Bone Loss

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FRH Teaching 5/12/11

Overview

- Causes of bone loss
- Pathophysiology
- Classification
  - Femoral
  - Acetabular

Causes of bone loss

- Osteolysis
- Stress shielding
- Osteoporosis

- Fracture
- Metastases
- Infection

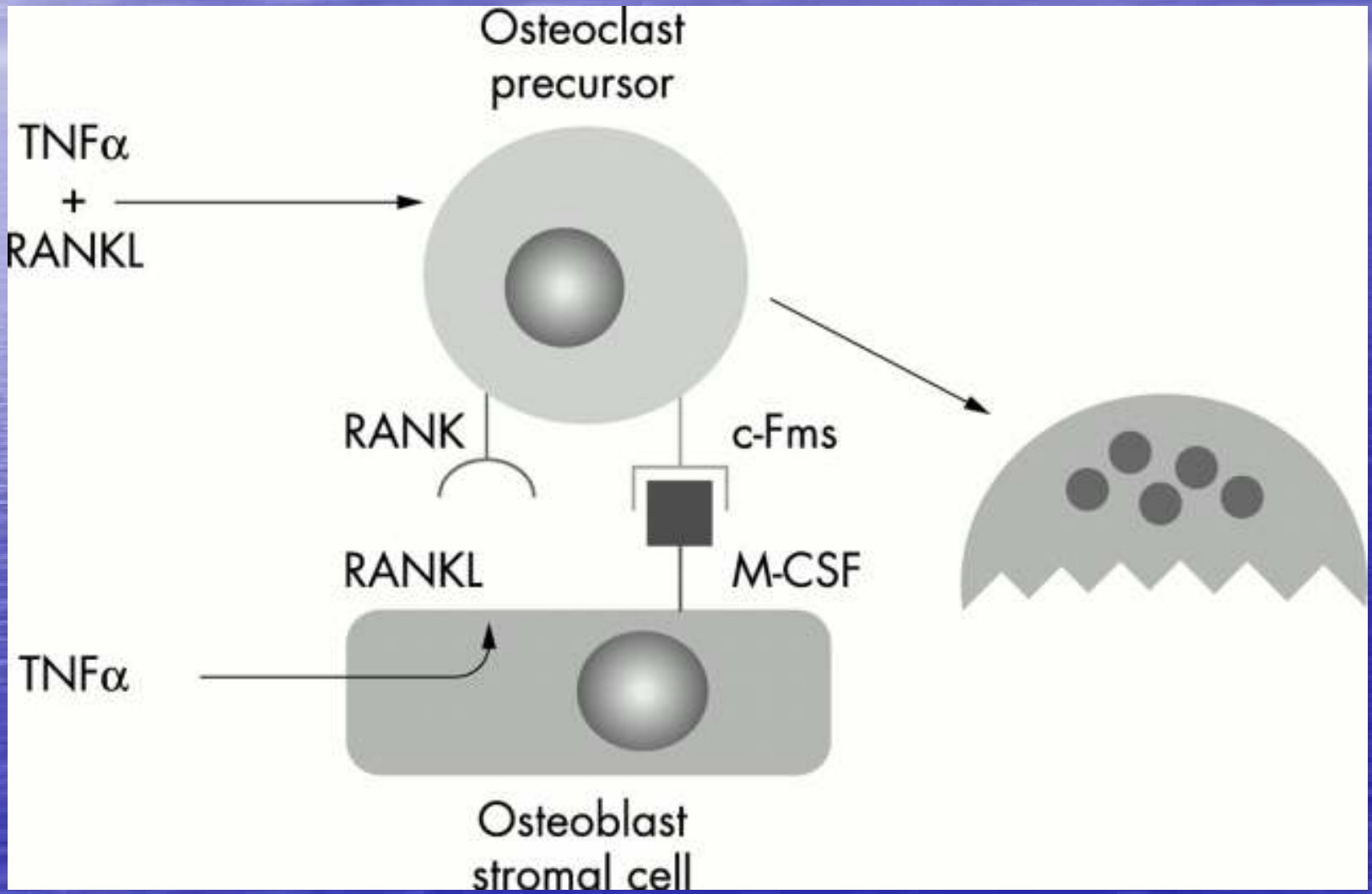
Osteolysis

- Particulate debris
  - Cement
  - Polyethylene
  - Metal
- Wear particles 0.1-10 μm
  - (peak activity 0.1-0.5 μm)
- Phagocytosis – macrophage

Osteolysis

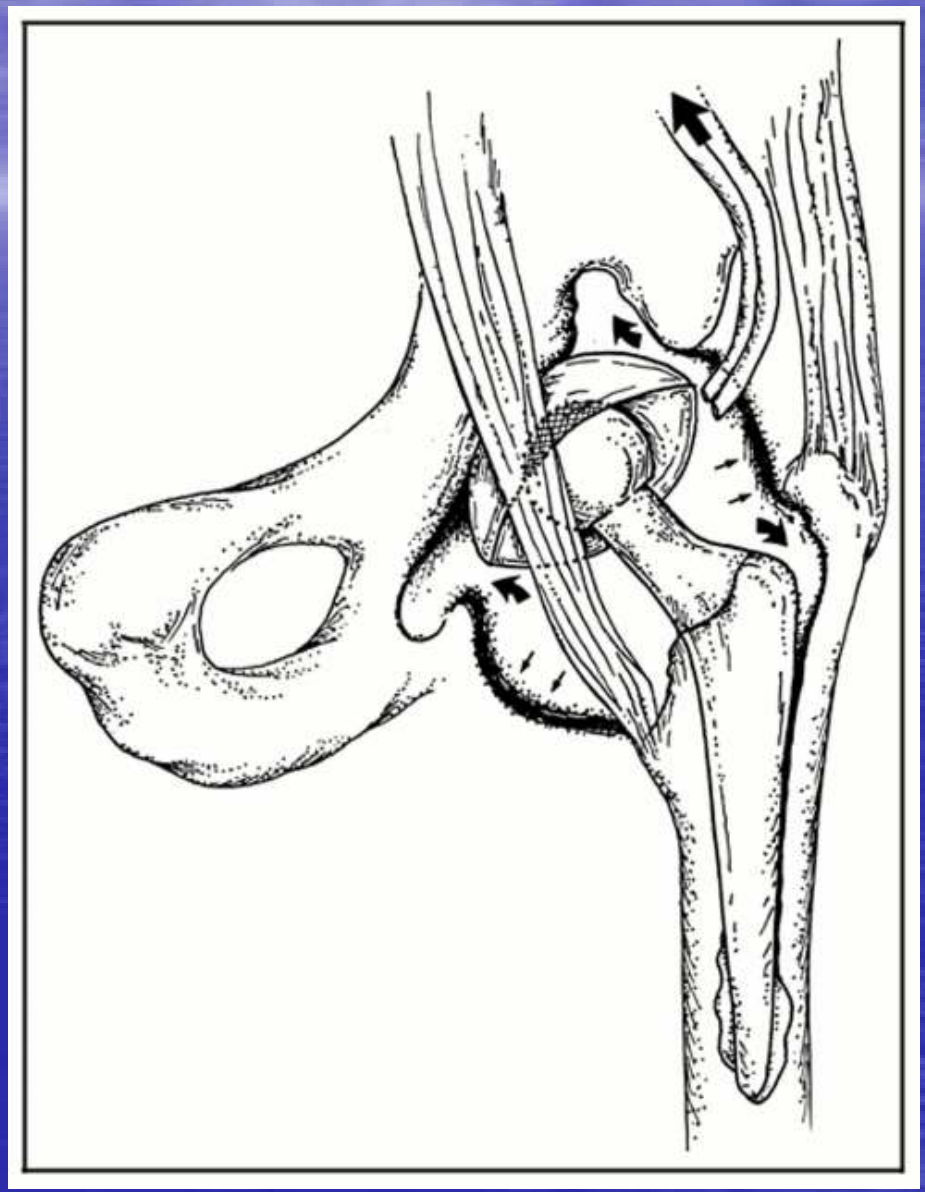
- Inflammatory mediators
  - Stimulate osteoclasts
    - IL-1, IL-6, TNF-α, TGF-β, PGE_2
  - Stimulate ostoclast precursors
    - Monocyte-CSF, granulocyte-CSF
  - Inhibit osteoblasts
    - IL-1
  - Expose bone
    - MMP, collagenase
- Around implants
    - RANKL

Osteolysis – osteoclast stimulation



Effective joint space

- Hydrostatic pressure



Stress shielding

- Fixation
  - Distal > Proximal
- Wolff's law
  - Adapt to usage
- Hoop stress
  - protective

Osteoporosis

- Reduced mineral density
- Increased medullary cavity
- Decreased cortical thickness
- Increased bone diameter

Femoral Classification

- AAOS
  - D'Antonio J, McCarthy JC, Bargar WL, et al. Classification of femoral abnormalities in total hip arthroplasty. *Clin Orthop 1993; 296:133-139*
- Paprosky
  - Della Valle CJ, Paprosky WG. Classification and an algorithmic approach to the reconstruction of femoral deficiency in revision total hip arthroplasty. *JBJS 2003; 85-A Suppl. 4: 1-6*

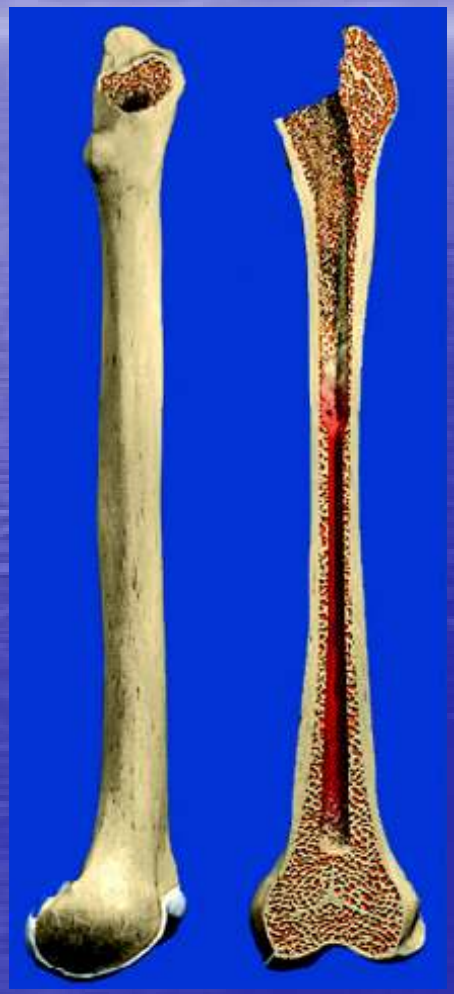
AAOS - femoral

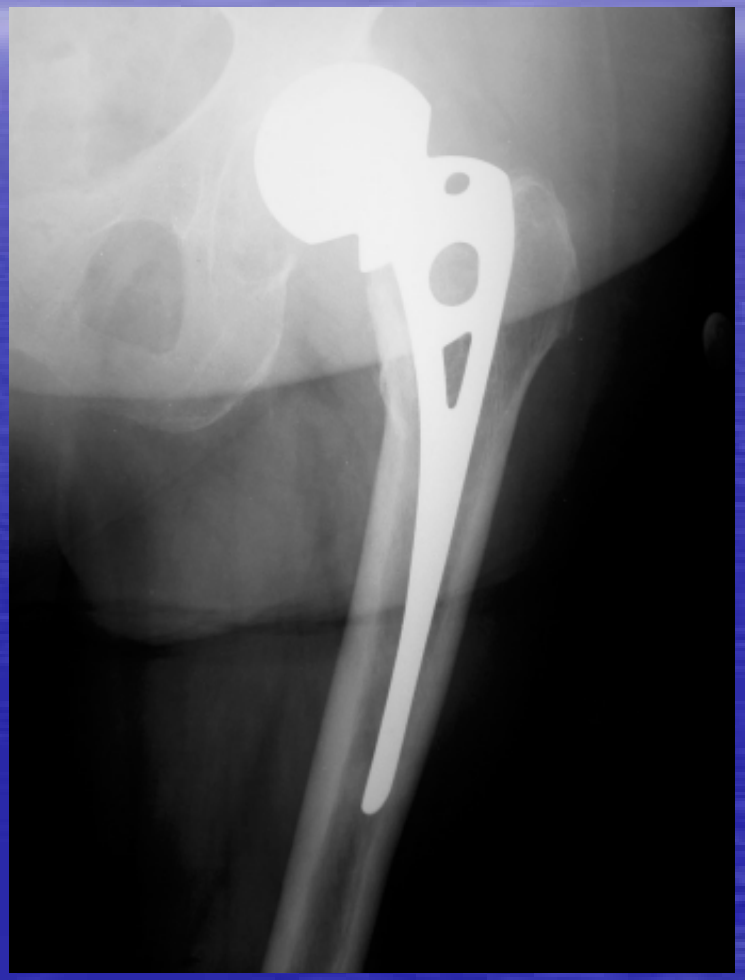
- Type I- segmental defects
- Type II- cavitary defects
- Type III- combined defects
- Type IV- femoral malalignment
- Type V- femoral stenosis
- Type VI- femoral discontinuity (fracture)

Paprosky - Femoral

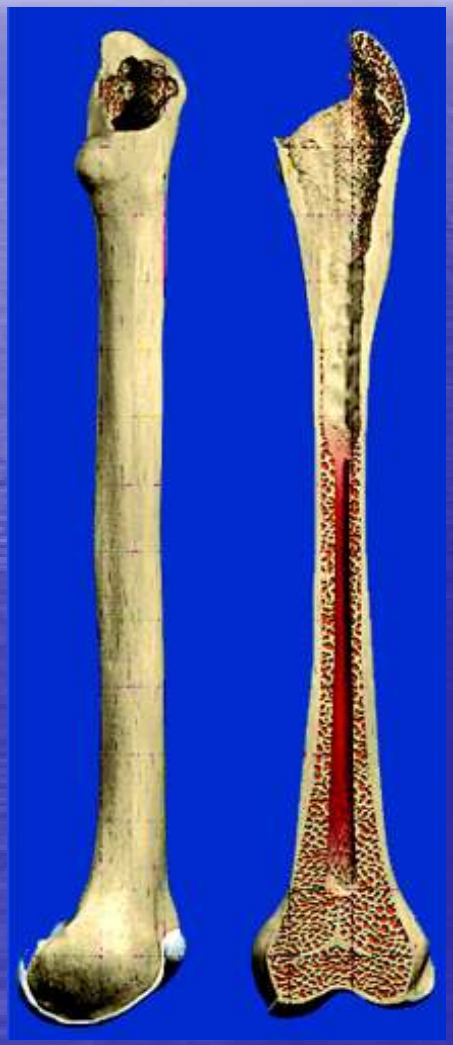
- Type I – minimal bone loss
- Type II – cancellous bone loss
- Type III – metaphysis unsupportive
  - A > 4cm diaphysis
  - B < 4cm diaphysis
- Type IV – drainpipe femur – no isthmus

Type-I femoral deficiency - minimal loss of metaphyseal cancellous bone and an intact diaphysis.

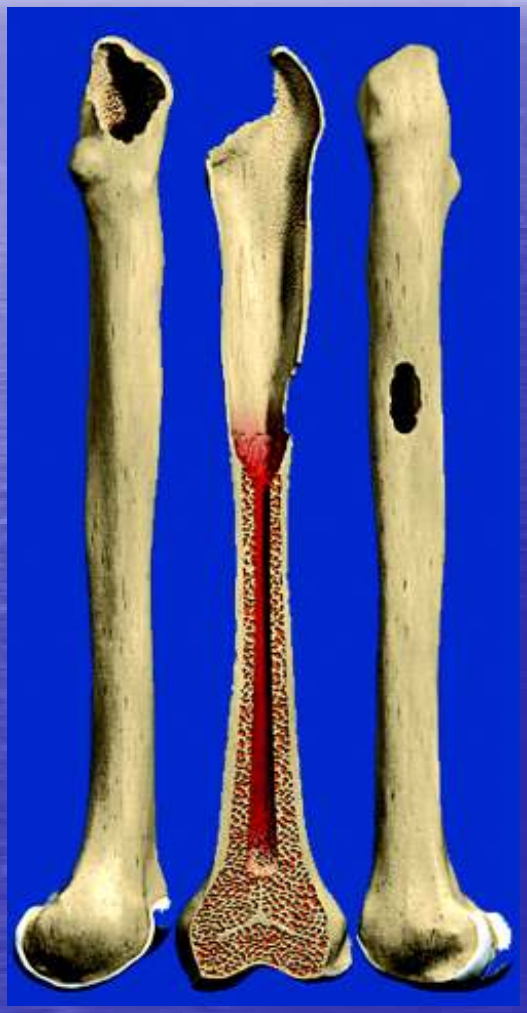




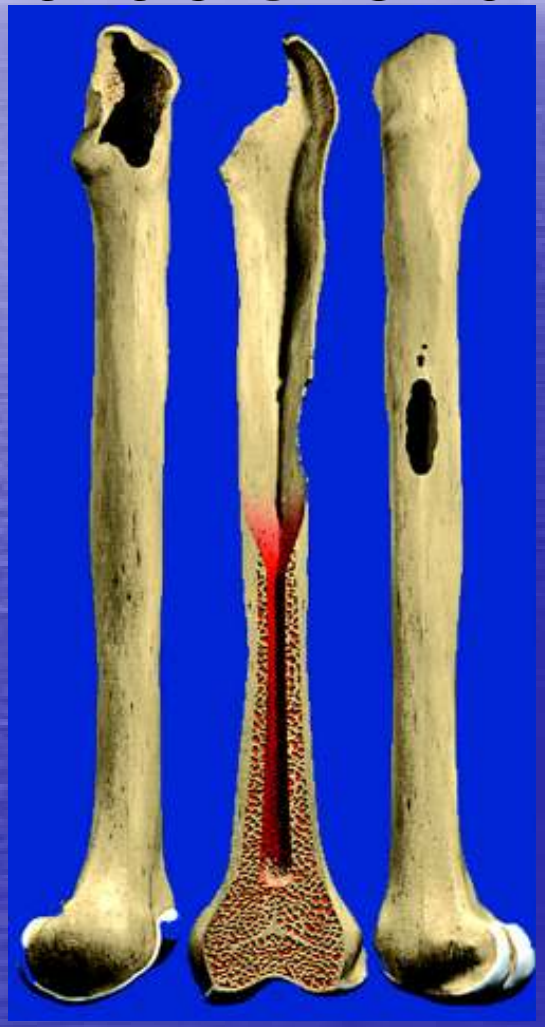
Type-II femoral deficiency - extensive loss of metaphyseal cancellous bone and an intact diaphysis.



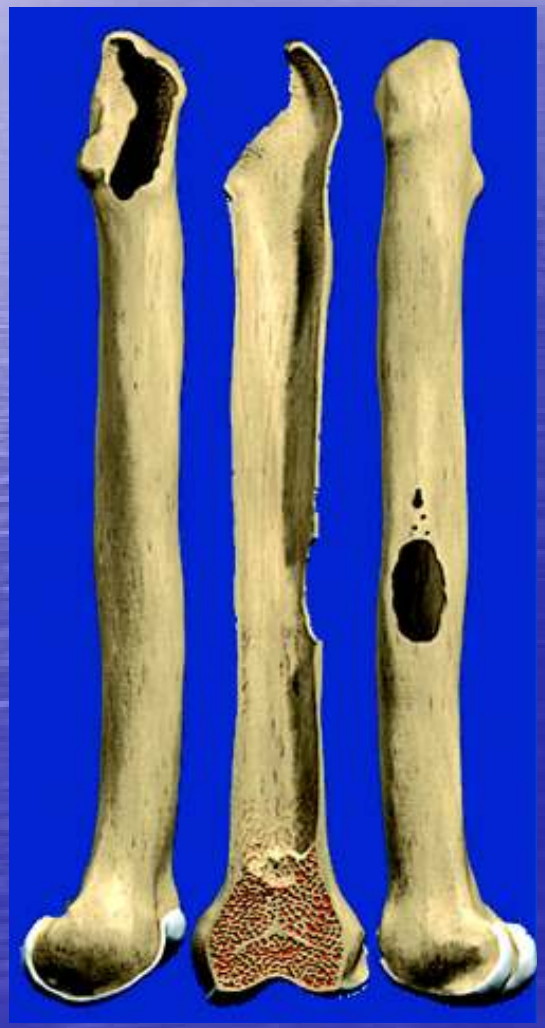
Type-IIIA femoral deficiency - The metaphysis is severely damaged and nonsupportive, with >4 cm of intact diaphyseal
bone available for distal fixation.



Type-IIIB femoral deficiency. The metaphysis is severely damaged and nonsupportive, with <4 cm of diaphyseal bone available for distal fixation.



Type-IV femoral deficiency - extensive metaphyseal and diaphyseal damage in conjunction with a widened femoral canal. The isthmus is nonsupportive.

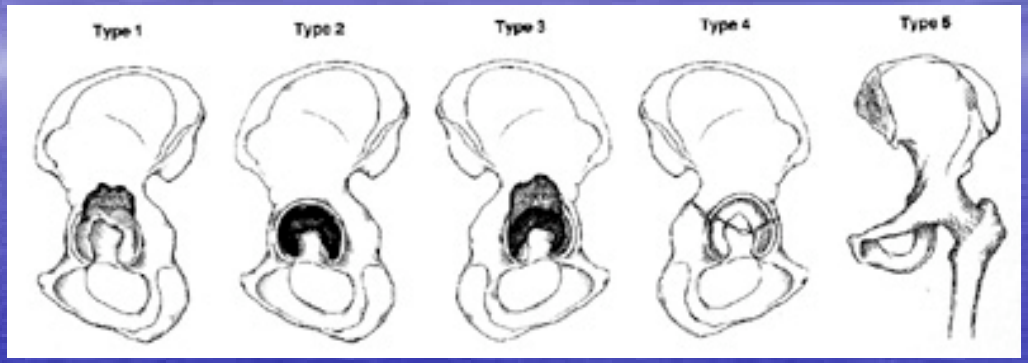


Acetabular classification

- AAOS
  - D'Antonio JA, et al. Classification and management of acetabular deformities in total hip arthroplasty. CORR 1989; 243: 126-137
- Paprosky
  - Paprosky WG, Perona PG, Lawrence JM. Acetabular defect classification and surgical reconstruction in revision arthroplasty.

    A six year follow-up evaluation. *J Arthroplasty 1994; vol. 9*.

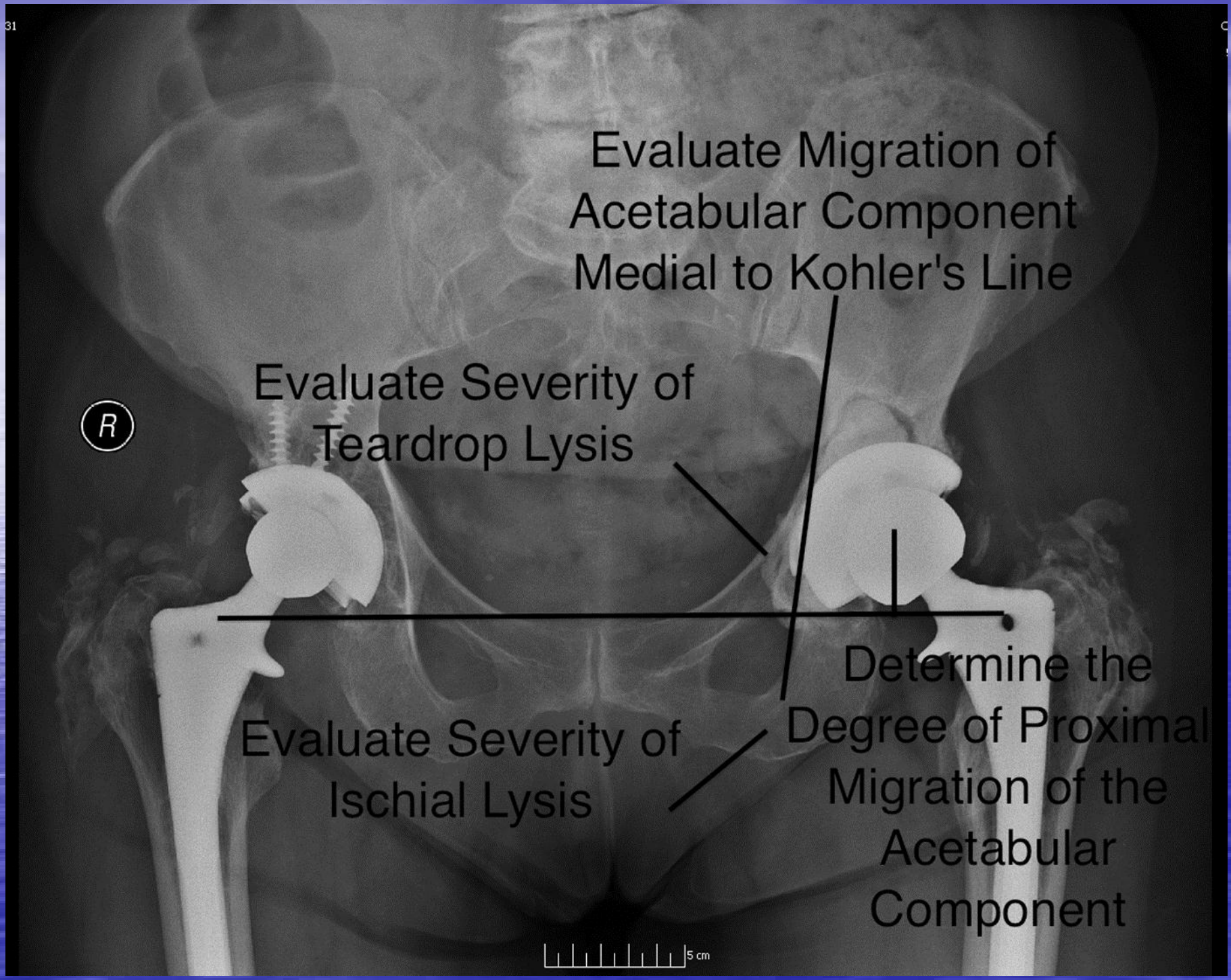
AAOS - acetabulum

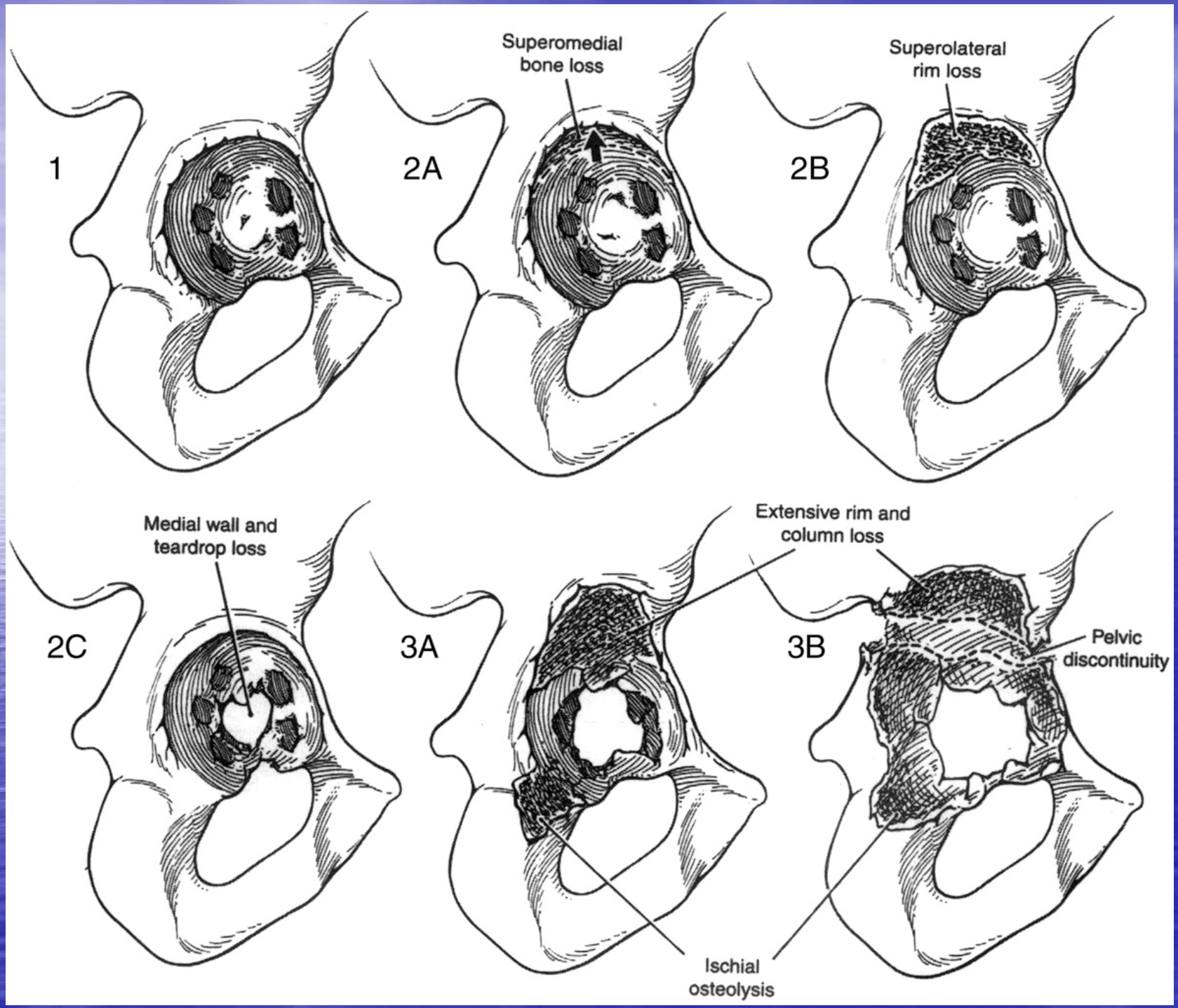


- Type I: Segmental
- Type II: Cavitary
- Type III: Combined
- Type IV: Pelvic discontinuity
  - Type IVa- Mild segm loss or cavitary only loss
  - Type IVb- Moderate-severe segmental loss or combined bone loss
  - Type IVc- prior pelvic irradiation
- Type V: Hip arthrodesis

Paprosky - acetabulum

- Type I – minimal bone loss
- Type II – < 3cm superior migration
  - A – Superomedial (rim intact)
  - B – Superolateral (rim)
  - C – Medial (breaching Kohler's line)
- Type III - > 3cm superior migration
  - A – Up and Out
  - B – up and In


Evaluate Migration of Acetabular Component Medial to Kohler's Line
Evaluate Severity of Teardrop Lysis
R
Evaluate Severity of Ischial Lysis
Determine the Degree of Proximal Migration of the Acetabular Component
5 cm


1
2A
Superomedial bone loss
2B
Superolateral rim loss
2C
Medial wall and teardrop loss
3A
Extensive rim and column loss
3B
Pelvic discontinuity
Ischial osteolysis

Type I

- Minimal bone loss

Type II A

- Superomedial lysis
- Rim intact
- Kohler's line intact

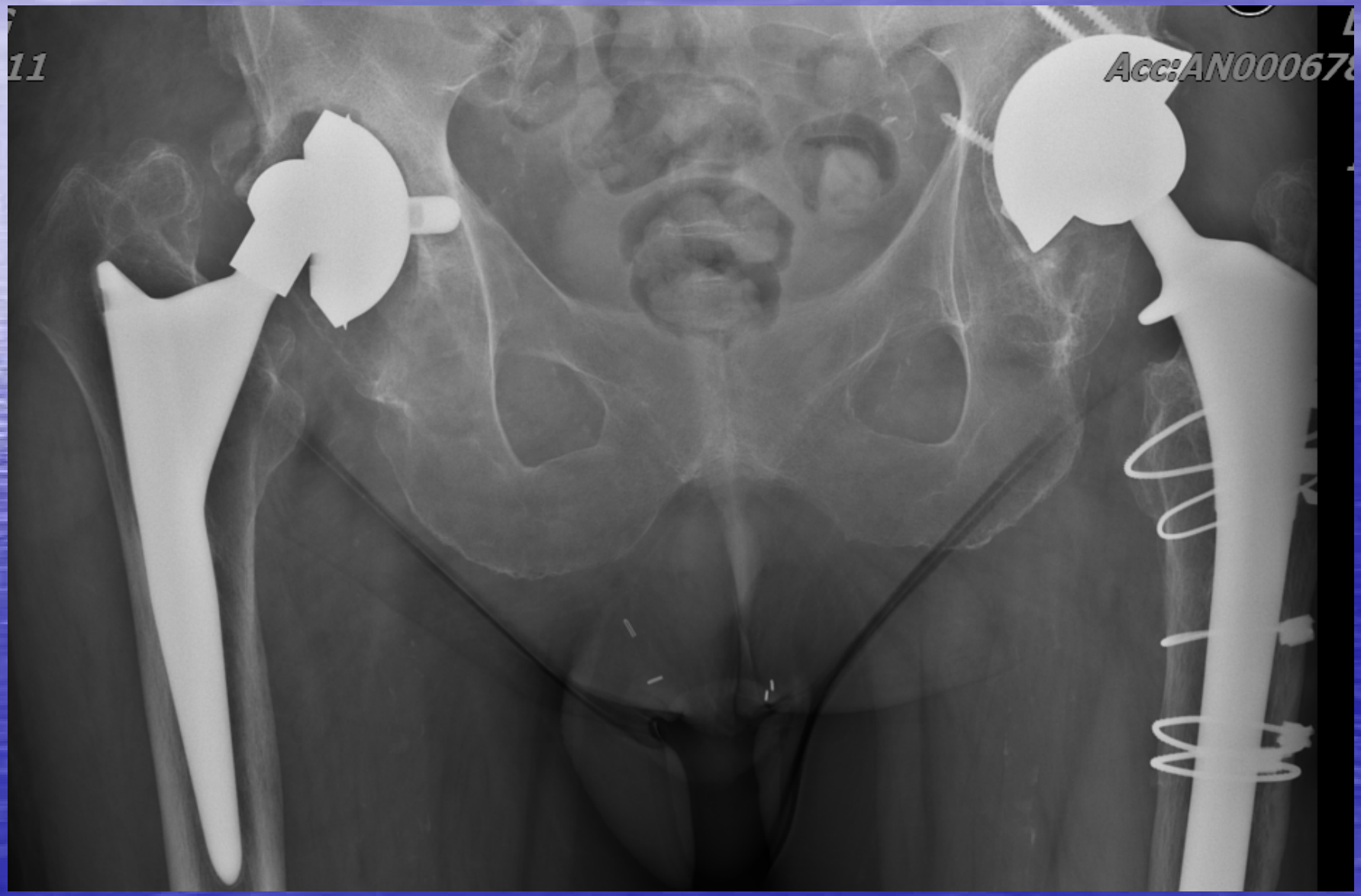
Type II B

- < 3cm
- Rim involved
- Minimal lysis
- Expect intact columns

Type II C

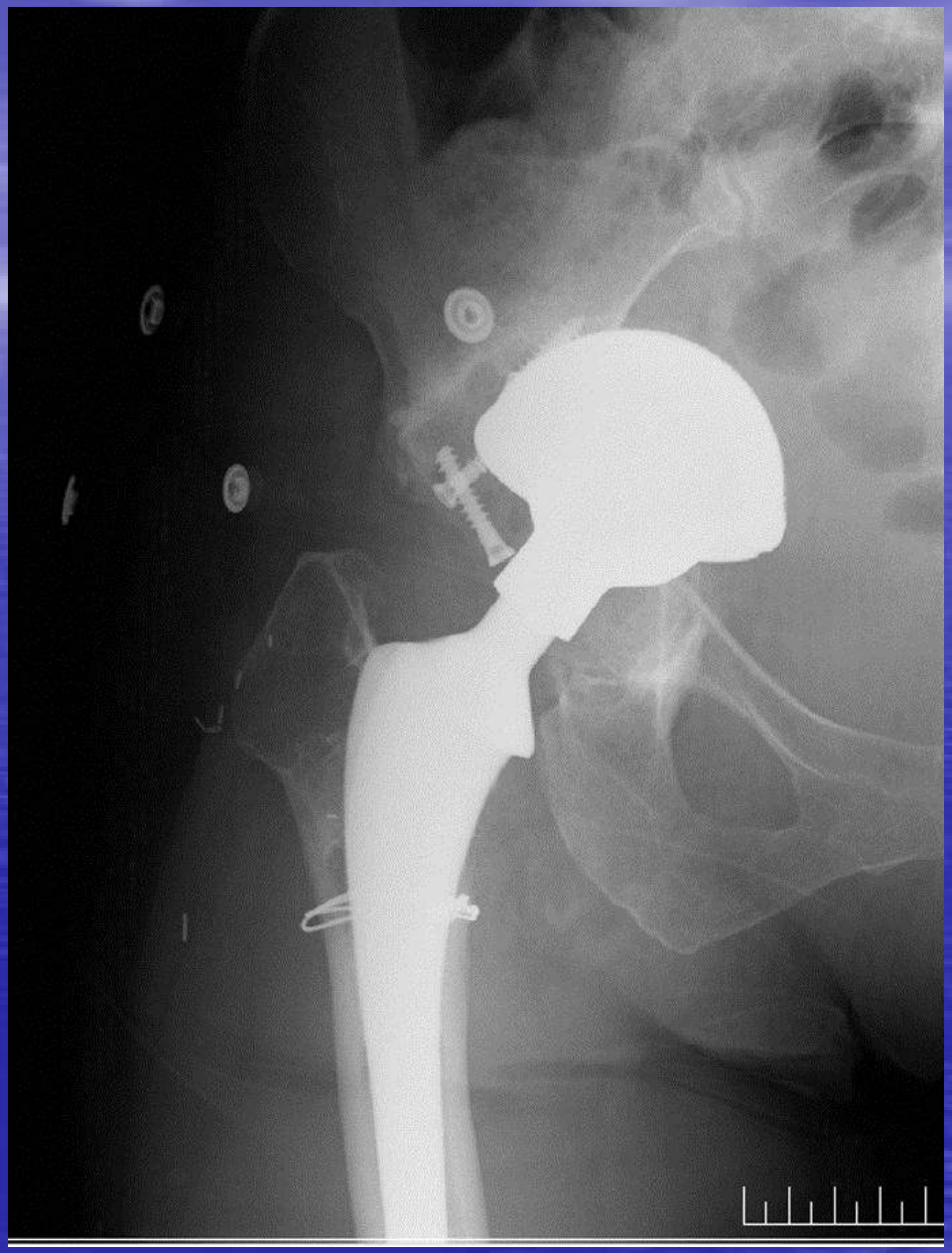
- < 3cm
- No lysis of teardrop/ischium
- Rim stable

Type II B (?)



Type III B

- Risk of pelvic dissociation



Summary

- Causes of bone loss
- Pathophysiology
- Paprosky classification
  - Femoral
  - Acetabular
- Informs management

Other references

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- Ramachandran – Basic Orthopaedic Science

- Miller – Review of Orthopaedics