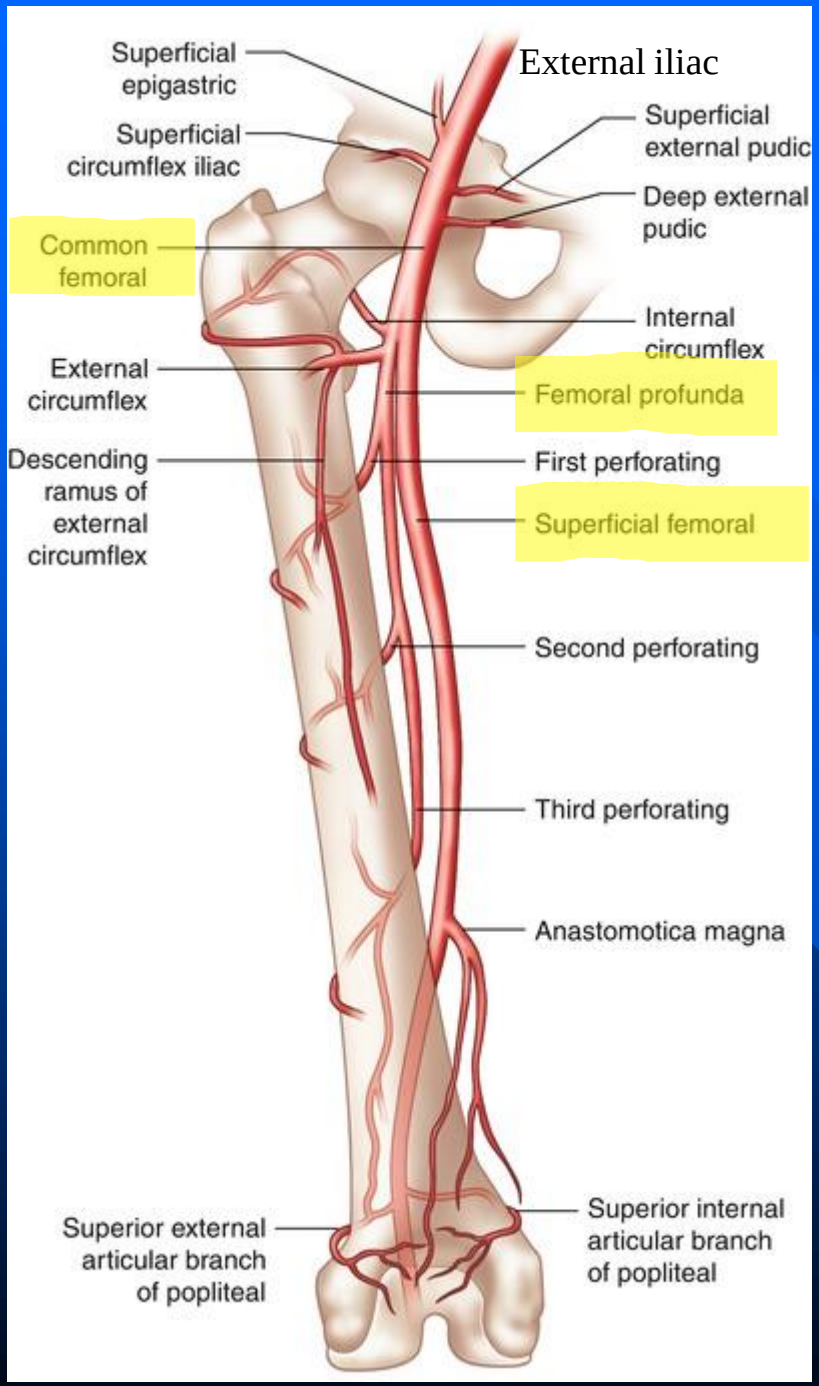
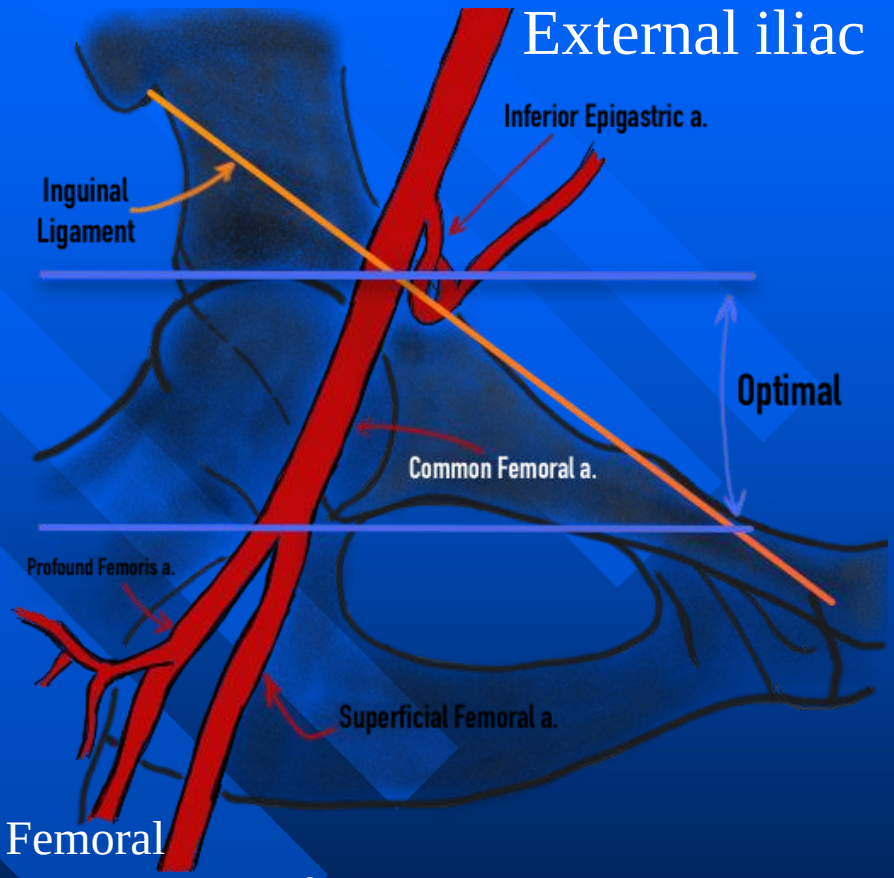
Blood Supply

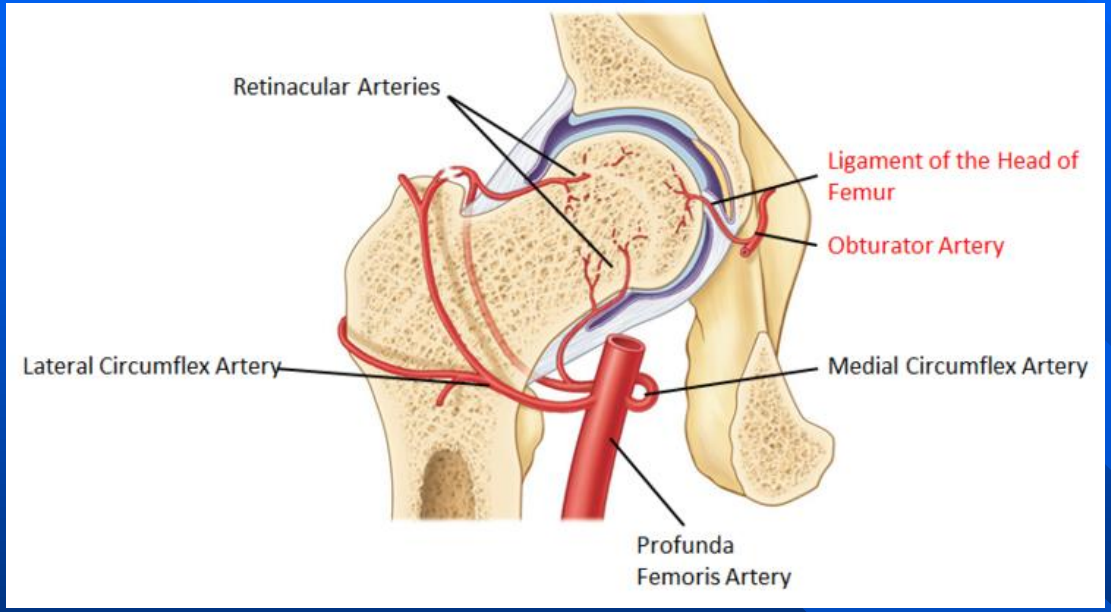
- Approximately 60% of patients, the two main arteries supplying the femoral head are:
  - Medial circumflex artery
  - Lateral circumflex artery (most comes from lateral)
    - » Gives rise to three or four retinacular vessels which supply the cartilaginous border of the head
  - Profunda femoris artery supplies circumflex arteries
- In AVN, the blood supply to the femoral head is obstructed or impaired.
- As a result, the underlying bone supporting the cartilage layer of the hip joint begins to die (“necrosis”), resulting in progressive degeneration of the femoral head with eventual collapse and flattening of the head.



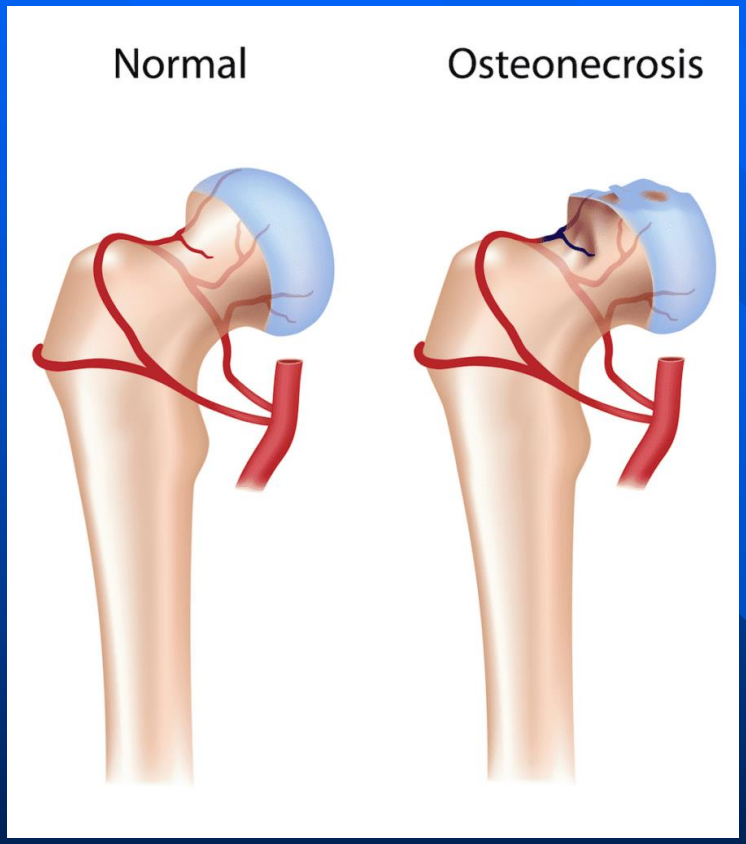


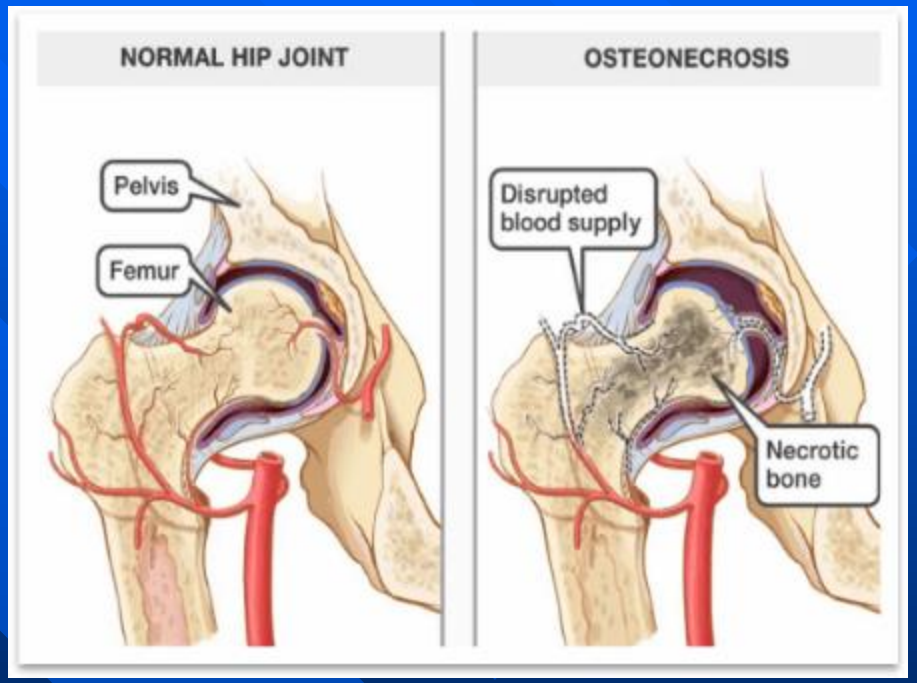
Deep Femoral

Superficial Femoral Artery



- Profunda femoris artery (also known as the deep femoral artery or deep artery of the thigh) is a branch of the femoral artery
- Is responsible for providing oxygenated blood to the deep structures of the thigh, including the femora.


Normal
Osteonecrosis


NORMAL HIP JOINT
OSTEONECROSIS
Pelvis
Femur
Disrupted blood supply
Necrotic bone

Information

- Though "idiopathic" is found at top of list for etiology of osteonecrosis (ON) in many discussions, another etiology often is present
  - Watch for clues in soft tissues and bones to discover etiology of ON
- Most frequent etiologies of ON in developed countries include
  - Corticosteroid use,
  - Alcohol abuse,
  - Sickle cell anemia
  - Trauma
- Bones that are mostly covered by cartilage are particularly at risk for developing ON
  - Femoral head, humeral head, scaphoid, lunate, talus, navicular

Etiology

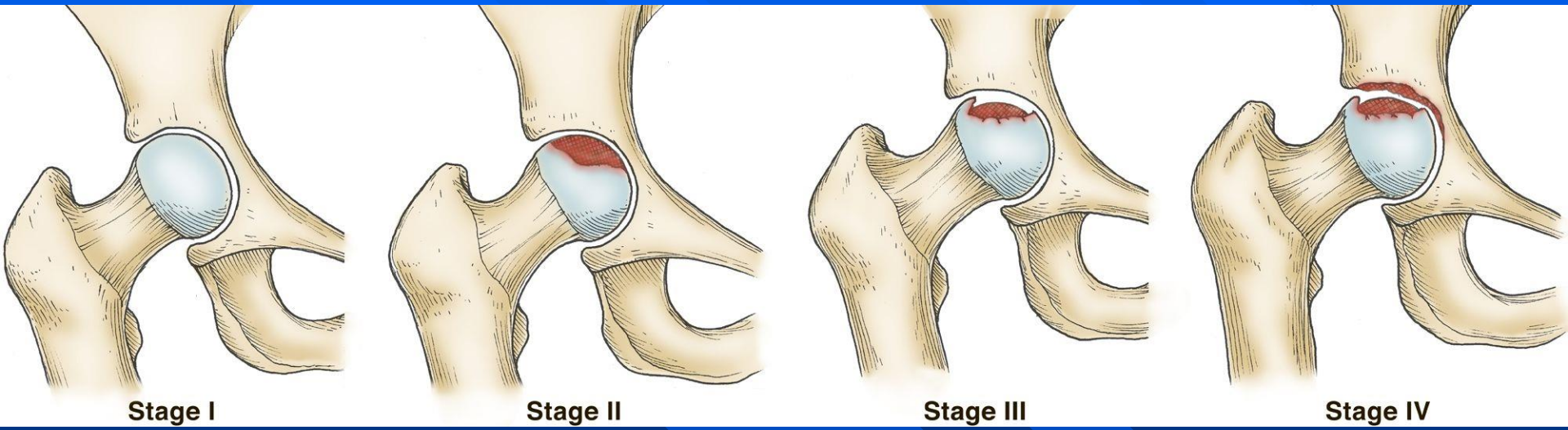
- Traumatic (secondary to the neck of femur fractures) or non-traumatic.
- Traumatic osteonecrosis is usually unilateral.
- In non-traumatic cases, it is mostly bilateral in 70-80%

Specific Etiolgies

- Posttraumatic: disrupted blood supply
- Hip dislocation: if not reduced < 12 hours, 50% develop ON
- Tear small vessels, compress larger vessels
- Ischemia initially reversible, but if prolonged, spasm and thrombosis lead to necrosis
- Subcapital fracture: ON in 30% of displaced fractures
- Other etiologies
- Sickle cell disease (SSD): sickled cells thrombose microvasculature at low oxygen tension
- Gaucher disease: marrow packing → ↑ pressure
- Systemic lupus erythematosus (SLE): vasculitis + corticosteroids; 5-40% develop ON
- Caisson disease: nitrogen embolization from dysbaric phenomena
- Radiation: vasculitis results in ON
- HIV/AIDS: antiretroviral therapy or hyperlipidemia
- Alcohol abuse: likely due to fat emboli from liver

ARCO classification of osteonecrosis (most recent)

- Most recent
- Stage 0
  - plain radiograph: normal
  - MRI: normal
  - clinically: no symptoms
- Stage I
  - plain radiograph: normal
  - MRI or bone scan: abnormal
  - clinically: no symptoms or presence symptoms
- Stage II
  - plain radiograph: trabecular bone changes without changes in subchondral bone; preserved joint space
  - MRI: abnormal, diagnostic appearance
  - clinically: symptoms present
- Stage III
  - presence of trabecular bone changes and subchondral fracture (crescent sign or subchondral bone collapse); preserved joint space
  - clinically: symptoms present
  - further subdivided with regard to the depth of femoral head depression: IIIA - depression ≤2 mm, IIIB - depression >2 mm
- Stage IV
  - features of osteoarthritis, with distorted femoral head shape, acetabular changes and narrowed joint space
  - clinically: symptoms present

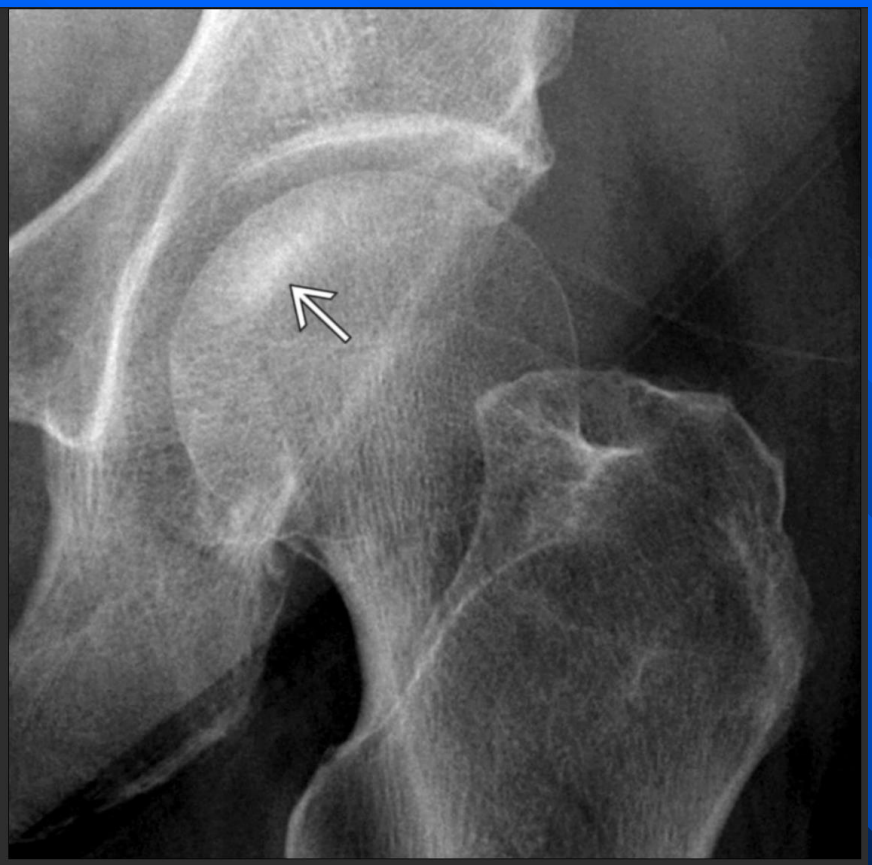

Stage I
Stage II
Stage III
Stage IV

X-Ray

- Early: patchy sclerosis of femoral head due to new bone formation along necrotic trabeculae
  - During 1st few months, infarcted bone will appear normal on radiography
- Advanced findings
  - Crescentic subchondral lucency indicative of fracture, may precede articular surface collapse
    - Frog-leg or false profile views show best
    - Orientation parallels articular surface
    - Crescent sign can also be present with noninfarcted subchondral insufficiency fracture (SIF)
    - Limits surgical options
- Articular surface collapse
  - May be subtle, requires close inspection, visible cortical break may not be evident
  - Often easier to appreciate on radiography vs. MR
- Articular surface fragmentation
- 2° osteoarthritis (OA): joint space narrowing, acetabular subchondral sclerosis, osteophytes

Treatment

- Treatment of early disease not always straightforward
- Some cases of renal transplant with MR-diagnosed ON are asymptomatic and resolve spontaneously
  - May represent insufficiency fractures
- Pain occasionally lessens spontaneously with conservative management
- Core decompression generally relieves pain promptly, likely from ↓ marrow edema and intraosseous hypertension; may elect to pack with graft
  - Useful in stage III patients with marrow edema
  - May continue with progression to collapse
- Core decompression with vascularized fibular grafting is not proven to be more efficacious than core decompression alone
- Hyperbaric oxygen may be useful in stage I or II
- Treatment of later disease: required in 50% of patients within 3 years of diagnosis
  - Varus and anterior angulated osteotomy rarely used to alter weight-bearing portion of femoral head
  - Collapse without OA: hemiarthroplasty
  - Significant OA: total hip arthroplasty



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AP radiograph in a 66-year-old woman on chronic corticosteroids shows a sclerotic band at the superomedial aspect of the femoral head → without collapse or subchondral crescent [Steinberg stage II osteonecrosis (ON) of the femoral head].

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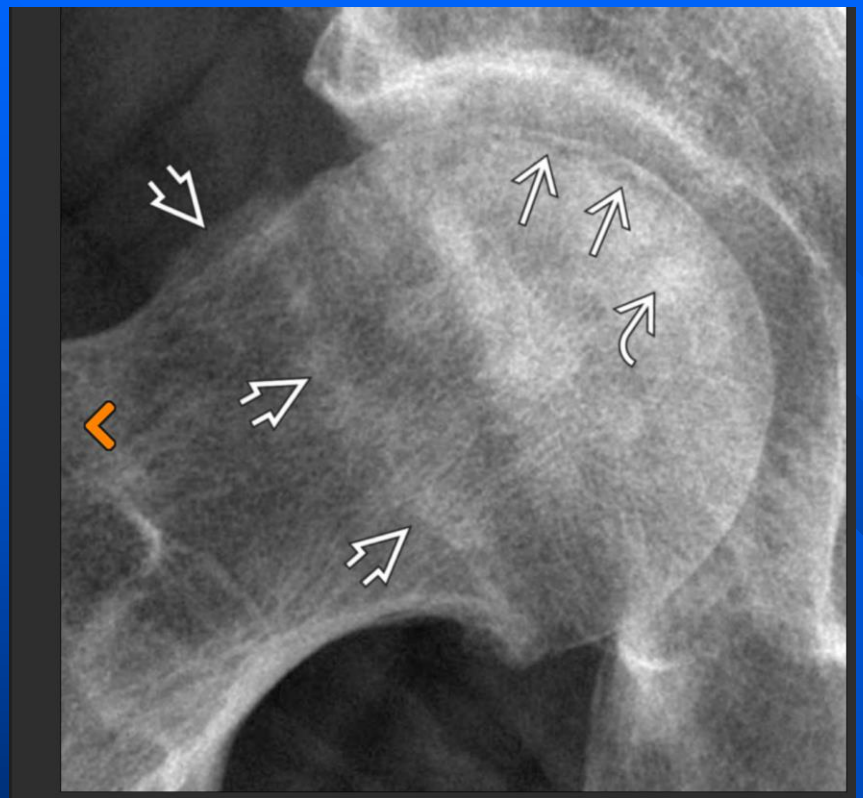
Coronal CT in the same patient helps to define the extent of ON and shows similar findings of sclerosis of the superomedial femoral head →. The relatively small size of the ON confers a lesser risk for subsequent collapse.



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Frog-leg lateral radiograph in a 54-year-old man being treated nonoperatively for a healing subcapital femoral neck fracture shows accompanying sclerosis and callus ⇆. A subchondral crescent → with patchy sclerosis ↗ is evidence for stage III ON.

Coronal NECT in a 65-year-old woman shows a subchondral crescent → with displacement of the subchondral bone plate and flattening ⇆ of the remainder of the femoral head. Mild superomedial joint space narrowing and collar osteophytes are present (stage V ON).

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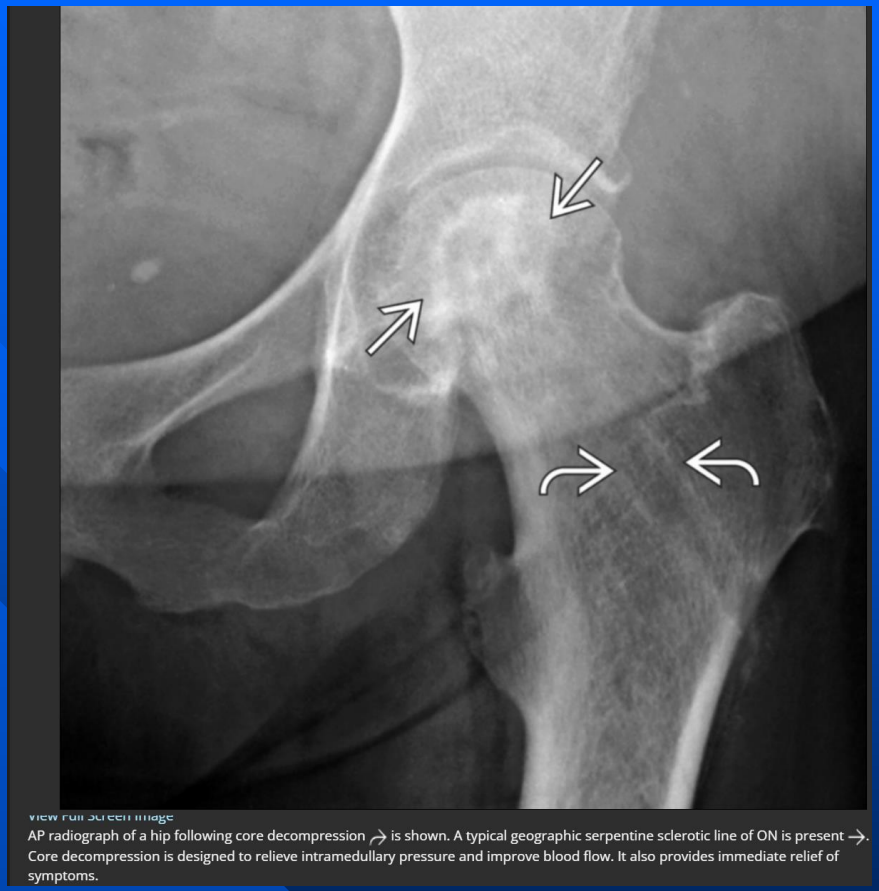
AP radiograph in a 14-year-old boy following percutaneous screw fixation of a femoral neck fracture shows mixed lucency and sclerosis in the superior femoral head → with subchondral bone plate collapse and loss of femoral head sphericity ⇄ (stage V ON).



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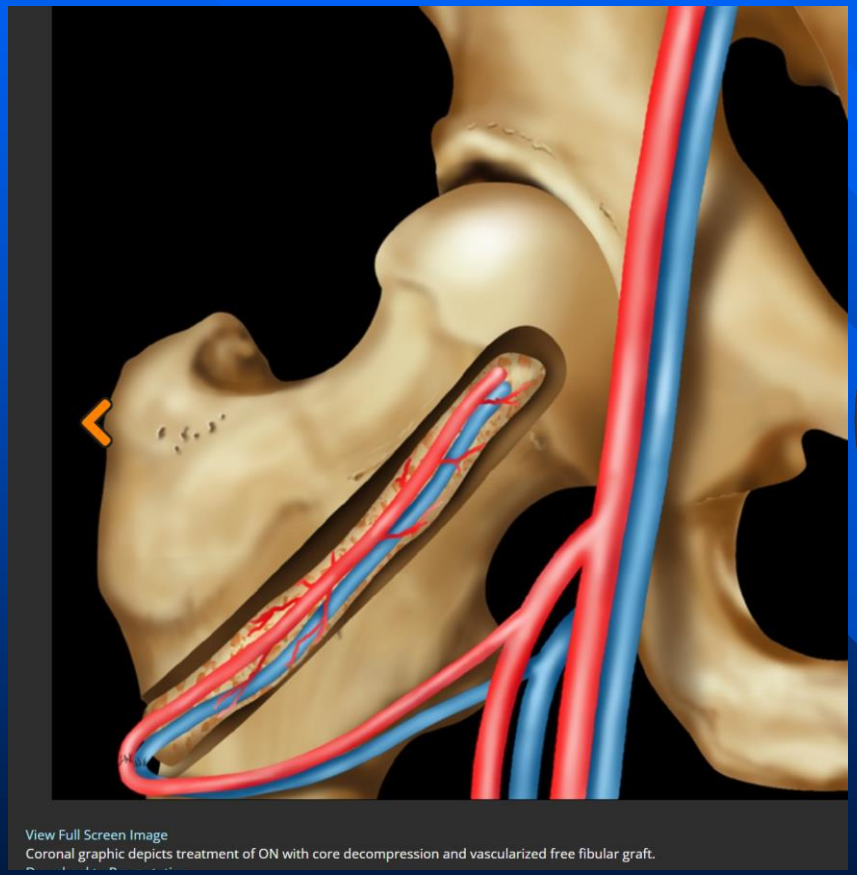
AP radiograph of a hip following core decompression ↗ is shown. A typical geographic serpentine sclerotic line of ON is present →. Core decompression is designed to relieve intramedullary pressure and improve blood flow. It also provides immediate relief of symptoms.

Microsurgical Vascularized Fibular Grafts for Avascular Necrosis of the Hip



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Coronal graphic depicts treatment of ON with core decompression and vascularized free fibular graft.