate is higher in patients with hip dysplasia. Due to both alterations in the anatomy and due to lengthening.
- The maximum acceptable lengthening (before shortening osteotomy should be undertaken) is 4 cm.
- Other risk factors include:
  - revision surgery, post traumatic, limb lengthening, female gender, anticoagulation and vascular insufficiency, surgeon experience.

What specific features should be looked for on the post-operative radiograph of the hip?

- I would want to assess
  - the amount of lengthening.
  - ensure that the reduction was congruent with no evidence of soft tissue interposed between femoral head and acetabulum.
  - assess for cement extrusion (and possible thermal damage).

What other features should be examined for and what investigations should be considered?

- ➢*Assess for LL alignment, any signs of hip dislocation.*
- ➢*Check for LLD (compared with pre op)*
- ➢*Check the wound for any signs of hematoma collection.*
- ➢*Neurological examination (the peroneal division is most commonly affected)*
- ➢*Place the affected limb in a resting position (hip extension and knee flexion)*
- ➢*Request AFO*
- ➢*Request pelvis radiograph to check for the reduction - LLD*
- ➢*U/S to check for any hematoma at the surgical site*
- ➢*CT to check for: retained cement – prosthesis malposition.*

When should exploratory surgery be undertaken?

- Surgery should be undertaken acutely if
  - the nerve may be entrapped or compressed (by hematoma or cement).
  - if there is a risk the nerve has been surgically transected or ligated with an ill placed suture.

Patients may present with a painful drop foot. Would your management differ in this instance?

- A painful neuropathy is more likely to represent **ongoing** compression and therefore I would be much more likely to offer surgical exploration.

What further investigations should be considered in the outpatient setting?

- Nerve conduction studies may be used to monitor reinnervation and referral to a Peripheral Nerve Injury Unit.

What is the outcome?

- 30-40% recover full strength.

What is the treatment

- Intra operative:
  - Hip dysplasia undergoing THA➔ downsizing of the components and sub-troachnetric osteotomy
- Immediate postoperative:
  - Hip extension and knee flexion➔ less tension across sciatic n.
  - Surgical: evacuation of hematoma, removal of cement..etc
- Persistent:
  - AFO
  - Tib. post transfer to dorsum of the foot

What are the structures passing through greater and lesser sciatic notch?

- Greater sciatic foramen:
  - Piriformis tendon
  - Above piriformis: superior gluteal nerve and vessels
  - Below piriformis:
    - Sciatic n
    - Inferior gluteal n and vessels
    - Posterior cutaneous nerve of the thigh
    - Internal pudendal nerve and vessels
    - N to quadrates femoris
    - N to obturator internus
- Lesser sciatic foramen:
  - Obturator internus tendon
  - N to obturator internus
  - Internal pudendal n and vessels

Viva 17

A fit and well 65-year-old man fell down stairs five years after a successful THA. He presents with pain in his right hip and an inability to weight bear.

1. Describe the radiograph.
2. Describe a classification system for this injury that helps to guide management.
3. Where does this injury fit with the classification system you have described?
4. How would you treat this injury?
5. What is the expected outcome following treatment?

Describe the radiograph.

- This is an anteroposterior radiograph of the right hip.
- It shows a peri-prosthetic femoral fracture around a cemented total hip replacement (tapered stem).
- The acetabular component is cemented and appears to be well fixed with acceptable inclination. There is a degree of heterotopic ossification.
- The femoral fracture involves the cement mantle and there is subsidence of the stem within the cement mantle, indicating that the stem is loose.

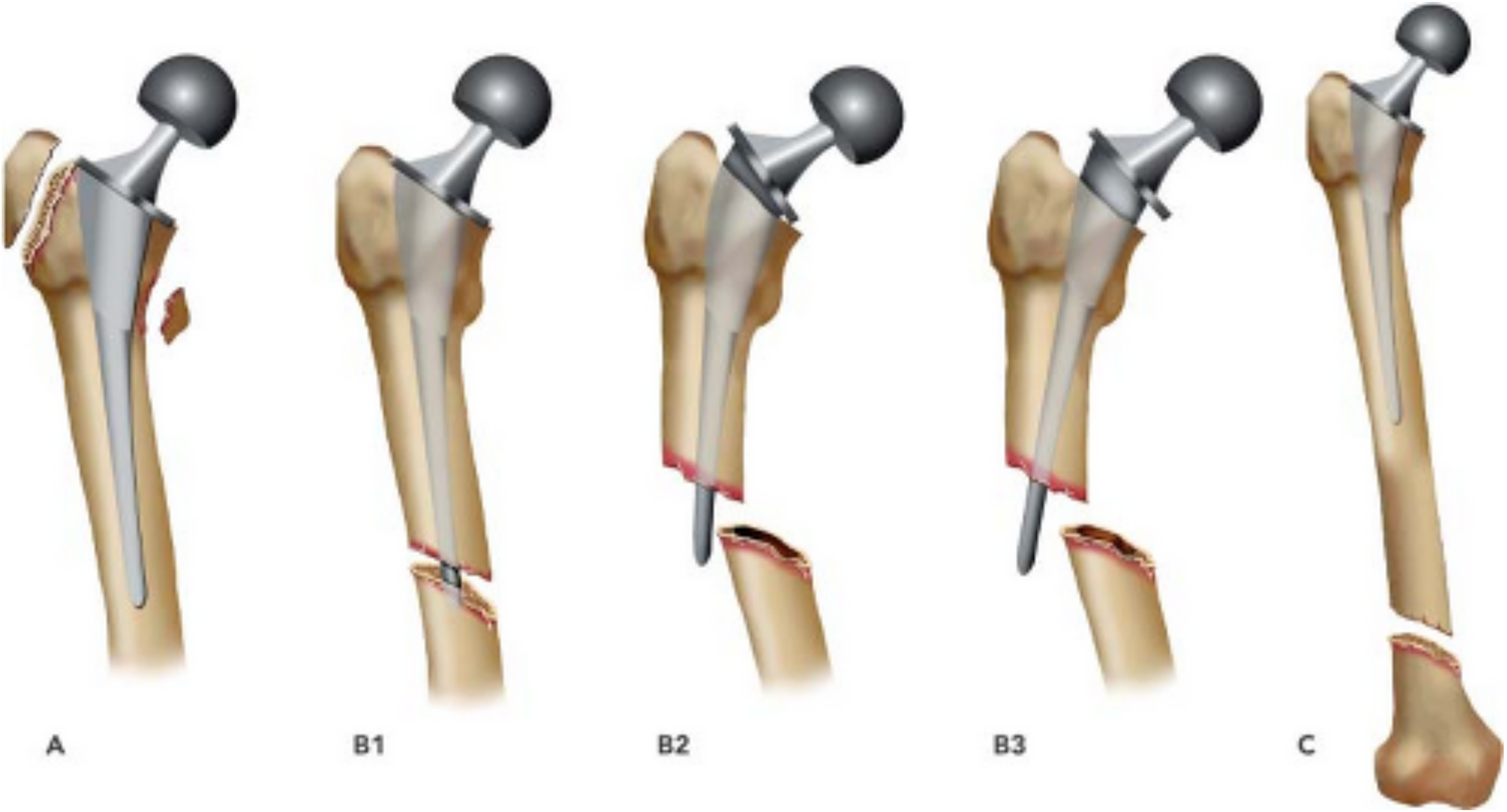
Describe a classification system for this injury that helps to guide management.

- The Vancouver classification based on :
  - fracture location,
  - stability of the implant,
  - surrounding bone stock.
- fracture location divided to three categories:
  - Type A   around the trochanteric region
  - Type B   near or just distal to the femoral stem
  - Type C   well below the femoral stem.
- Studies have found that the Vancouver classification is reliable, reproducible, and valid.
- One limitation of the system is that plain radiographs may not always provide enough information to distinguish between type B1, type B2, and type B3 fractures. If there is any questioning of implant stability, it should be assessed intra-operatively.

Modified Vancouver classification

Type	subtype	description	Treatment
A	AL	Lesser trochanter	Consider ORIF if large segment of the medial cortex involved
	AG	Greater trochanter	Consider ORIF if >2.5 cm displacement
B	B1	Well fixed prosthesis	ORIF(circulage wires or plates)
	B2	Loose Prosthesis with good bone stock	Revision THR with longer-stem +/- ORIF
	B3	loose Prosthesis with poor bone stock	Revision THR and augmentation of bone stock with allograft or oncologic prosthesis
C		Fracture well below the tip of the prosthesis	ORIF with plate and screw

Fixation or revision of any periprosthetic fracture should bypass the fracture site by 2 cortical thickness or diameter


A
B1
B2
B3
C

Where does this injury fit with the classification system you have described?

- This is a Vancouver type B2. The fracture involves the femoral stem and the cement mantle is fractured with resulting subsidence of the prosthesis. The bone stock appears good, with no obvious deficiency / lysis.

How would you treat this injury?

- I would perform a revision total hip replacement using a long-stem prosthesis. Prior to the operation I would ascertain the implant type and sizes of all of the components.
- I would have all the equipment and prostheses available to enable me to deal with any intra-operative eventuality.
- I would approach the hip through the old incision, curving this posteriorly at its proximal end to perform a posterior approach.

How would you treat this injury?

- I would
  1. open the fracture site and <u>expose</u> the cement mantle and stem using an extended trochanteric osteotomy if necessary.
  2. remove as much cement as possible with an osteotome. Distally this could be done with a drill and sequential reaming or by using an OSCAR cement removal system or osteotomes.
  3. reconstitute the femoral canal with cerclage cables.
  4. use a long stem modular, uncemented, tapered, revision prosthesis.

How would you treat this injury?

- If this cannot be achieved, further options would be either a long cemented femoral stem or a distally locking stem.
- I would
  1. after removal of the femoral stem assess the acetabular component for wear and stability.
  2. If loose, or if there is evidence of polyethylene wear I would remove the acetabular component and cement.
  3. I would then assess the remaining bone stock and decide upon either a further cemented or uncemented acetabular component.

Distally locking stem

What is the expected outcome following treatment?

- : Springer et al5 reported a survival of 90% at five years and 79.2% at ten years for Vancouver type B peri-prosthetic femoral fractures with revision or removal of the femoral implant for any reason as the end point. Those treated with uncemented, extensively porous-coated implants having the best results.
- Corten et al6 reported no revisions at 46 months follow-up after treatment of 31 B2 fractures with a cemented long-stem. Similarly, Fink et al7 reported all excellent results in 22 B2 and B3 fractures treated with a modular, uncemented, tapered, fluted revision prosthesis. A review of 1049 peri-prosthetic fractures of the femur from the Swedish National Hip Arthroplasty Register found that the risk of failure of treatment was reduced for Vancouver type B2 injuries if revision of the implant was undertaken or revision and open reduction and internal fixation were performed.

What are the Risk factors for periprosthetic fractures?

- Under-reaming
- Cementelss implant fixation
- Poor bone stock
- Irradiated bone
- Revision surgery
- Minimally invasive techniques
- Female
- Hip dysplasia

<u>Viva 18</u>

Loosening & Osteolysis

How can you define the term wear?

- progressive loss of bearing substances of the materials as a result of chemical or mechanical action.
- Types of mechanical: adhesive, abrasive, fatigue.
- Chemical: corrosive

What exactly do you mean by abrasive-adhesive and fatigue wear?

- **Adhesive wear**: occurs when two articulating surfaces come in contact, the fragment from the weaker material will be torn off and adhere(stick) to the stronger material.
- **Abrasive wear**: two modes:

- Two body abrasive wear: when the sphericities from one surface scraping materials from the weaker opposed articulating surface.
- Third body abrasive: when a third body particle interposed between two articulating surfaces. e.g: retained cement.

What exactly do you mean by abrasive-adhesive and fatigue wear?

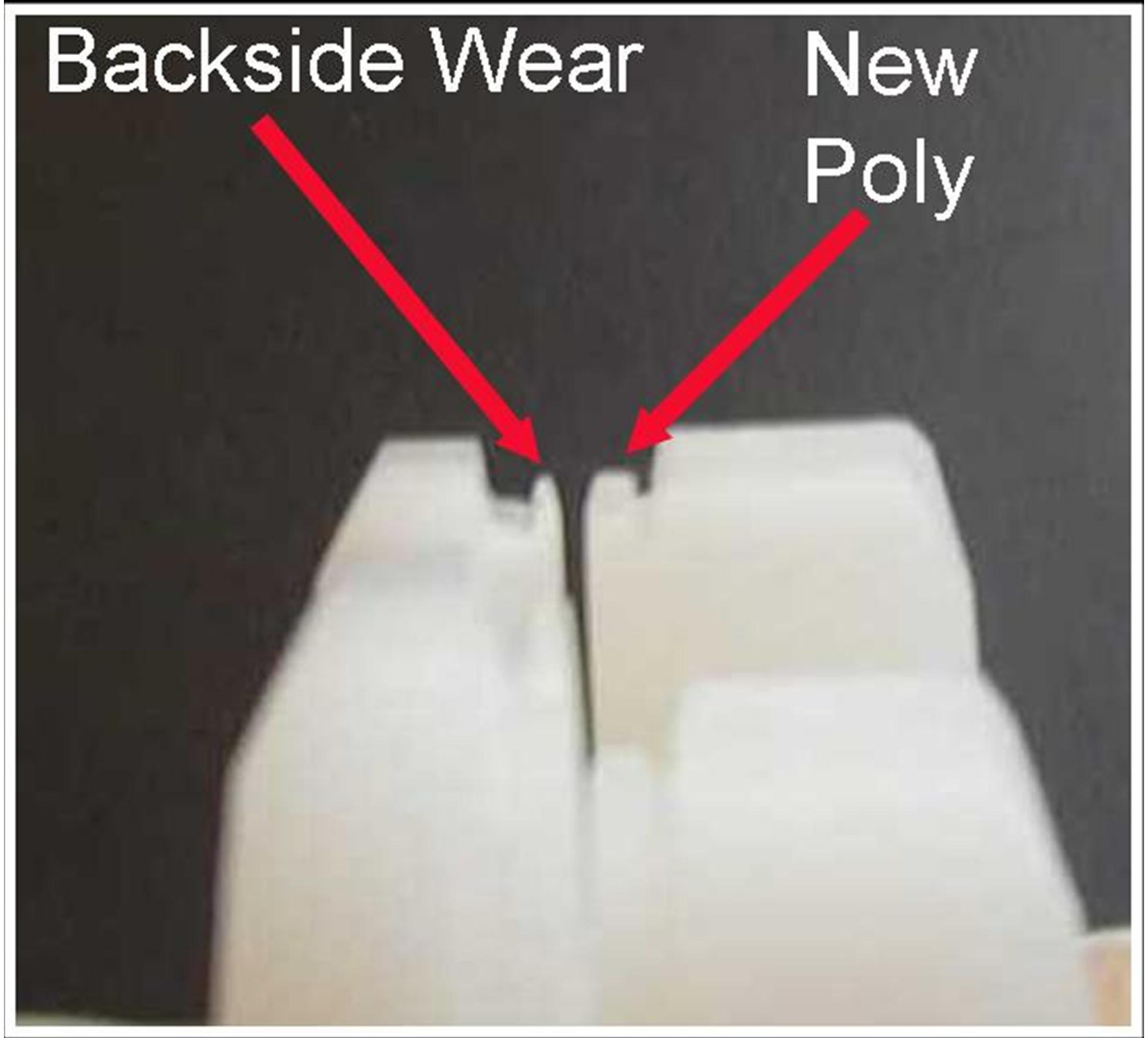
- **Fatigue wear**: failure at stress lower than the yield strength, due to repeated loading.

What is fretting wear?

- **Fretting corrosion:** A mode of destruction at the contact site from the micromotion of two materials or two components

What is backside wear?

- **Backside wear:** *occurs between the two non-articulating surfaces, eg: the back surface of a polyethylene hip bearing and its corresponding acetabular shell or the back of a polyethylene component of a total knee replacement with the tibial tray(occurs* because of micromotion at the undersurface articulation that occurs with loading)


Backside Wear
New
Poly

What are the wear sources in joint replacement surgery?

- bearing surfaces
- cement/prosthesis micromotion
- cement/bone micromotion
- prosthesis/bone micromotion
- third-body wear.

what are the different modes of wear?

- Between articulating surfaces intended by design
- Between surfaces not intended by design e.g. femoral head articulating with acetabular shell following wear of polyethylene insert
- Third body wear
- Between two non-bearing(articular) surfaces e.g. Morse taper, backside wear

what is the effective joint space?

- Any area where the joint fluid can come in contact with the bone, this is can occur in

➢ the acetabulum, wear debris can reach the interface through unfilled screw holes or via non-ingrown areas of the shell.

➢ On the femoral side, use of circumferential porous coating has reduced the incidence of diaphyseal osteolysis by blocking access of wear particles.

What factors influence wear?

❖ **Patient-specific factors**

- *Body mass index and body weight. Increased body weight can be associated with increased magnitude of force and altered kinematics.*
- *Young patients.*
- *Activity level. Patients with active lifestyles that markedly increase joint loading conditions.*
- *post-traumatic arthritis and AVN have been associated with higher prosthesis failure rates*
- *Special cultural demands (e.g. kneeling)*

What factors influence wear?

❖ **Surgical factors**

- ➢ *Component position.*
- ➢ *Restoration of the appropriate mechanical alignment.*
- ➢ *Soft tissue balance*

What factors influence wear?

- **Implant-specific factors**
  - *Coefficient of the friction of the materials (low friction = low wear)*.
  - *Roughness (surface finish)*
  - *Toughness (abrasive wear)*
  - *Hardness (scratch resistance)*
  - *Presence of 3rd body particle.*
  - *non-cross linked PE*
  - *longer shelf-life for liners g-irradiated in air*
  - *thickness of PE.*

what are the consequences of wear particles?

- *Synovitis*
- *Osteolysis*
- *Immune reaction*

what is osteolysis?

- it is a biological response to wear particles that can result in bone loss and loosening of the implants
- *Wear particles lead to macrophage activation which release osteolytic factors such as : (IL-1b), (IL-6), (TNF-a), (PDGF) and (RANKL). RANKL → binds to receptors on osteoclast precursors → stimulate differentiation into active osteoclasts → osteoclast (posses ruffled borders to increase surface area) attach to bone via integrin which is extracellular protein on bone surface (vibronectin) → osteoclasts resorb bone via producing of (TRAP)Tartrate resistance acid phosphatase and proteinases like cathepsin K through ruffled borders into resorption space which lower the PH and increases the solubility of Hydroxyappetite → proteolysis of matrix*

How does the patient with aseptic loosening present?

- *the pain is aggravated by weight bearing (typically **start up pain**).*
- *improved with rest and rarely constant.*
- *Pain at the **extremes of movement suggests** **loosening**.*

What are the zones of loosening?

- DeLee and Charnley zones (acetabulum)

➢ *The acetabulum is divided into three zones: superior I, middle II and inferior III.*

- Gruen zones (femur)

➢ *The femur is divided into seven zones on the anteroposterior radiograph: zone 1 is the greater trochanter whilst zone 7 is the lesser trochanter.*

What are the modes cemented femoral stem loosening(modes of femoral stem failure)?

Gruen described mechanisms of stem loosening:

- *Grade 1a is the subsidence (pistoning) of the stem in cement*
- *Grade 1b is subsidence of the cement mantle and stem*
- *Grade II is pivoting of the stem around its middle(medial midstem pivot)*
- *Grade III is the pivot of the stem around the proximal part of the stem(calcar pivoting)*
- *Grade IV is cantilever bending.*

What are the modes cemented femoral stem loosening?

- ***Mode I Pistoning behaviour***

➢ *1a: A radiolucent line is seen between the stem and cement at the superolateral part of the stem. The stem is displaced distally, producing the radiolucent zone and a punched-out fracture of the cement near the tip of the cement mass.*

➢ *1b: A radiolucent zone can be seen about the entire cement mass,*

What are the modes cemented femoral stem loosening?

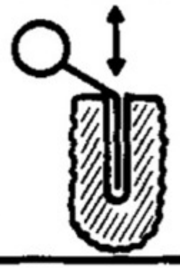
- **Mode II Medial midstem pivot**
- Caused by medial migration of the proximal portion of the stem. Lateral migration of the distal tip due to inadequate superomedial and inferolateral cement support.

What are the modes cemented femoral stem loosening?

- **Mode III Calcar pivot**
- Caused by medial and lateral toggle of the distal end of the stem, While the proximal part is well fixed
- The distal stem lacks support and a bone reaction develops. Adequate proximal support produces a windscreen-wiper type of reaction at the distal stem with sclerosis and thickening of the cortex medially and laterally at the level of the tip of the stem.

What are the modes cemented femoral stem loosening?

- **Mode IV Cantilever bending(opposite of calcar pivoting)**
- Caused by loss of proximal support of the stem while distally the stem is securely fixed. Radiolucent zones may develop proximally, medially and laterally to the stem, and may progress to stem failure

I	Ia	Pistoning: Stem within Cement	
	Ib	Pistoning: Stem within Bone	
II		Medial Midstem Pivot	
III		Calcar Pivot	
IV		Bending Cantilever (Fatigue)	

How can you classify bone loss?

- The Paprosky classification evaluates the femoral diaphysis for its ability to support an uncemented, fully porous coated prosthesis. It is less detailed than the AAOS classification but is more useful in decision making if an uncemented <u>revision</u> is to be performed.

How can you classify bone loss?

- **Paprosky Classification of Femoral Bone Loss**

- Type I: Minimal metaphyseal bone loss/normal intact diaphysis (seen after removal of uncemented component without biological ingrowth on surface)
- Type II: Extensive metaphyseal bone loss with intact diaphysis (seen after removal of cemented prosthesis).
- Type IIIa: Extensive metadiaphyseal bone loss, minimum of 4 cm of intact cortical bone in the diaphysis for distal fixation

How can you classify bone loss?

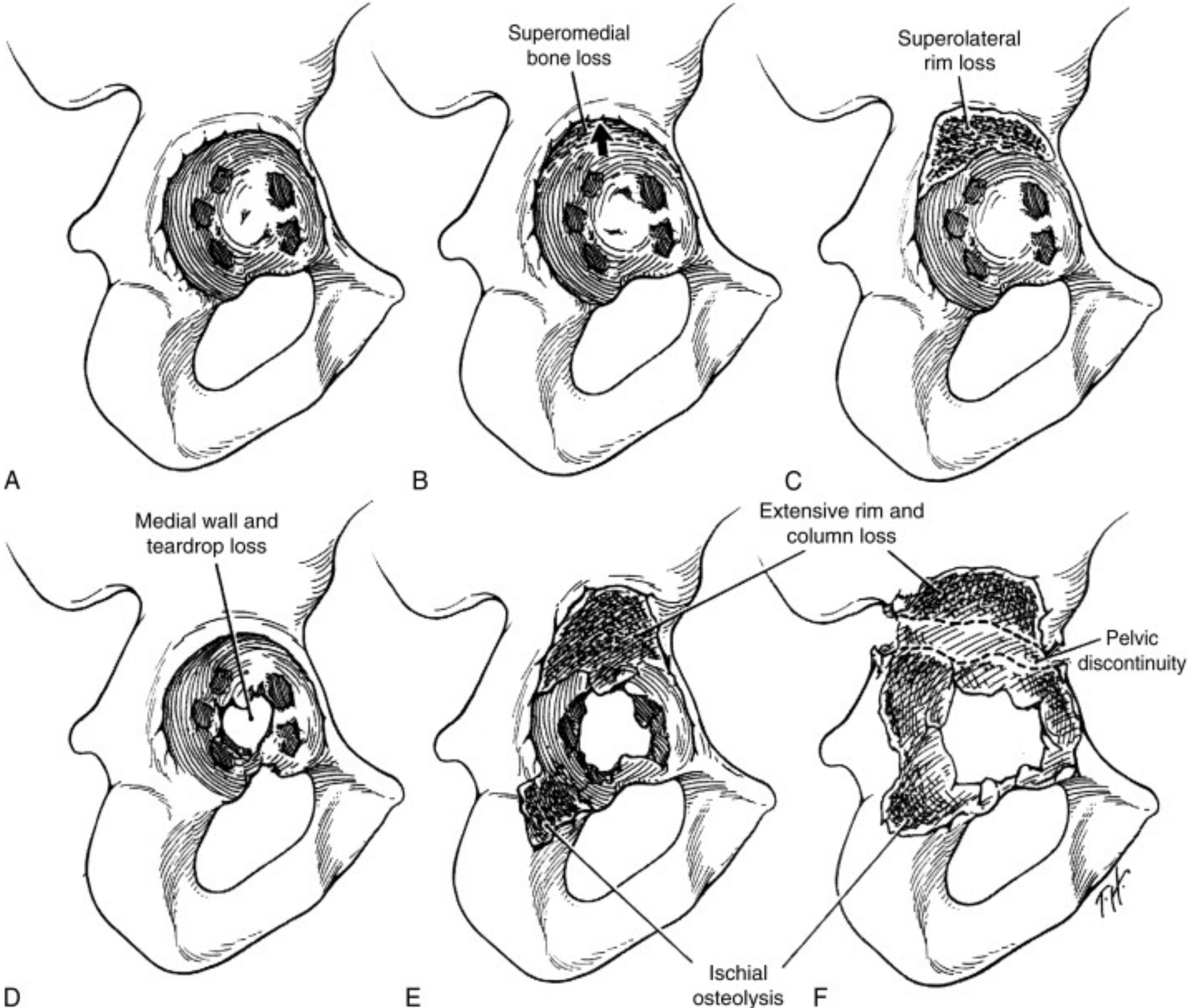
❖ **Paprosky Classification of Femoral Bone Loss**

- Type IIIb: Extensive metadiaphyseal bone loss, with less than 4 cm of intact cortical bone in the diaphysis for distal fixation.
- Type IV: Extensive metadiaphyseal bone loss and a nonsupportive diaphysis. cannot provide adequate fixation for a long stem

How can you classify bone loss?

- **Paprosky classification of acetabular bone defects**

- Type I: minimal bone loss, with intact rim, no cup migration .
- Type IIa: Superior bone lysis with intact superior rim.
- Type IIb: Absent superior rim, superolateral migration.
- Type IIc : Localized destruction of medial wall
- Type IIIa : superolateral migration. Bone loss at 10am and 2pm around rim
- Type IIIb : superomedial migration. Bone loss from 9am and 5pm around the rim



A
Superomedial bone loss
B
Superolateral rim loss
C
Medial wall and teardrop loss
D
Extensive rim and column loss
Pelvic discontinuity
Ischial osteolysis
E
F

Any further test would you like to do?

Yes. CT. useful for determining extent of osteolysis, assessment of component position

What are the treatment options?

❖ **Femoral revision**

- Type I: primary THA components
- Type II: uncemented extensively porous-coated long stem prosthesis
- Type IIIa: uncemented extensively porous-coated long stem prosthesis.
- Type IIIb : impaction bone graft.
- Type IV : impaction bone graft.

An illustration of an allograft prosthetic composite used for massive metadiaphyseal damage with thin cortices and a widened femoral canal.

What are the treatment options?

- ❖ **acetabular revision**

- ➢rim is competent (> 2/3 of rim remaining) >> **porous-coated hemisphere cup secured with screws.**
- ➢rim is incompetent (< 2/3 of rim remaining) >> **reconstruction cage with structural bone allograft**

Viva 19

THA Dislocation

Overview

- More than half of all dislocations occur within the first 3 months postoperatively.
- more than three fourths occur within 1 year.
- Early dislocation (within 6 months) after THA is usually caused by non-compliance with the post-op instructions or technical error during surgery.
- Late dislocation has a multifactorial etiology.

Risk factors

Patient factors:

- Elderly >70 years. Reasons may include a greater incidence of confusion, non-compliance, fall, poor soft tissue.
- Female
- neuromuscular disorders (Cerebral palsy-Muscular dystrophy)
- cognitive disorders (Psychosis-Dementia-Alcoholism)
- patient non-compliance with precautions.
- patients who undergo THA after acute fracture may lack the stabilizing capsular hypertrophy and fibrosis found in patients who undergo THA for osteoarthritis.

Risk factors

Patient factors:

- history of surgery (for any indication) on the same hip has been shown to double the risk of dislocation after primary THA
- the most common complication of revision surgery with polyethylene exchange is dislocation.

Risk factors

Surgical factors include:

- Surgical approach.
- Component design.
- Component positioning.
- soft-tissue tension.
- surgeon experience.

Risk factors

Surgical approach

- Because 75% to 90% of dislocations are in the posterior direction, surgical approaches that compromise posterior structures theoretically contribute to instability.
- Recent studies have showed that repairing capsule and reconstructing external rotators bring dislocation rate close to anterior approach.

Risk factors

Component design

- Larger femoral head >> increased head-neck ratio >> increased primary arc range >> increased excursion (jump distance) >> decreased dislocation rate and impingement (component).
- Excursion distance = radius of the femoral head and it is the distance that the head needs to travel before it dislocates.
- Use of a skirted component may be avoided to reduce impingement.

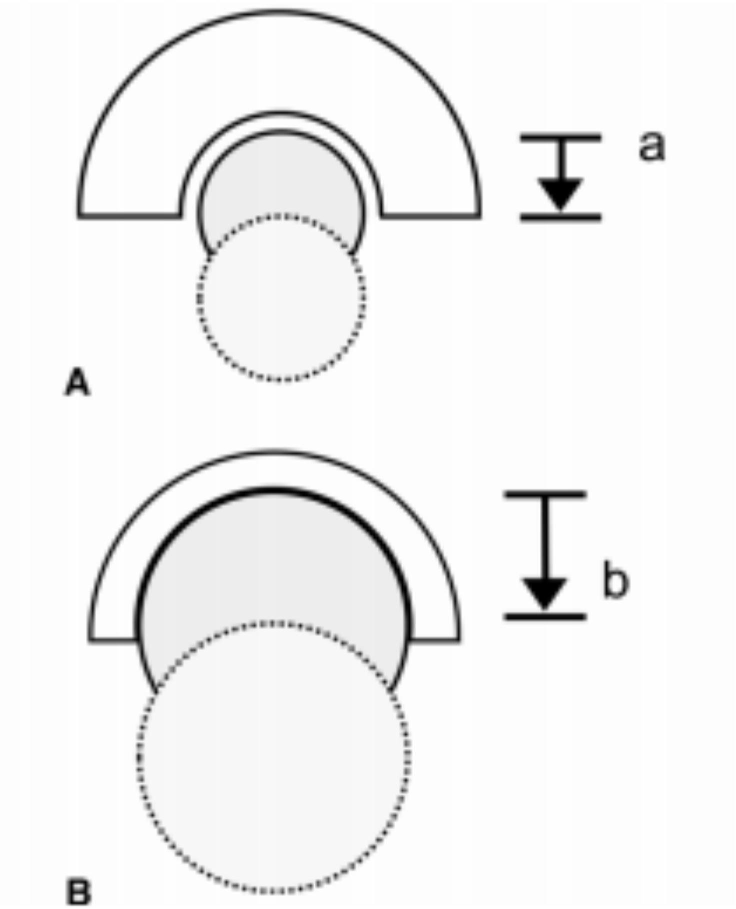
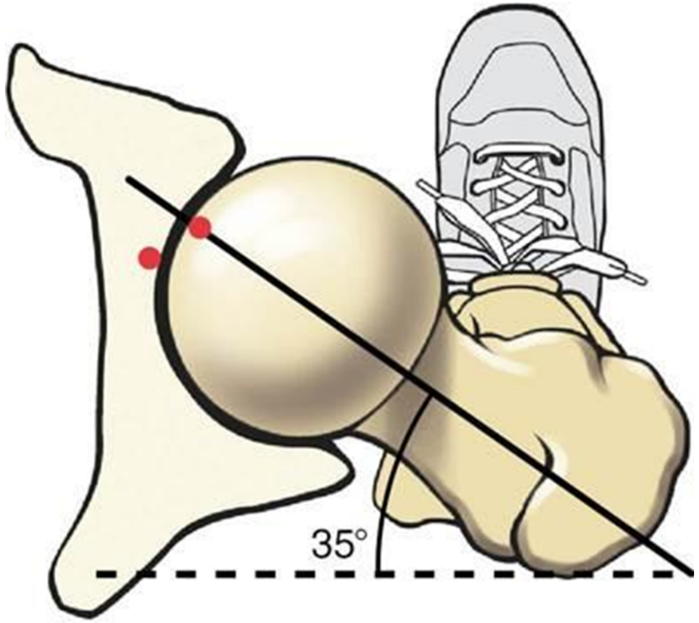


Figure 2 **A,** A smaller femoral head may dislocate after traveling only a short distance (a) and is therefore theoretically less stable. **B,** A larger head must travel a greater distance (b) before dislocating and is therefore considered more stable.

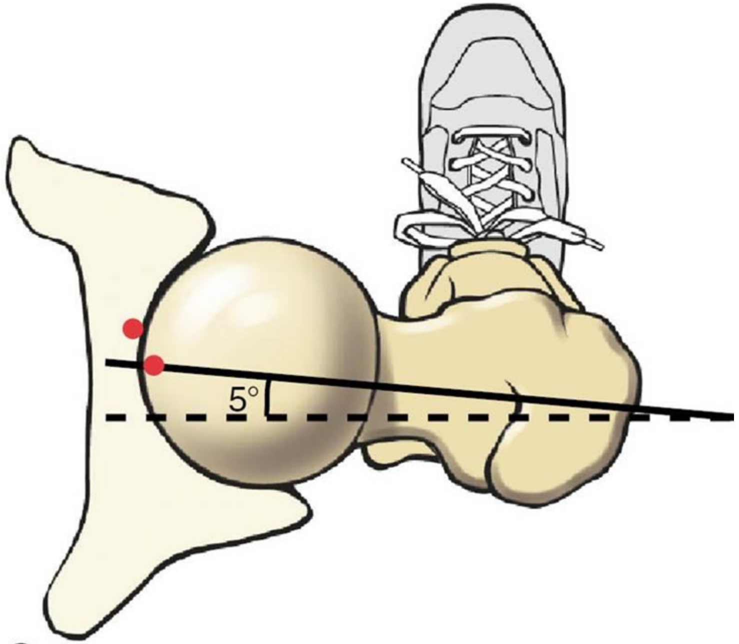
Risk factors

Component positioning

- Femoral component: stem anteversion 10-15°.



A Excessive anteversion



C Retroversion

Risk factors

Component positioning

- Acetabular component

➢ Cup anteversion should be 20° ± 5°.

➢ For most patients, cup abduction of 30° to 50° is considered to be the "safe zone" of lower dislocation risk.

Risk factors

Component positioning

- Cup :

- ➢Retroversion➔ posterior dislocation.
- ➢Excess anteversion➔ anterior dislocation.
- ➢High abduction angle (vertical cup)➔eccentric PE wear. posterior-superior dislocation.
- ➢Low abduction angle (horizontal cup)➔inferior dislocation. Impingement with flexion. Limited abduction

- Stem:

- ➢Retroversion➔ Risk is posterior dislocation.
- ➢Excess anteversion➔ Risk is anterior dislocation.

Risk factors

Soft tissue tension

- Soft-tissue tension can be greatly affected by femoral offset.
- **Increased offset >>** increased soft tissue tension – increased stability - decreased joint reaction force.
- **Decreased offset >>** instability (increased risk for dislocation) – abductor weakness – increased JRF.
- *Femoral offset doesn't affect component impingement.*

Risk factors

Soft tissue tension

- Methods to increase femoral offset

➢ Lateralizing femoral stem (the most commonly used method)

➢ Increasing femoral neck length (may decreases primary arc range)

➢ Decreasing femoral neck-shaft angle (trochanteric bursitis-chronic pain).

➢ Trochanteric advancement

Risk factors

Surgeon experience

- surgeons who had performed fewer than 30 procedures had a markedly higher dislocation rate (approximately twofold) than their more experienced counterparts

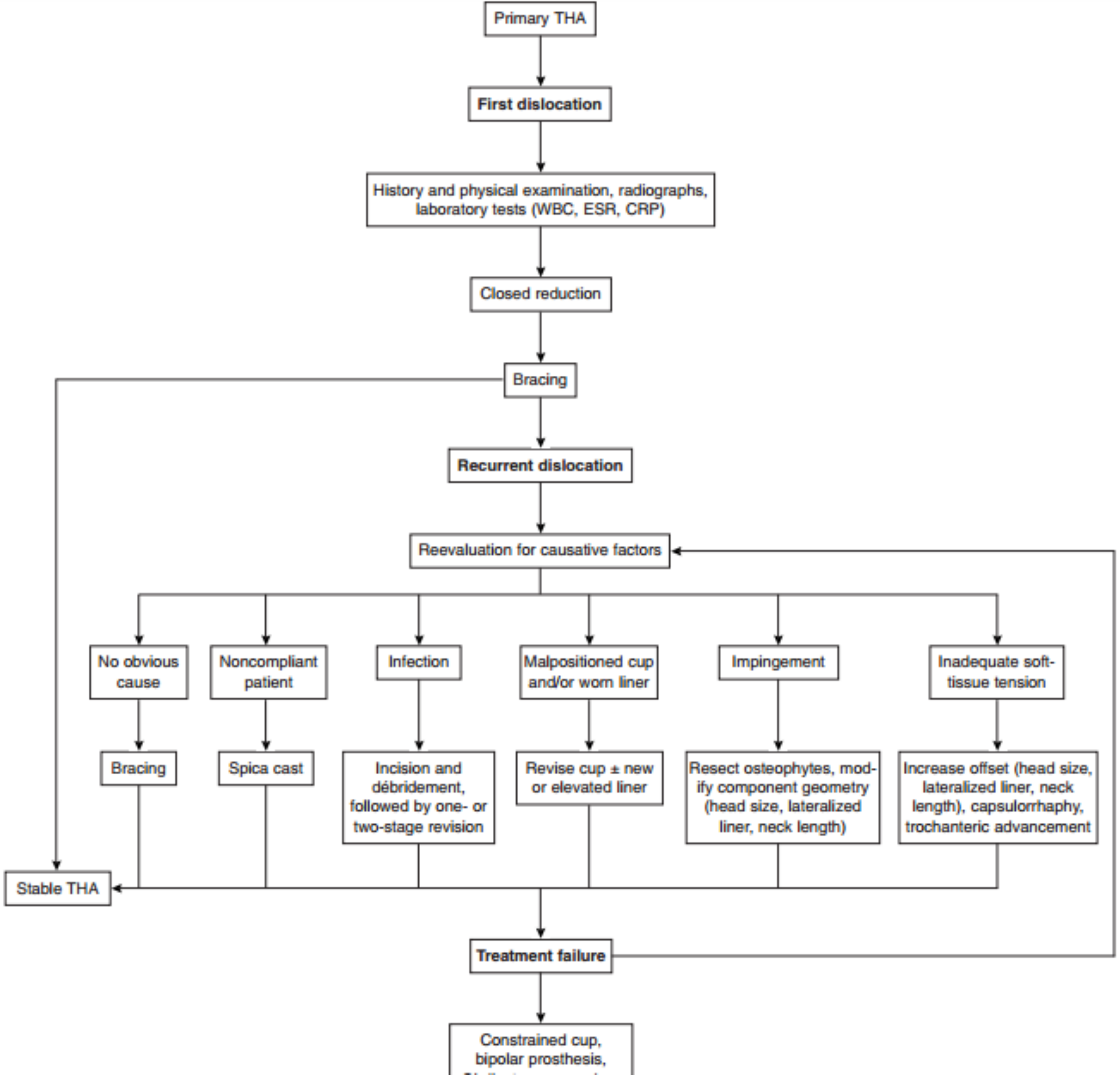
Assessment

- History
- Physical examination.
- Radiographs.
- Laboratory tests (ESR-CRP)

Closed reduction

- The choice of reduction manoeuvre is guided by the direction of dislocation.
- After successful reduction of a early posterior dislocation, many surgeons treat the patient for at least 6 weeks with a hip brace that provides abduction and a flexion stop.
- The patient also should be reminded to avoid provocative positions (flexion >90°, adduction, and internal rotation).
- Spica cast can be reserved for the most noncompliant patients or those with neuromuscular or cognitive disorders.

Revision



Primary THA
First dislocation
History and physical examination, radiographs, laboratory tests (WBC, ESR, CRP)
Closed reduction
Bracing
Recurrent dislocation
Reevaluation for causative factors
No obvious cause
Noncompliant patient
Infection
Malpositioned cup and/or worn liner
Impingement
Inadequate soft-tissue tension
Bracing
Spica cast
Incision and débridement, followed by one- or two-stage revision
Revise cup ± new or elevated liner
Resect osteophytes, modify component geometry (head size, lateralized liner, neck length)
Increase offset (head size, lateralized liner, neck length), capsulorrhaphy, trochanteric advancement
Stable THA
Treatment failure
Constrained cup, bipolar prosthesis,

Salvage

Constrained liners

- It is an acetabular component that uses a mechanism to restrain the femoral head within the liner.
- Constrained designs inhibit ROM and transmit significant forces to the bone prosthesis interface, which may lead to loosening. (not a good choice for young patients!)
- When dislocations do occur with a constrained design, they can be difficult to manage. Surgery is required in most cases to reset a disengaged locking ring, replace a broken one, or address a displaced liner or cup.

Salvage

Constrained liners

- should be reserved for:

➢ patients with recurrent dislocation with well positioned components.

➢ elderly patients who do not require implant longevity or have a low functional demand (due to significant forces to the bone prosthesis interface)

➢ patients with deficient or non-repairable abductor mechanisms or unrepairable soft-tissue insufficiency.

Salvage

Constrained liners

- Segmental bone defects are a contraindication to the use of constrained components due to increased stresses being transferred to the implant-bone interface.

Salvage

Bipolar Femoral Prostheses

- conversion to a hemiarthroplasty with a bipolar femoral prosthesis.
- By using of a larger femoral head >> increased head-neck ratio >> increased primary arc range >> improve stability.
- The main disadvantage is that the mobile head articulates directly with the acetabular bone and can cause pain and medial bone erosion.
- Contraindicated if the acetabula bone compromised

Salvage

Girdlestone resection

- The last resort for salvage is the Girdlestone resection arthroplasty of the femoral head and neck.
- can be used after multiple failed revisions of THA

Viva 20

This is an anteroposterior (AP) radiograph of a 52-year-old woman who presents to your clinic with non-specific right hip pain. She had a right metal-on-metal hip resurfacing procedure performed 3 years ago

- What can you see?
- What are the possible causes of painful MOM hip?
- How are you going to investigate this patient?
- What is a pseudotumor and what is the difference between ALVAL and pseudotumor?
- What are the risk factors for pseudotumor?
- How would you follow symptomatic & asymptomatic patients with MoM hips?
- What are the principles of pseudotumor revision surgery?

What can you see?

- *This is anteroposterior (AP) radiograph of the pelvis demonstrates a higher abduction angle (lateral opening) than normal. Several studies have demonstrated the importance of optimal cup positioning with regard to wear, metal ion levels and the revision rate. The head size appears small; the current recommendations are that unless a minimum 46mm head size can be used the procedure should not be performed because of the risks of ALVAL and pseudotumors. There is no radiolucency about the metaphyseal stem, no obvious narrowing of the neck and no divot sign (it is a depression in the neck contour just below the junction with the femoral component often associated with a reactive exostosis. It is believe to be caused by repetitive bone-to-component abutment due to impingement)*

What are the possible causes of painful MOM hip?

❑***Extrinsic***

❖*Remote:*

- *Spine*
- *Vascular*
- *Hernia*

❖*Local*

- *Trochanteric bursitis*
- *Gluteal tendinopathy*
- *Psoas tendinitis*
- *HO*
- *ALVAL and pseudotumour*

What are the possible causes of painful MOM hip?

❑***Intrinsic***

- *Infection*
- *Aseptic loosening*
- *Femoral neck fracture*

How are you going to investigate this patient?

- *Full comprehensive history. It is crucial to determine if the pain is arising from intrinsic (indicating hip pathology) or extrinsic sources (referred pain).*
- *I would obtain the old operating notes to ascertain the particular model of the prosthesis and head size.*
- *Complete clinical examination.*
- *Investigations: As for any hip replacement I would first like to exclude infection. Plain AP radiograph pelvis &AP/Lateral Involved hip. I would request inflammatory markers. I would request whole blood metal ion levels*
- *Investigations as needed as per BOA/BHS recommendation*

What is a pseudotumor and what is the difference between ALVAL and pseudotumor?

- *ALVAL (aseptic lymphocyte-dominated vasculitis associated lesion) is caused by metal particulate debris. Patients present with localized hip pain and a localized osteolytic reaction. A more severe inflammatory reaction is termed a pseudotumor.*
- *Pseudotumor: non-neoplastic, non-infected, solid or semiliquid soft tissue periprosthetic mass communicating with the hip joint. The origin of pseudotumor is probably multifactorial caused either by excessive wear, metal hypersensitivity, a combination of the two, or as yet an unknown cause. Pseudotumor-like reactions have also been reported in non-metal-on-metal bearings*

What are the risk factors for pseudotumor?

- *female sex*
- *age less than 40 years*
- *small component size*
- *hip dysplasia*

How would you follow symptomatic & asymptomatic patients with MoM hips?

According to **MHRA (Medicines and Healthcare Regulatory Agenc) recommendations 2017**

- *Whole blood should be used to test for cobalt and chromium metal levels.*
- *Whole blood metal levels ≥7ppb (*7 parts per billion) *(119 nmol/L cobalt or 134.5 nmol/L chromium) in one or both metals, indicates the need for closer follow-up and cross-sectional imaging. Then blood tests repeated at 3 months.*
- *If levels are rising on a 2nd sample and the hip is painful then MARS MRI or US is recommended.*
- *MARS MRI scan more important decision making process revise MOM hip replacement than elevated cobalt/chromium levels. Solid lesions more concerning than cystic*

Device implanted	**Hip resurfacing (no stem):** - female - male (femoral head diameter ≤48mm) - All DePuy ASR hip resurfacing devices **Stemmed total hip replacement (THR):** - femoral head diameter ≥36mm	**Hip resurfacing (no stem):** - male (femoral head diameter >48mm) **Stemmed total hip replacement (THR):** - femoral head diameter <36mm		
Patient and device group	**Symptomatic and asymptomatic**	**Symptomatic**	**Asymptomatic**	
			• All stemmed THR • Resurfacing devices without 10A ODEP rating	Resurfacing devices with 10A ODEP rating (Table 2)[5,6,7]
Frequency of follow-up after primary operation date	Annually while the device remains implanted.	Annually while the device remains implanted.	Annually for the first five years, two yearly to ten and three yearly thereafter	First year, once at seven years and three yearly thereafter
Questionnaire	Oxford Hip score assessment	Oxford Hip score assessment	Oxford Hip score assessment	Oxford Hip score assessment
Imaging	• MARS MRI or ultrasound recommended if negative change in Oxford Hip Score is observed and/or elevated/rising blood metal levels.	• MARS MRI or ultrasound in all cases	• Plain radiographs • MARS MRI or ultrasound recommended if negative change in Oxford Hip Score is observed and/or elevated/rising blood metal levels.	• Plain radiographs • MARS MRI or ultrasound recommended if negative change in Oxford Hip Score is observed and/or elevated/rising blood metal levels.
Blood Metal Level Test [1,2,3]	All patients.	All patients.	All patients.	All patients.
Consider need for revision [4]	If imaging is abnormal and/or blood metal levels rising, and/or hip related clinical function / Oxford hip score deteriorating	If imaging is abnormal and/or blood metal levels rising, and/or hip related clinical function / Oxford Hip Score deteriorating	If imaging is abnormal and/or blood metal levels rising, and/or hip related clinical function / Oxford Hip Score deteriorating	If imaging is abnormal and/or blood metal levels rising, and/or hip related clinical function / Oxford Hip Score deteriorating

How would you follow symptomatic & asymptomatic patients with MoM hips?

Three broad categories patients:

1.Patients with high hip scores and good function and low metal ions and normal imaging. They need simple and infrequent follow-up.

2. Patients with poor function, pain, limp, high metal ions and worrying imaging. They generally require early revision.

3. Patients with risk factors such as high risk components, small sizes, female gender, suboptimal component orientation who area symptomatic. Patients with minor symptoms and/or slightly raised ions and/or minor abnormality (usually small fluid collections) on imaging. These are the most difficult and need to be discussed at local arthroplasty multidisciplinary meetings or referred to appropriate experts

What are the principles of pseudotumor revision surgery?

- *Early revision surgery as the longer the MOM resurfacing implant is left in place the more extensive the soft tissue destruction will most likely be.*
- *Similar to the treatment of infection. Aggressive debridement of all involved soft tissue*
- *I would use a metal on-polyethylene bearing surface. A ceramic bearing surface has the potential for catastrophic fracture. I would use an uncemented implant.*
- *It would be sensible to get a second opinion from an experienced hip surgeon as per British Hip Society guidelines to confirm and support the appropriateness of the management plan.*
- *The surgery should be preformed by an experienced hip surgeon.*
- *I would keep the option of using a constrained cup open as the soft tissues may be so poorly compromised that the hip is unstable but obviously would prefer to avoid this, as components will loosen early in this situation.*