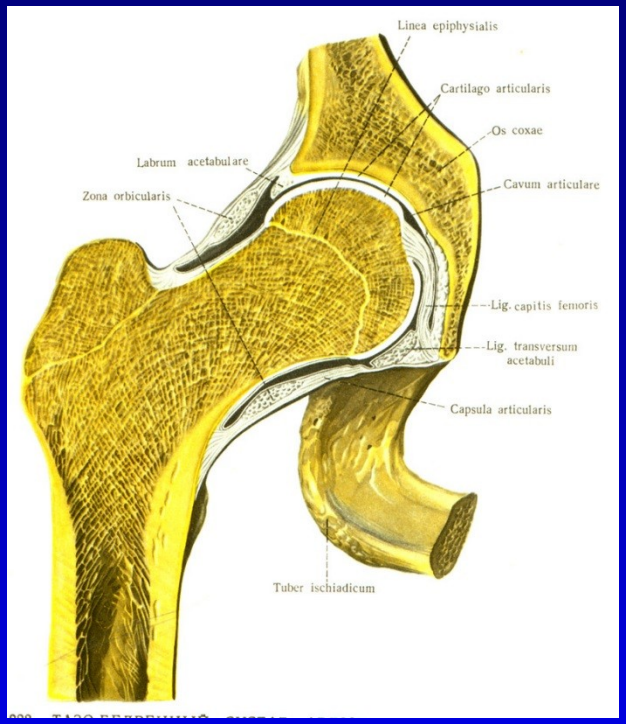
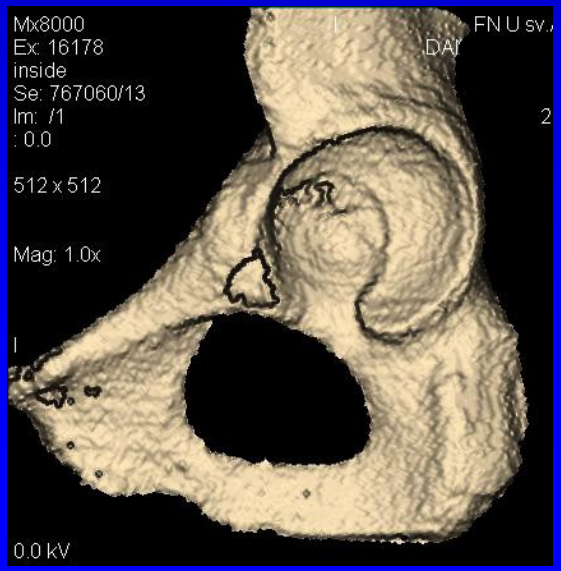
# Total hip arthroplasty

J. Emmer, Z. Rozkydal

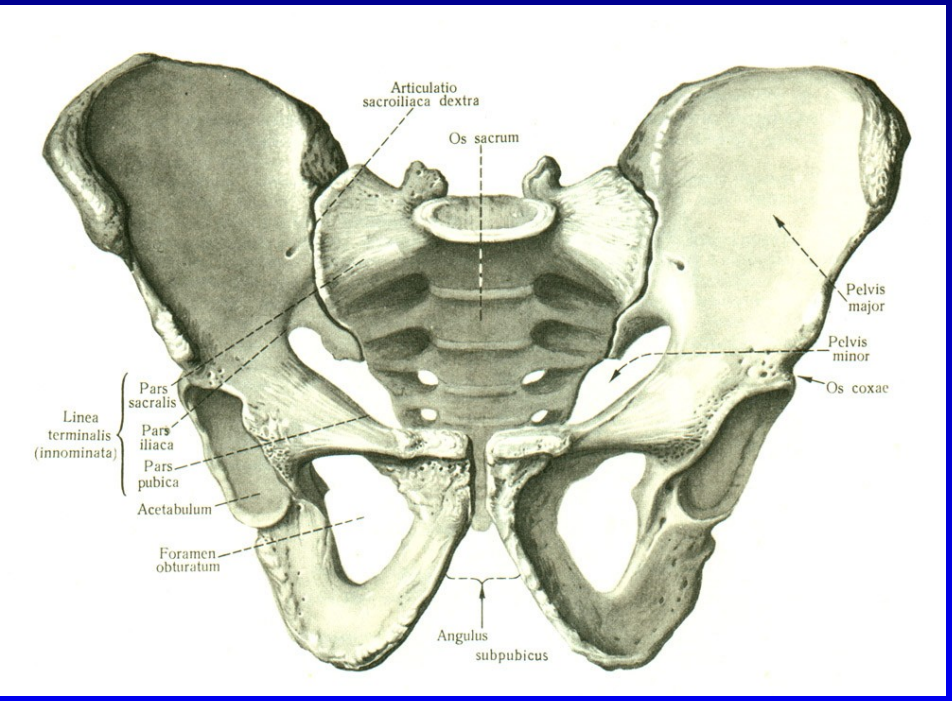
# Hip joint

Enarthrosis

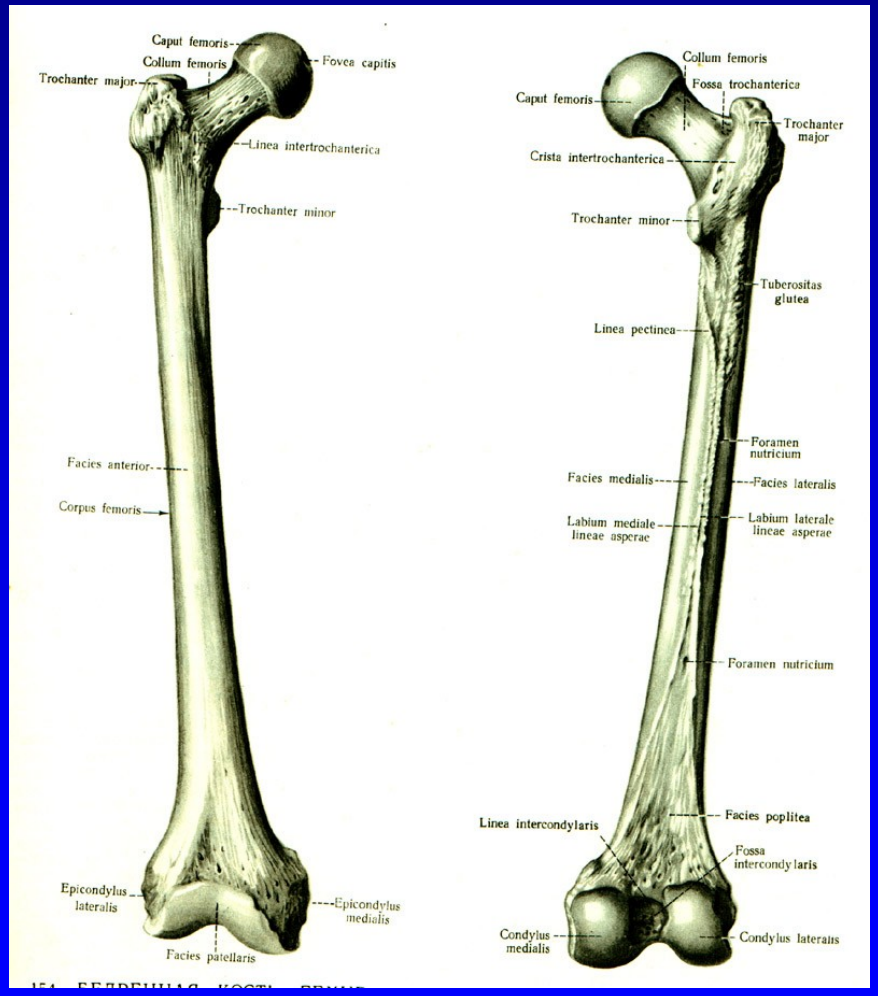


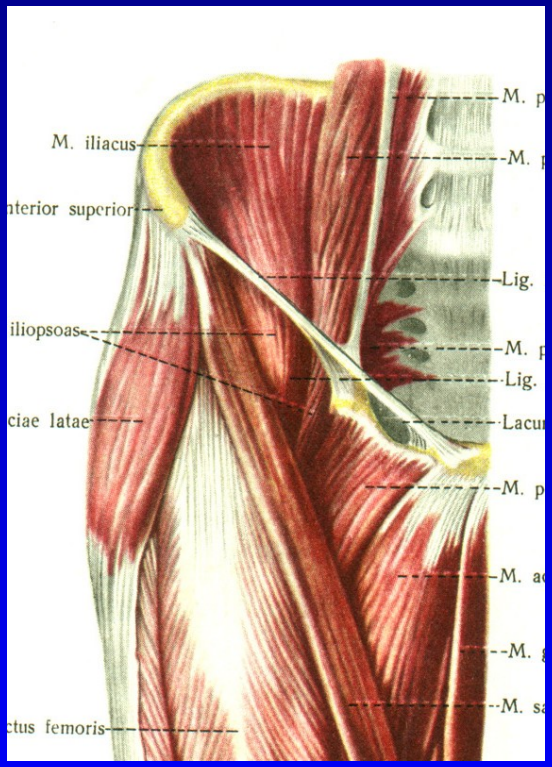
# Pelvis

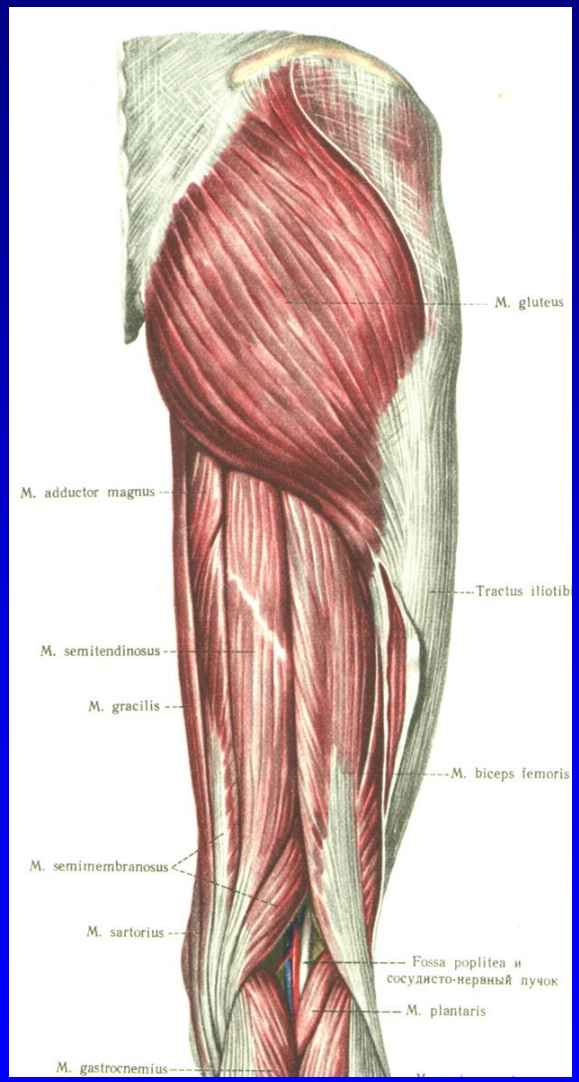


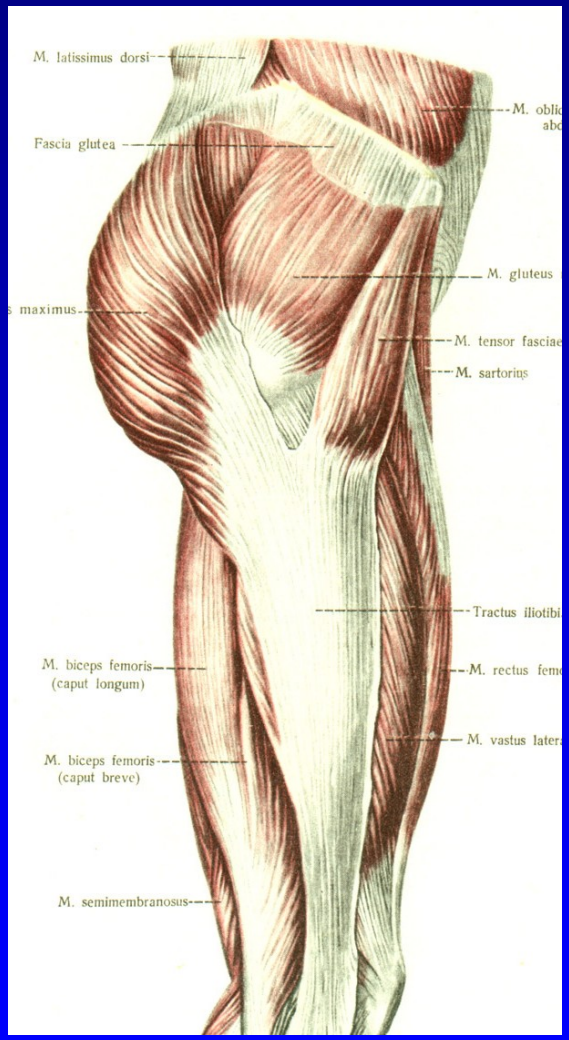

# Femur



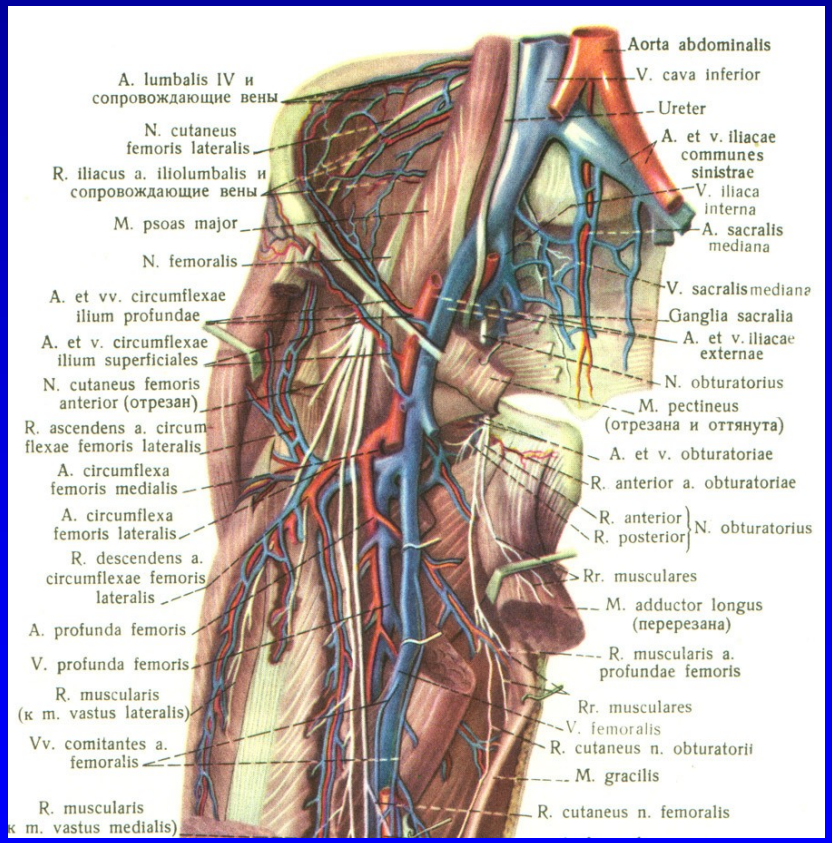
# Muscles


M. iliacus
Lig.
Lig.

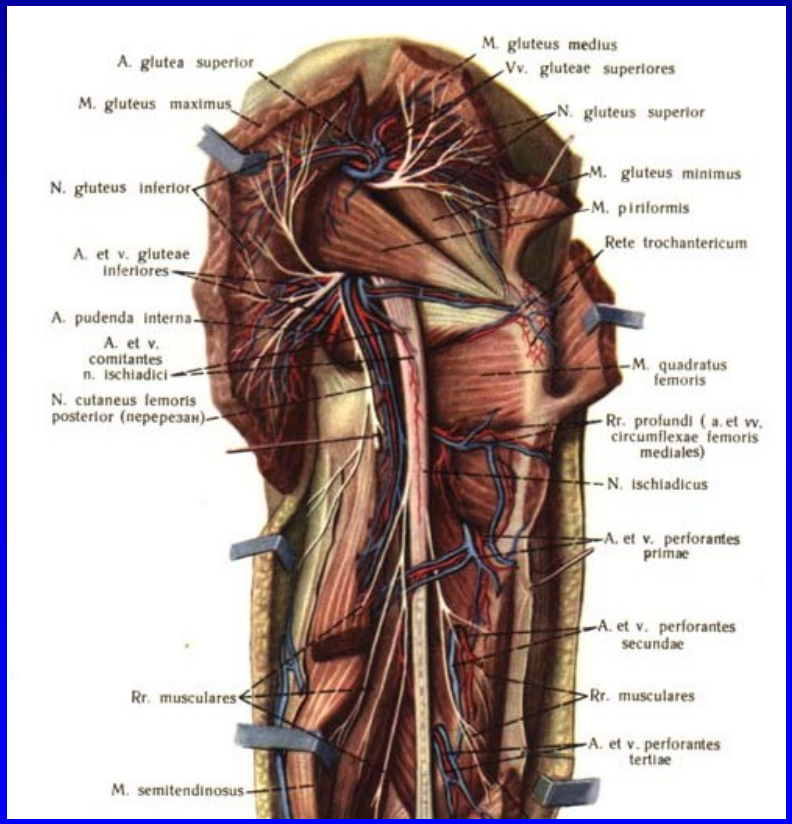

M. gluteus
M. adductor magnus
Tractus iliotib
M. semitendinosus
M. gracilis
M. biceps femoris
M. semimembranosus
M. sartorius
Fossa poplitea и
сосудисто-нервный пучок
M. plantaris
M. gastrocnemius


M. latissimus dorsi
Fascia glutea
M. gluteus
M. tensor fasciae
M. sartorius
Tractus iliotibi
M. biceps femoris
(caput longum)
M. biceps femoris
(caput breve)
M. semimembranosus

# Femoral nerve




# Sciatic nerve



# THR indications

- Painfull hip joint  condition
- Poor effect of conservative therapy
- Life comfort deteriorated
- No salvage surgeries indicated

# Indications

Primary osteoarthrosis

Secondary osteoarthrosis:
congenital, posttraumatic,
after infection

Rheumatoid arthritis
Psoriatic arthropathy

Avascular necrosis
of the femoral head

Primary osteoarthritis

# THR indications

- OA primary
- OA secundary
- Psoriatic arthropathy
- Aseptic femoral head necrosis
- Rheumatoid arthropathy
- Tumors
- Intracapsular femoral neck fracture, no indication for OS or conservative therapy (vital indication!)

# THR contraindications

- Poor general condition, poor physical status (ASA IV)
- Persistent infection
- Severe comorbidity with poor prognosis
- Extreme obesity
- No compliance

# Contraindication

- Active infection of the hip
- Infection in the body
- General condition not good
- Neurogenic arthropathy
- Extreme low bone quality
- No cooperation of the patient

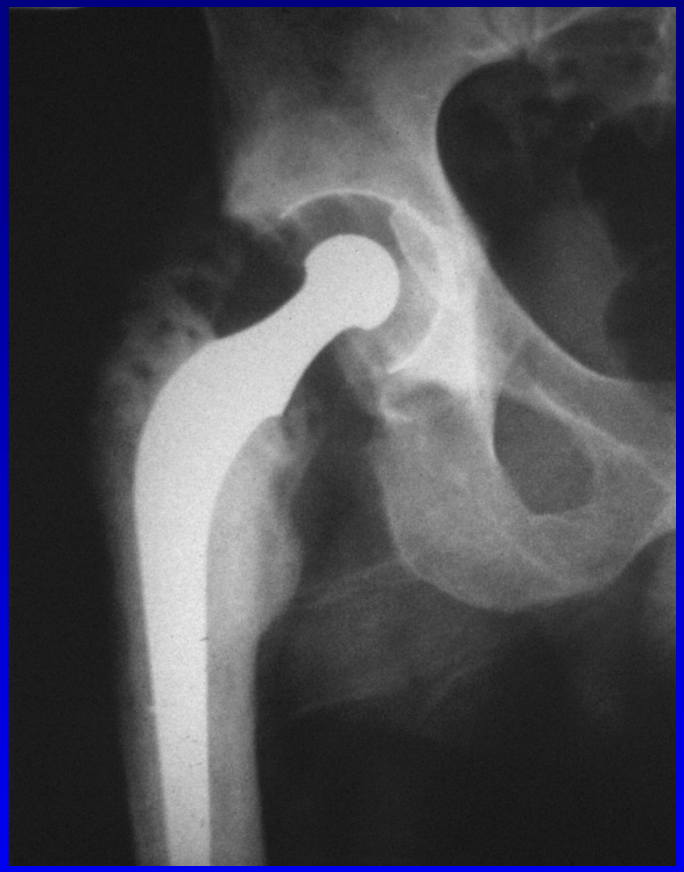
  elevated ESR, CRP

# History

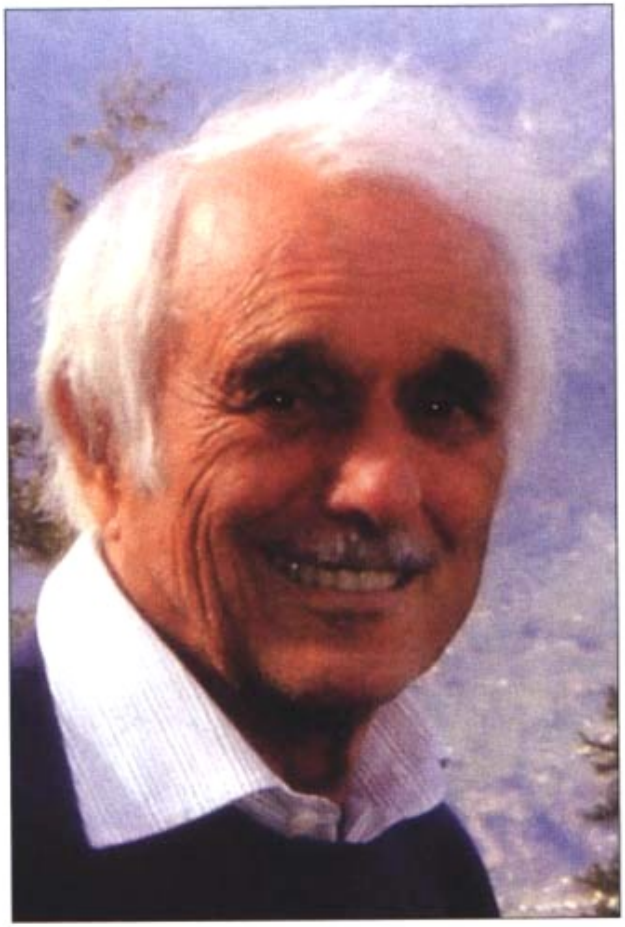
Sir John Charnley
Low friction arthroplasty
Acrylic dental cement

Polymethylmetacrylate
– bone cement

1962



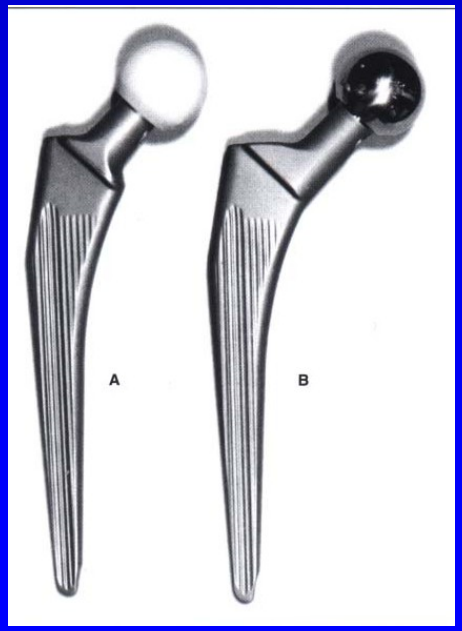
Low friction arthroplasty



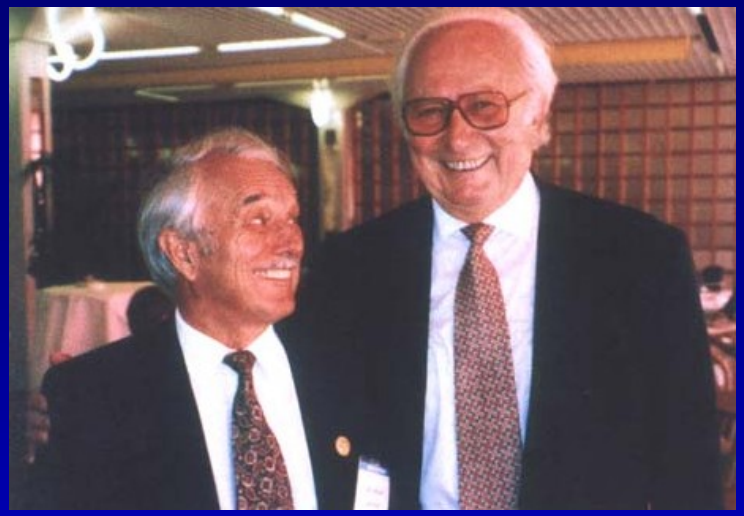
Prof. M. E. Müller

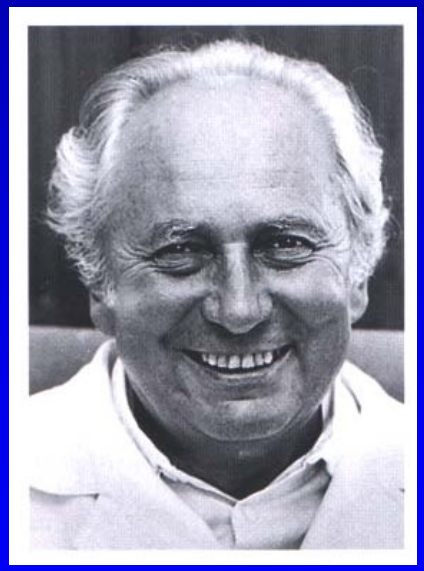

1964 -1965
Setzholzprothese

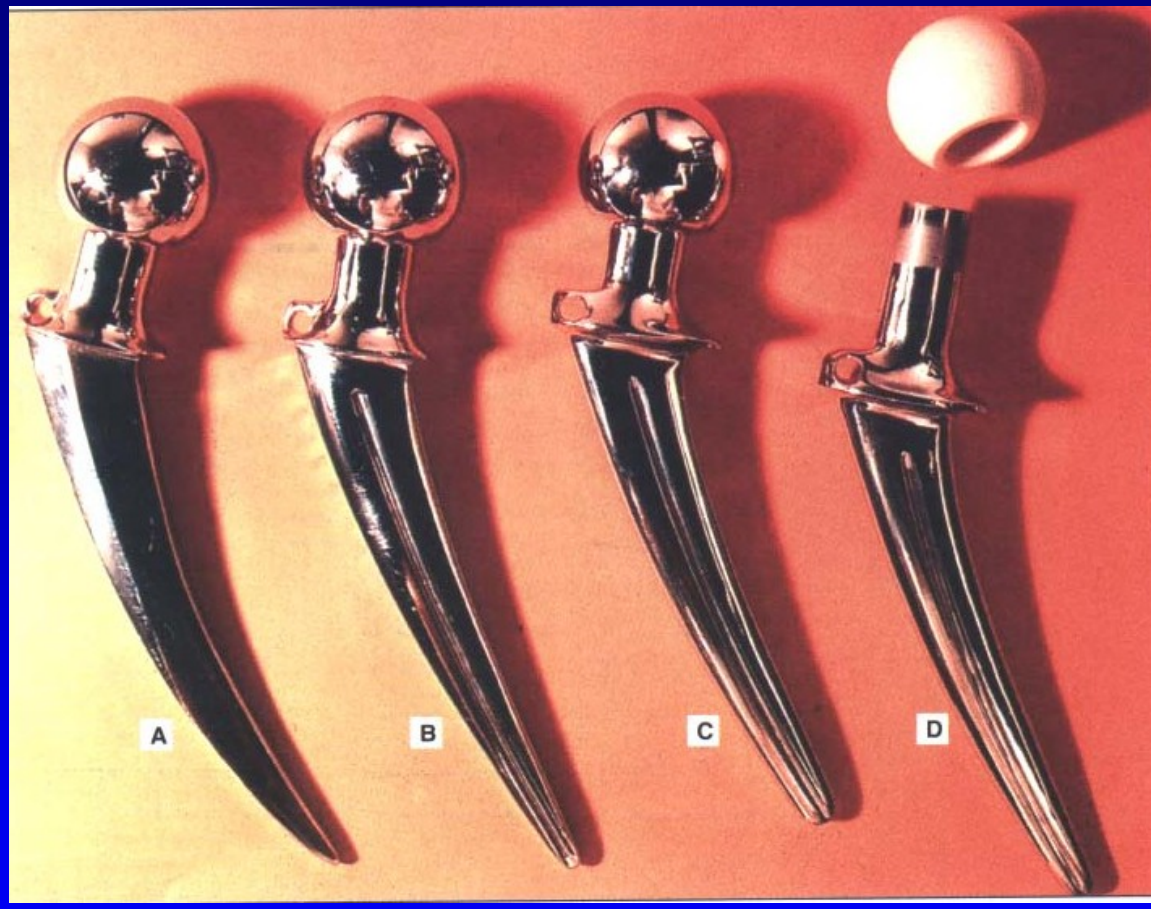
1966
Banana - shaped




1977
Geradschaftprothese








1972

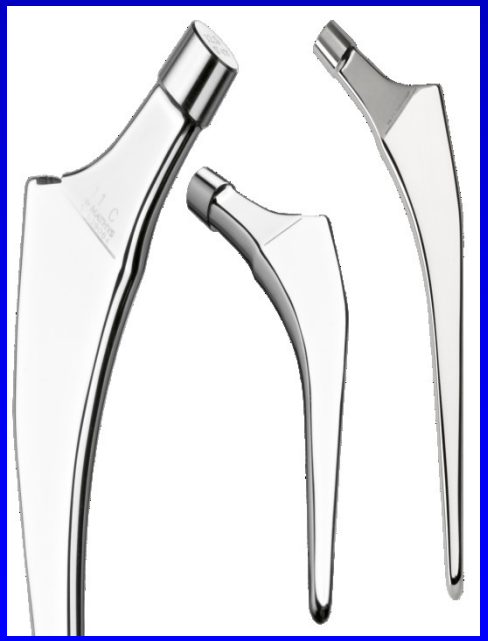
1986

Stems Poldi- Čech

Prof. MUDR.Oldřich Čech, DrSc.

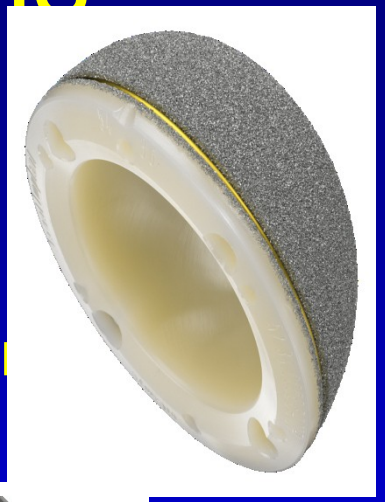
# THR fixation options

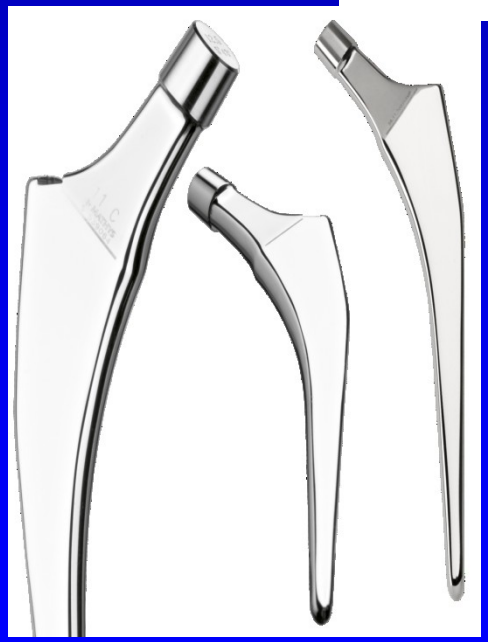
- Cemented
  - Both components fixed with bony cement
  - Older patients > 70 y.o.
  - Poor bone quality - osteoporosis



# THR fixation options

- Hybrid
  - One component fixed with bone cemen
    (femoral)
  - 65-70 y.
  - Better implant survival

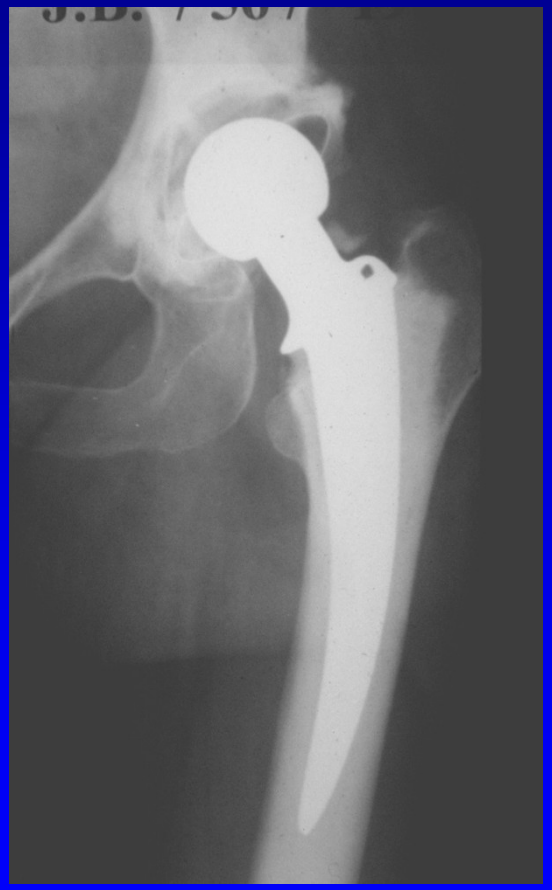




# THR fixation options

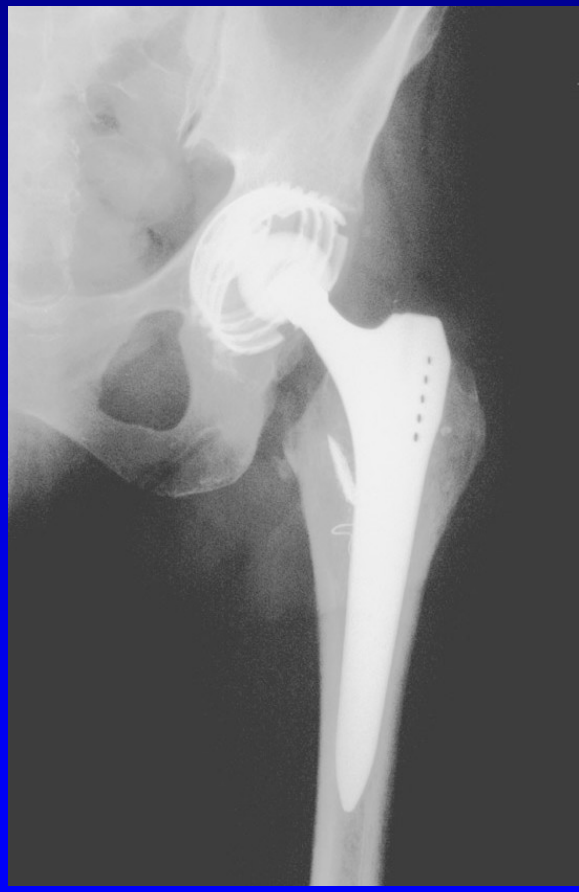
- Cementless
  - Both components fixed without cement
  - age bellow 65 y.o.
  - Good bone quality
  - Contraindication for bone ceme (alergy, right ventricle function)
  - Best implant survival
  - The most expensive

# Fixation in the bone
# Types of THA



Cemented

Hybrid



Uncemented

# Primary THA

Polyethylene cup

Head

Neck

Stem

# Revision THA

# For tumors


# Femoral head prosthesis

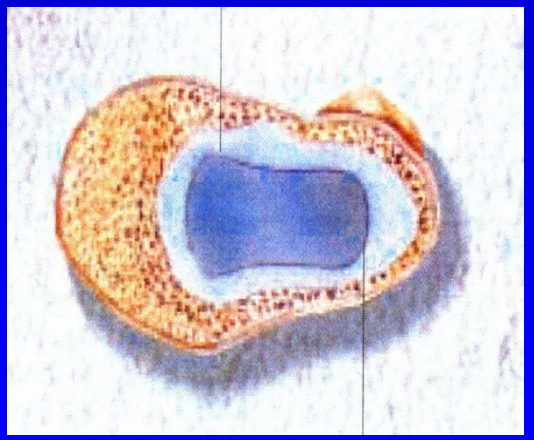
## Thompson


# Metal

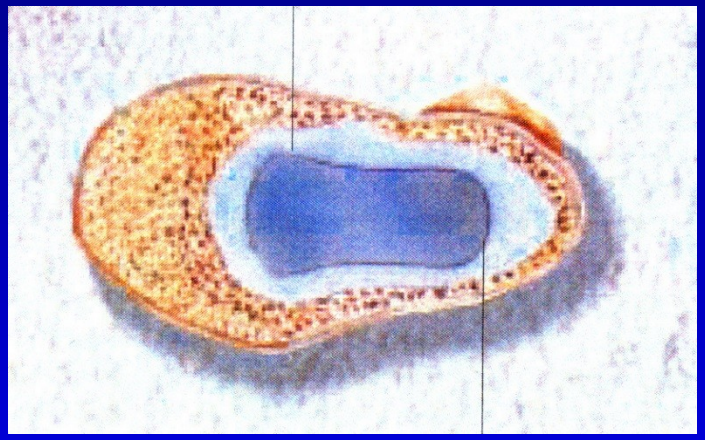
- Steel
- Cobalt - chromium-molybdenum alloys
- Titanium alloys

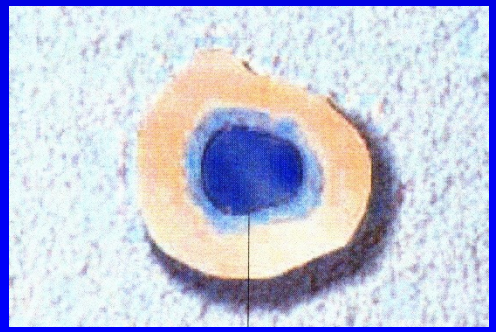
# Bone cement

- Polymethyl methacrylate (metylesther metacrylic acid)
- Powder polymer, liquid monomer
- Exotermic response
- Stabilisation of the implant in 10 minutes
- Cytotoxic effect
- Protein coagulation (termical + chemical)
- Microembolisation



# Cemented THA

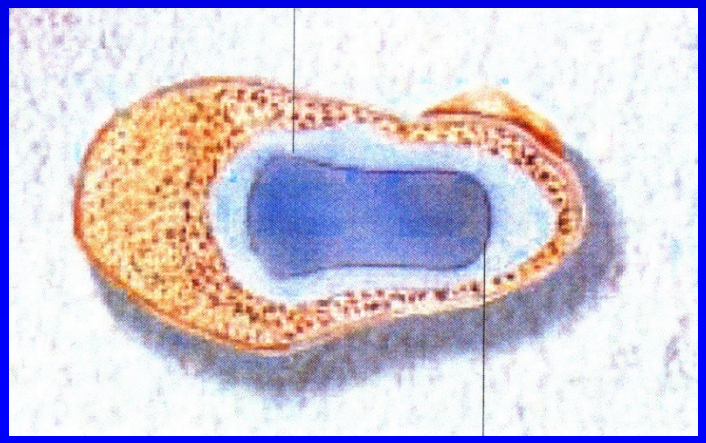


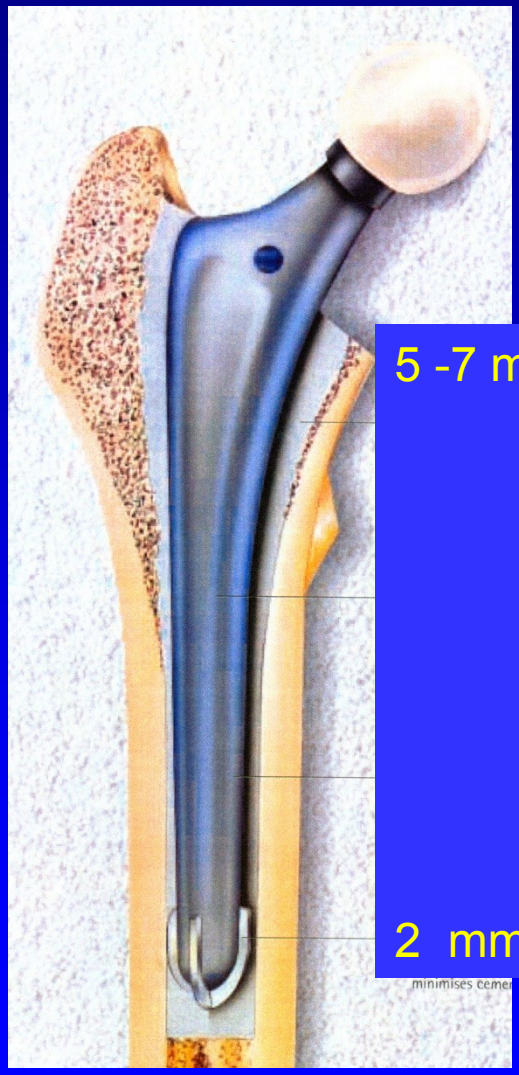


# Cementing technique

- Interdigitation into bone trabeculae

- Regular layer:
  under the cup 3 mm
  around the stem 2- 7 mm





# Polyethylen

- UHMWPE :

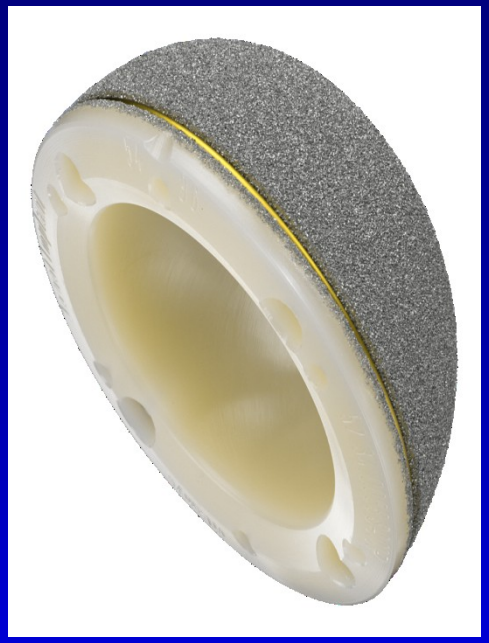
  ultra- high- molecular- weight- polyethylen

# PE

- Polyethylen
  - Longest used material for cup
  - Viscoelastic
  - Plastic deformation (cold flow)
  - Higer wear rate
  - Oxidative degradation

# PE

- Polyethylen
  - UHLMWH - Ultra high molecular weight polyethylen
  - HXLPE – cross - linked
  - PE + vit E
  - Aim:
    - Wear reduction
    - Oxidative degradation reduction
    - Keeping elasticity modulus

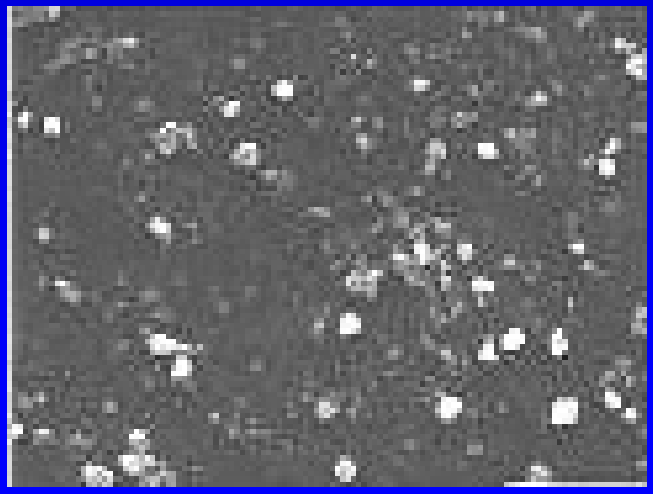


# Polyethylen

- Linear wear  0,1 - 0,2 mm / year
- Volumetric wear 0,3 - 10 mg / year

- Cold flow – plastic deformation
- Abrasion and delamination
- Oxidative degradation

- Modern trends:
  highly crosslinked polyethylen
- with vitamin E



PE wear particles, 1 um

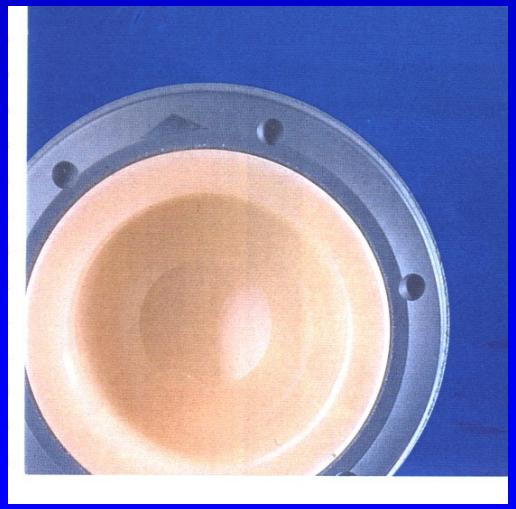
# XPE- highly-cross-linked polyethylen + vitamin E

Antioxidant

Increases mechanical properties of PE

# Ceramic

- Corundum or Zirconium $AL_2O_3$
- Smooth surface
- Less wear: 0,005 - 0,15 mm / year

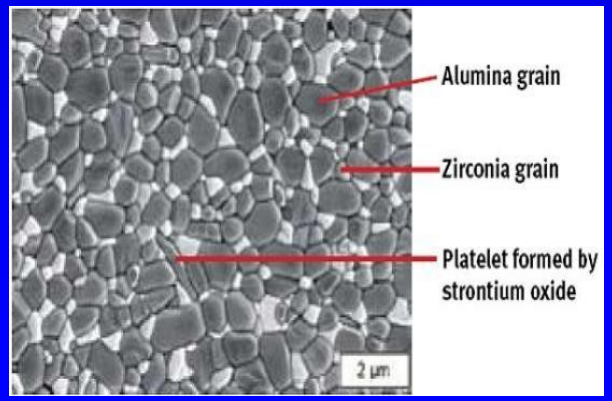


# Materials – ceramic

- Pure aluminium oxide - $AL_2O_3$ - corundum
- $ZrO_2$ – zirkonium oxide
- Extremely smooth surface, minimal friction ratio
- An order of r
  rate comapa
- Fragile
- Expensive

# Materials – ceramic

- Biolox forte
  - Pure $AL_2O_3$ (yellow)
- Biolox delta
  - Stronger
  - Lower grain size – even more s
  - More homogenic
  - Pink
  - $AL_2O_3$
  - $ZrO_2$
  - Zirconium oxides stabilized by

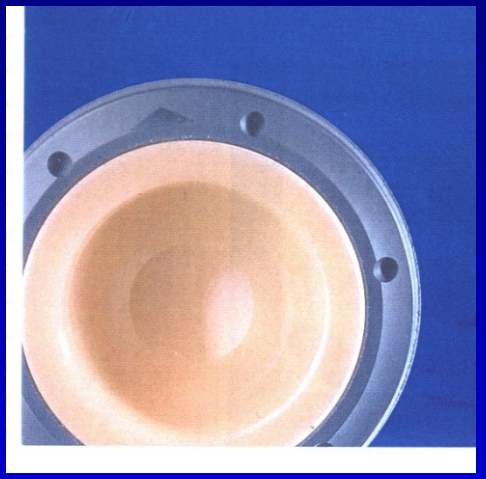


# Materials – Oxinium

- Zirconium oxides
- Combines properties of alloy and ceramic
- 2x harder than ceramic
- Abrasion and scratch resistant
- Fracture resistance
- Trace amount of Ni only (hypoallergenic)
- 20% lighter than CoCr

# Contact : head - cup

- Metal- polyethylen
- Ceramic- polyethylen
- Ceramic -ceramic

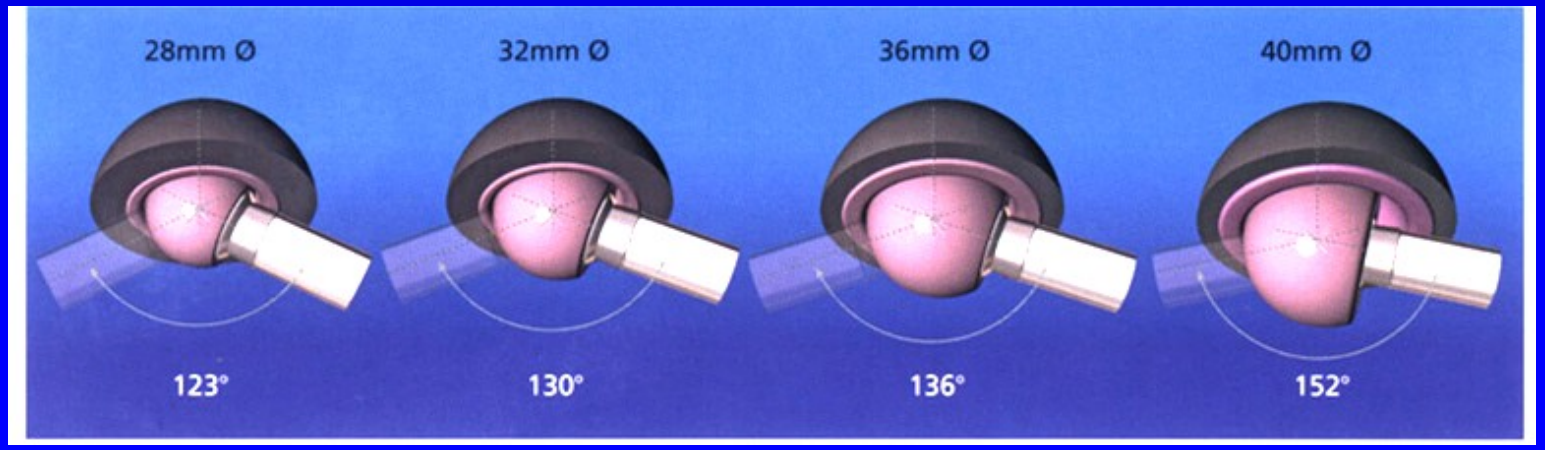


# Diameter of the head

22, 28, 32, 36, 38, 40 mm

Advantage of 36 mm head:

Higher stability
Greater range of motion
Less impingement neck- edge of the cup



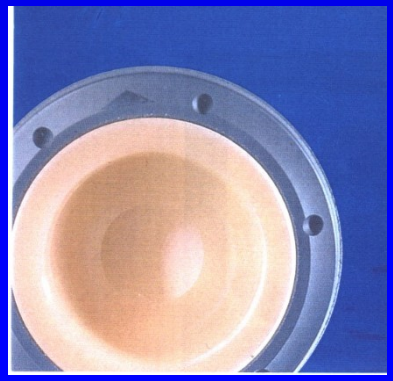
# Acetabular component

- Cemented: polyethylen

- Noncemented: metal- backed

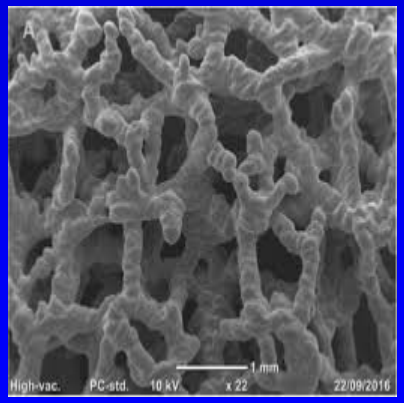
  with PE insert

  with ceramic insert



# Materials

- Cementless implants requirements – bone adjacent surface
  - Trabecular titan
  - Trabecular tantal
  - Hydroxyapatite surface




# Hydroxyapatite surface

Bioactive

Osteoconductive

Chemical bonds bone- hydroxyapatite

# Surface of cementless implant

Macroporosity

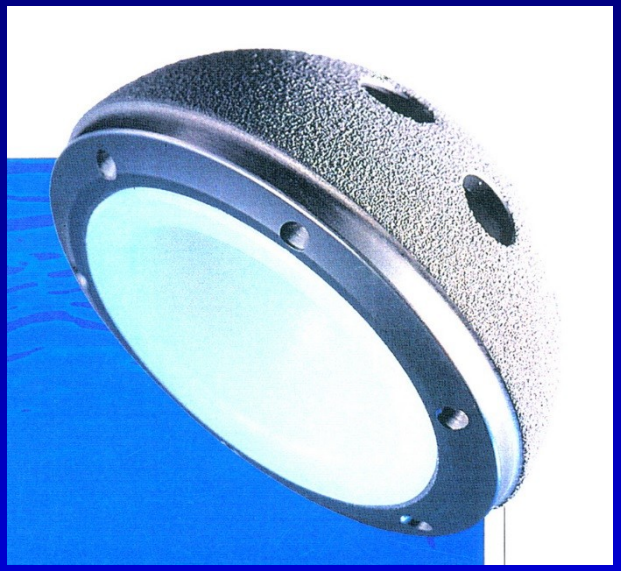
Microporosity

Pores on the surface 50μm - 600 μm

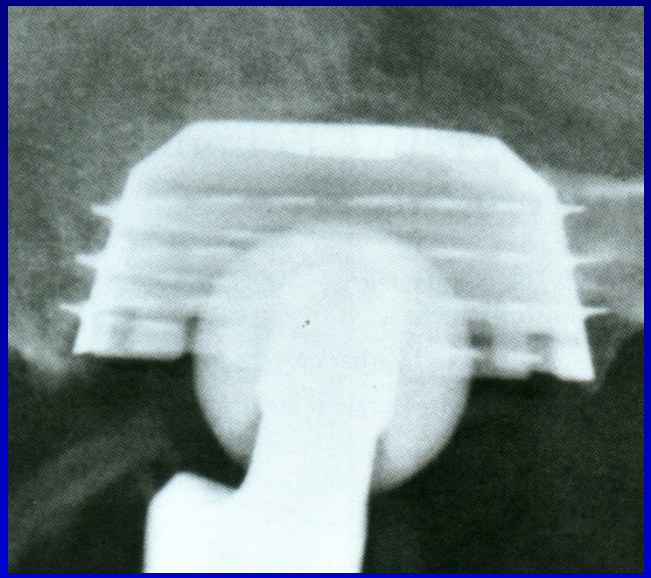
Pores above 800 μm- fibrous tissue

Adhesive surfaces:
Trabecular Metal
Trabecular Titan
Pores 300 μm
High initial stabiity

# Uncemented cup



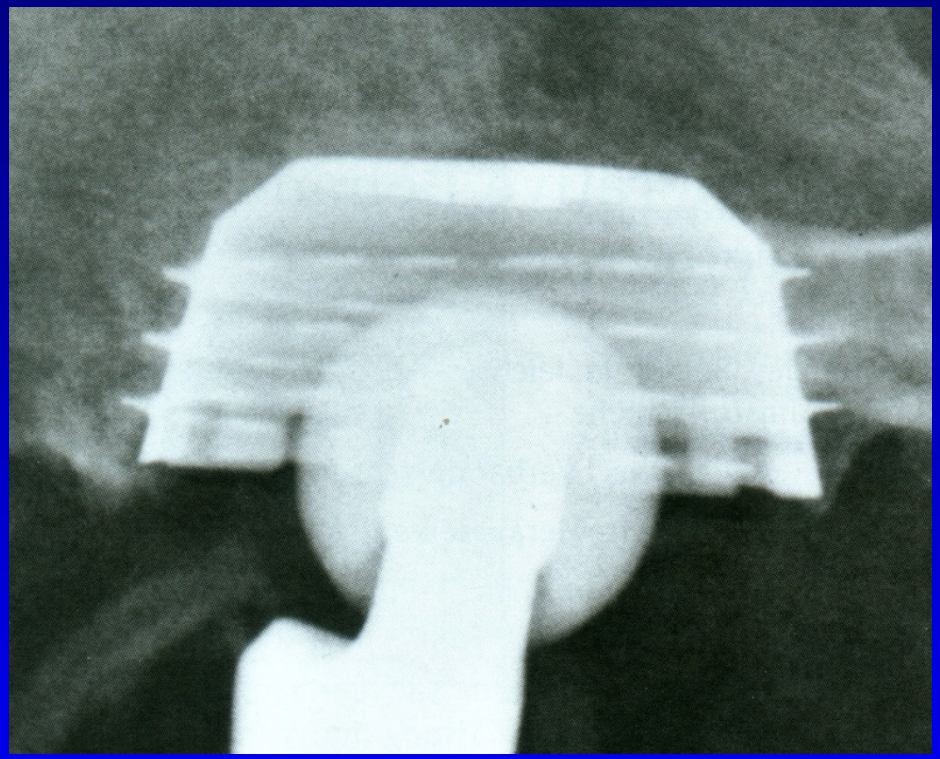
Press - fit



Threaded

Primary fixation:  mechanical anchorage in the bone

# Uncemented cup

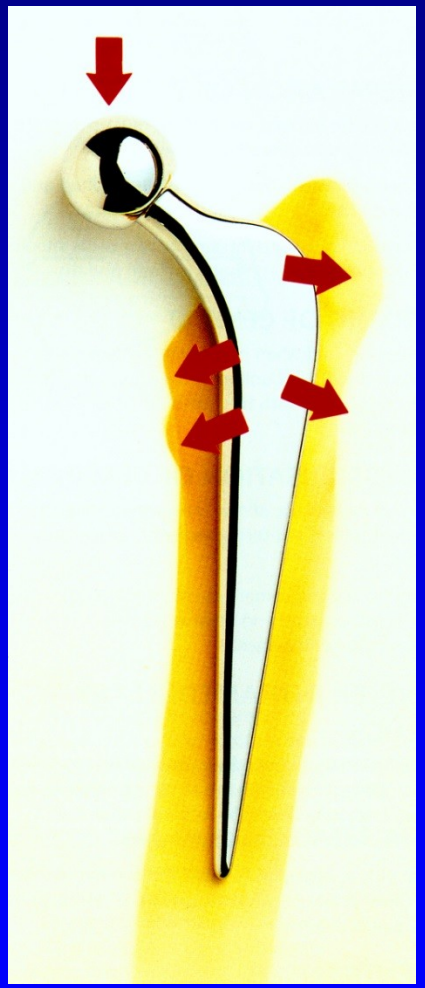


Secondary fixation: osteointegration of the implant on the surface of bone

# Bicon – Zweyműller cup

# Femoral component

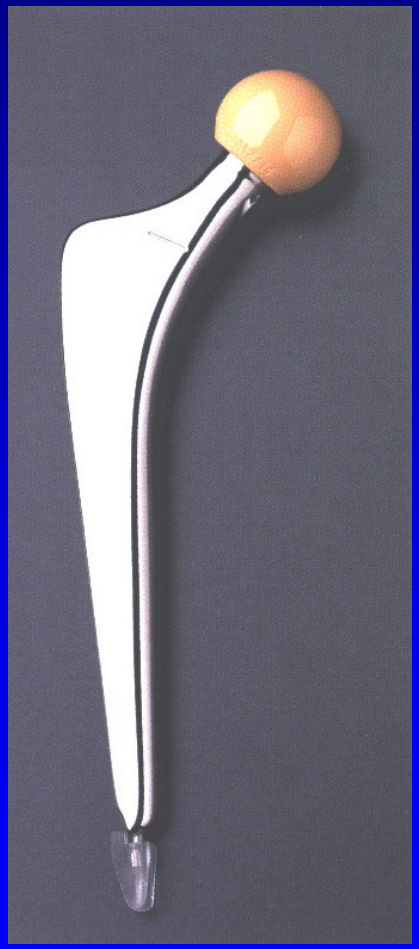
- High polished surface
  for cementing fixation
- Porous surface
  for cementless fixation



Cemented

Cementless

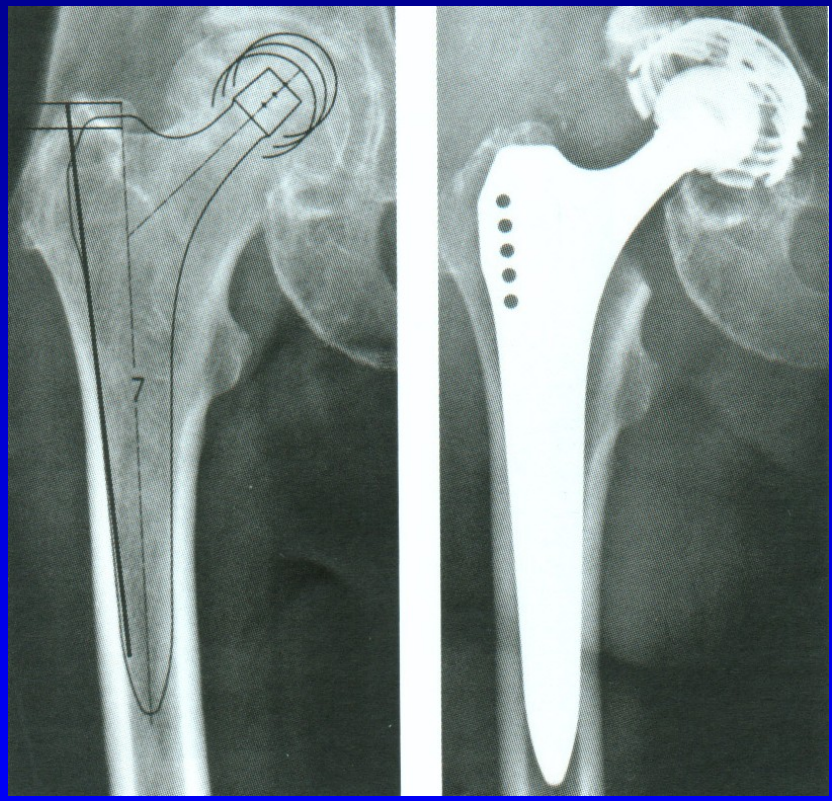
# **M**orscher, **S**potorno MS – 30 stem cemented



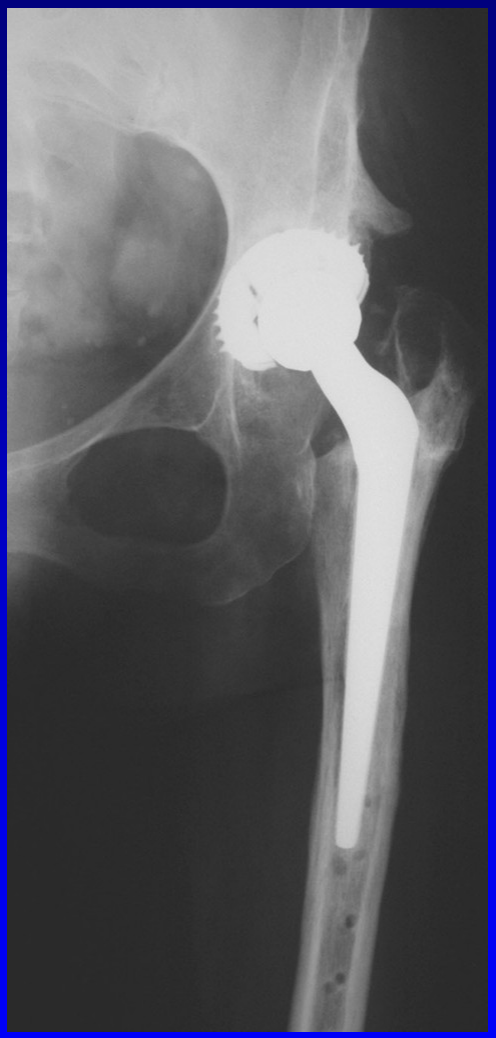
# Uncemented stem

- Primary fixation:
- Mechanical anchorage
  in the bone

- Secondary fixation of the implant on the bone surface



# Uncemented stems



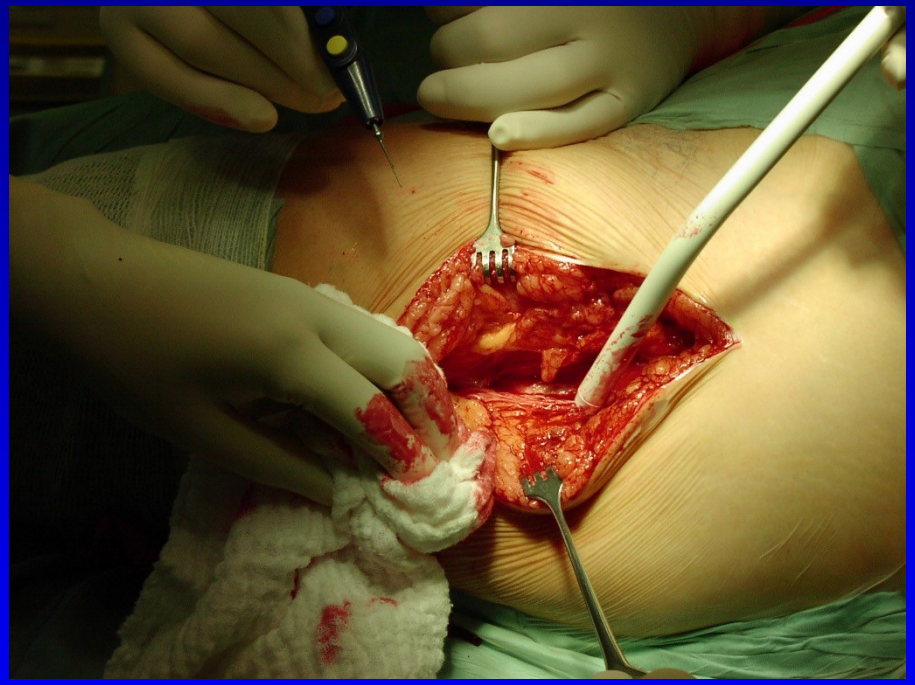
Proximal fixed

Distal fixed

# Indication scheme

- Uncemented to 60 y.
- Hybrid 61 - 70 y.
- Cemented over 70 y.

# Approaches



# MIS- mini invasive surgery

# Physiotherapy

Day:
1. Sitting, drainage ex
2. - 5. walking
6. + stairs

7-21 – in physiotherapy dpt.

3 months- spa resort

Full weight bearing. Cemented THA after one month
Uncemented after 12 weeks

Fast track physiotherapy, discharge 3-4 days, home care

# Post op.  management

- ITU - one day
- Hospitalisation at orthopedic ward for 5 days
- Verticalisation the first post op. day
- Complex rehabilitation protocol, rehabitalitation nurse obligatory
- 6. day – transfer to rehabilitation ward
- Spa  resort in CZ covered by public health insurance in 3 post op. months
- DVT prevention – 6 weeks
- Prevention of dislocation of THR- no adduction, no deep flection, no axial extremity traction!
- Modern trends: Shortening of inpatients period (risc of nosocomial infection, economic aspects)
- Fast track physiotherapy
- Outpatient surgery?

# Follow up

- Standardized
- First check up:  by orthopedical surgeon in 6 weeks (X ray included)
- Second check up: in 3 months, then 6 month
- Every 2 years (X ray included) if no problem present
- EDUCATION
  - Activity, limitation and régime with THR
  - PJI prevention
  - Urgent check – up if suspected PJI

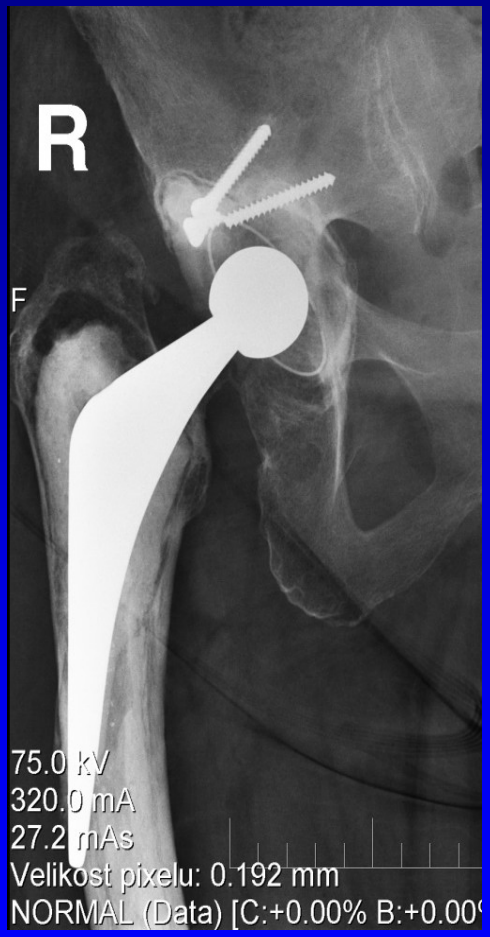
# Complications

- Peri and early post op. morbidity and mortality
  - Nervous and vascular injury
  - Blood loss
  - Perioperative fracture
  - Hip displacement (luxation)
  - Pulmonary embolism
  - IM
  - General decompensation
  - Development of delirium

# Complications

- THR dislocation
  - Shortening and (extra)rotation of extremity, pain, no active hip flexion
  - No active walking and no weight - bearing
  - Therapy:
    - Close hip redduction attempt. Hip orthesis with reduced ROM obligatory
    - Revision, identification of cause,  solution
    - Longer head, stabilisation elements
    - Replantation

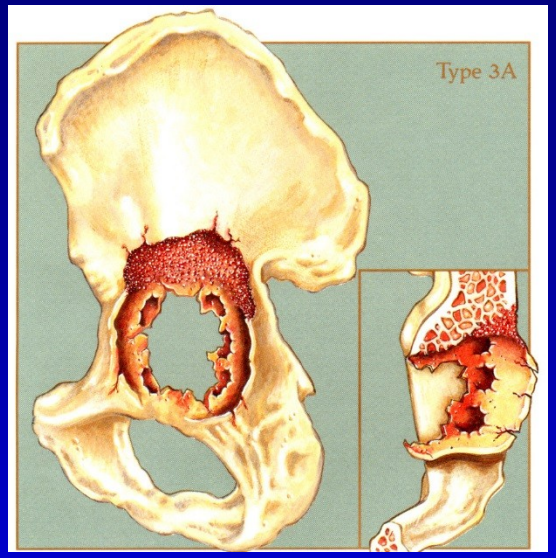
# Aseptic loosening - therapy

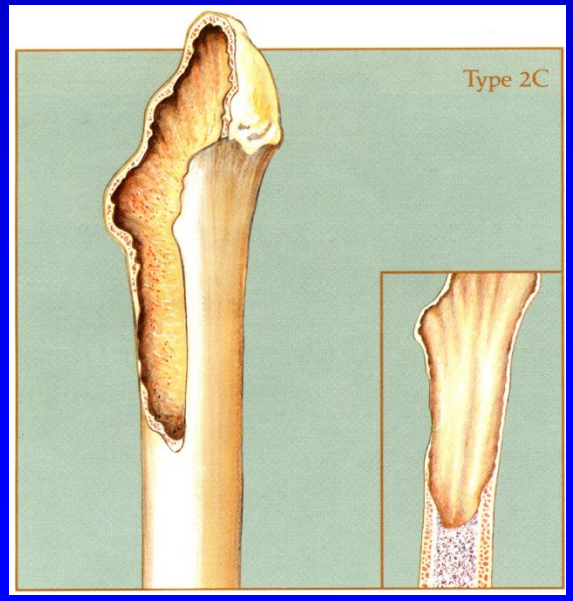


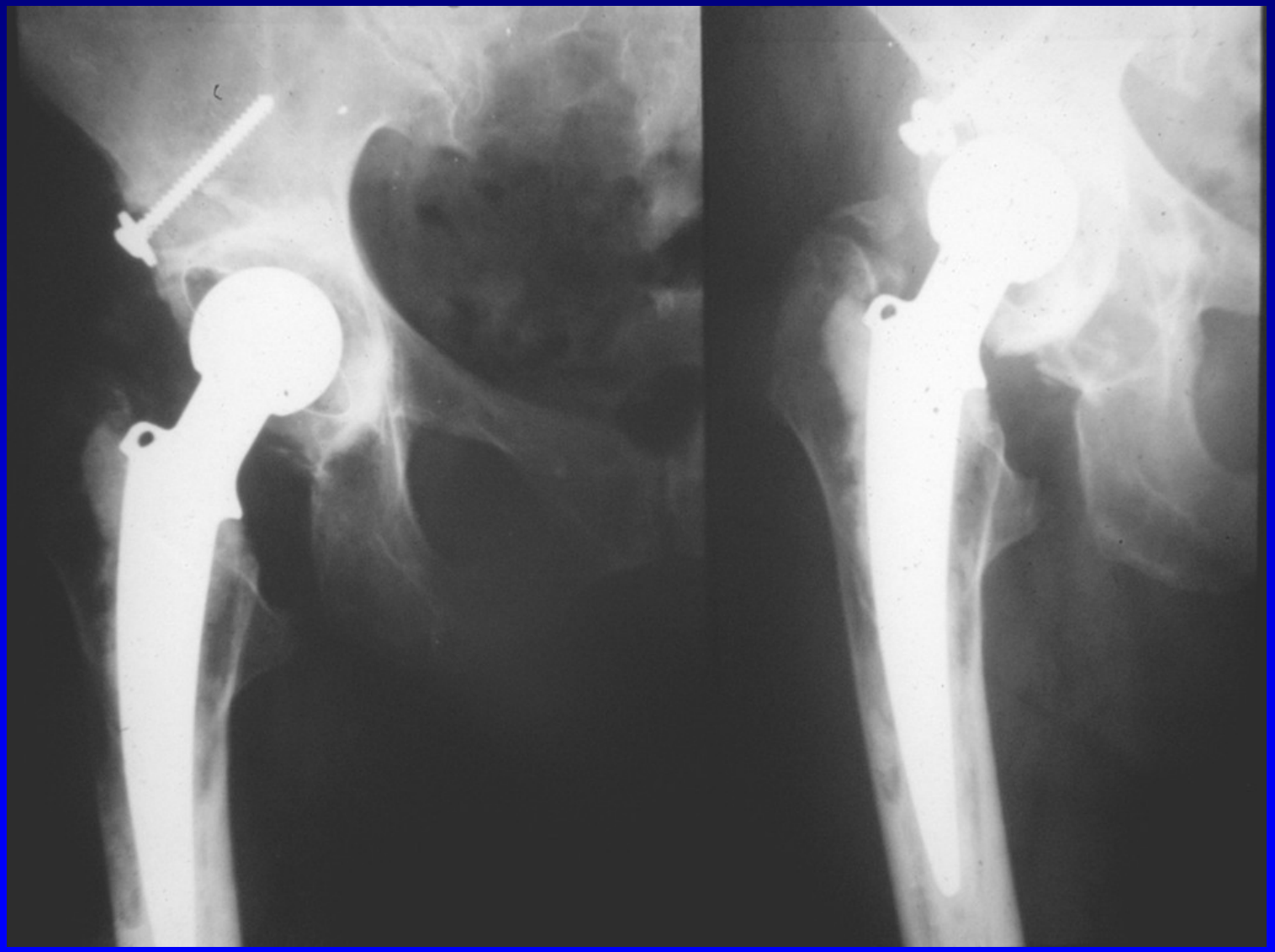

# Aseptic loosening - therapy

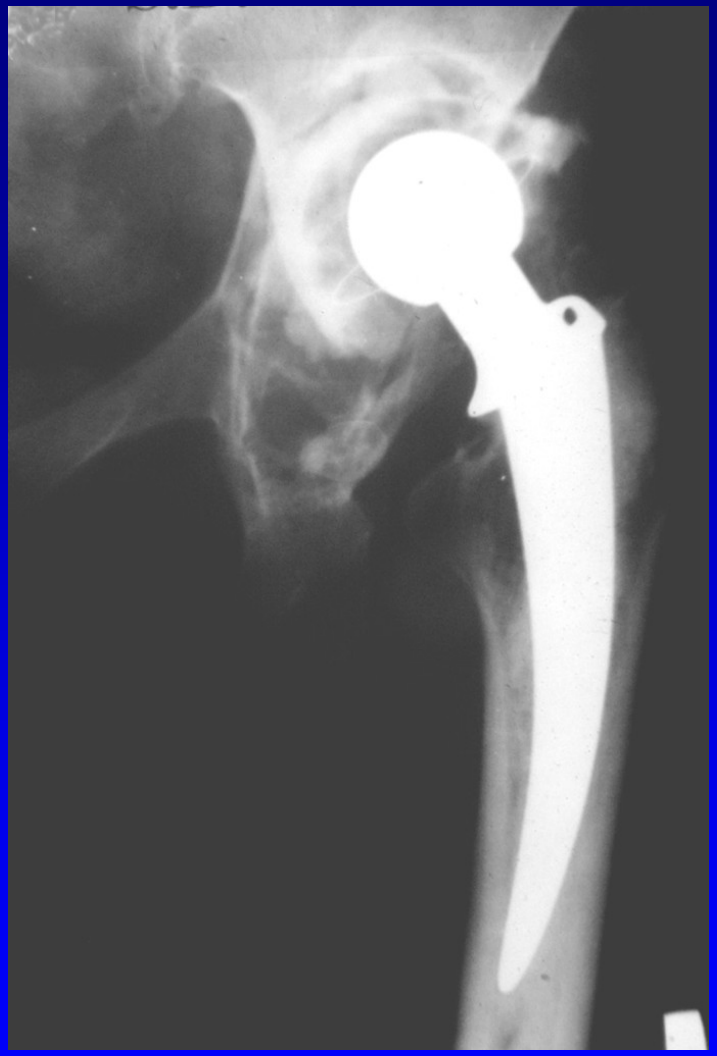
- Revision, replantation
- Revision systems, augments, spongioplasty (alografts)…
- Double ATB combination – higer infection risk
- Higher complication rate
- Inferior outcome
- Lower ROM
- Longer no full weight bearing period (3M)
- Higher mortality
- Higher displacement risk ratio

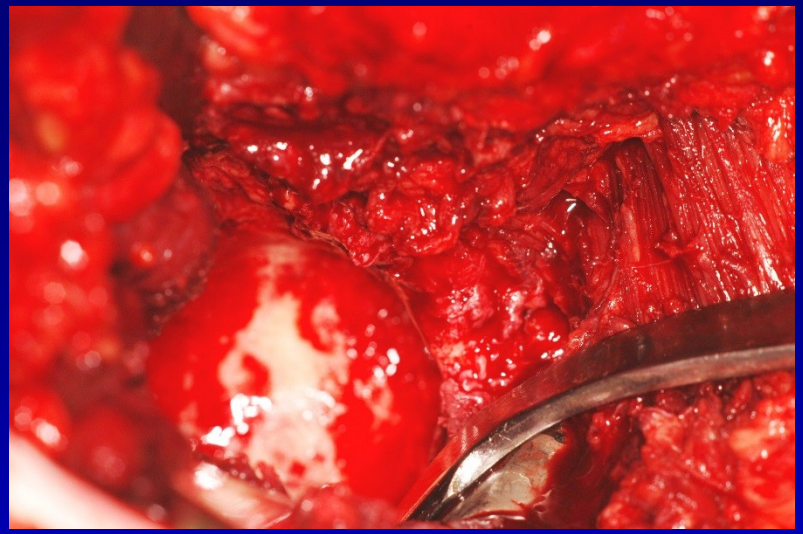
# Revision THA

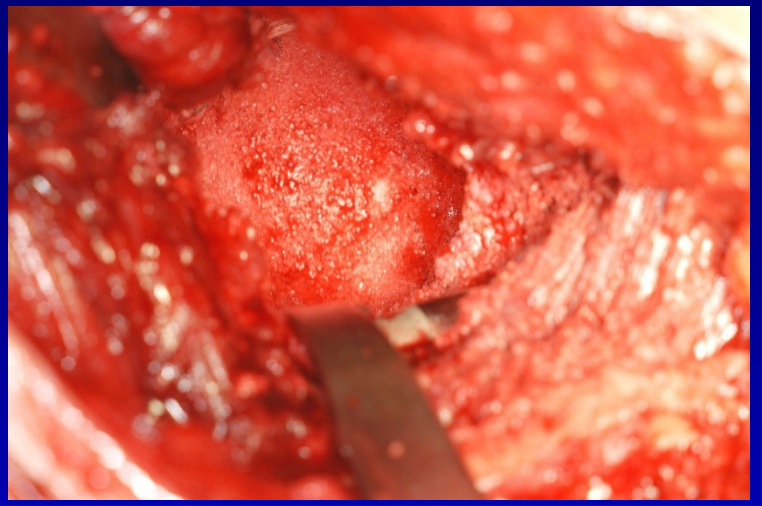


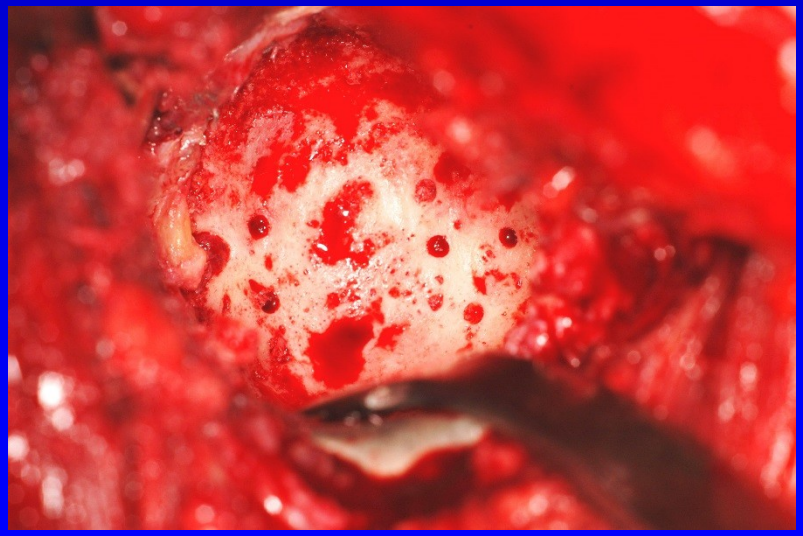


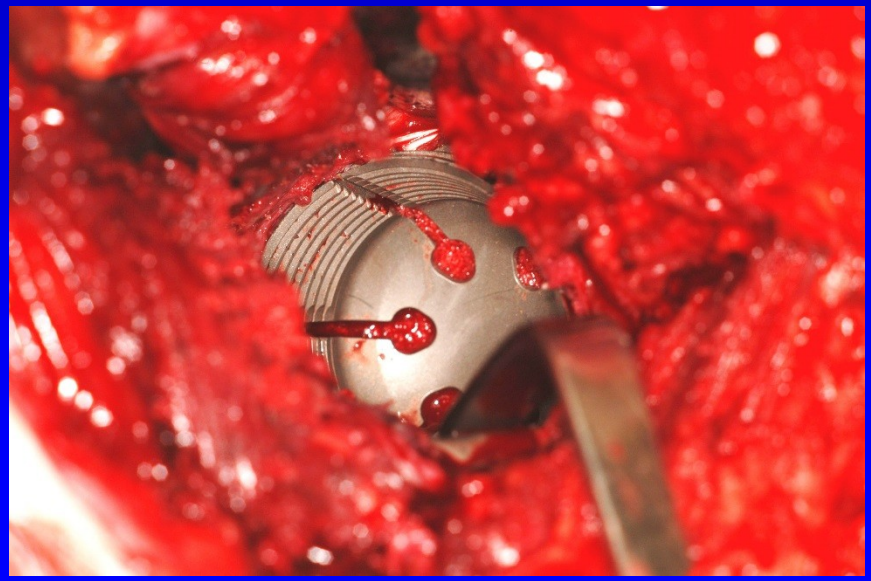




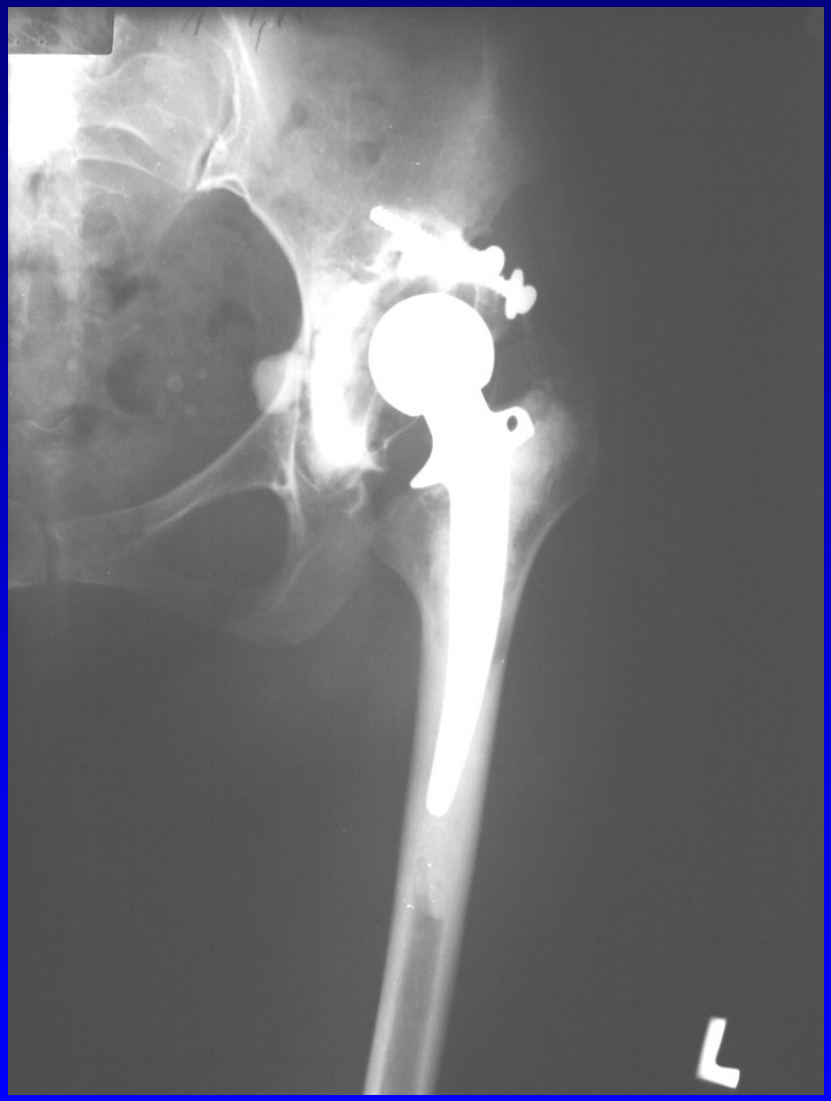


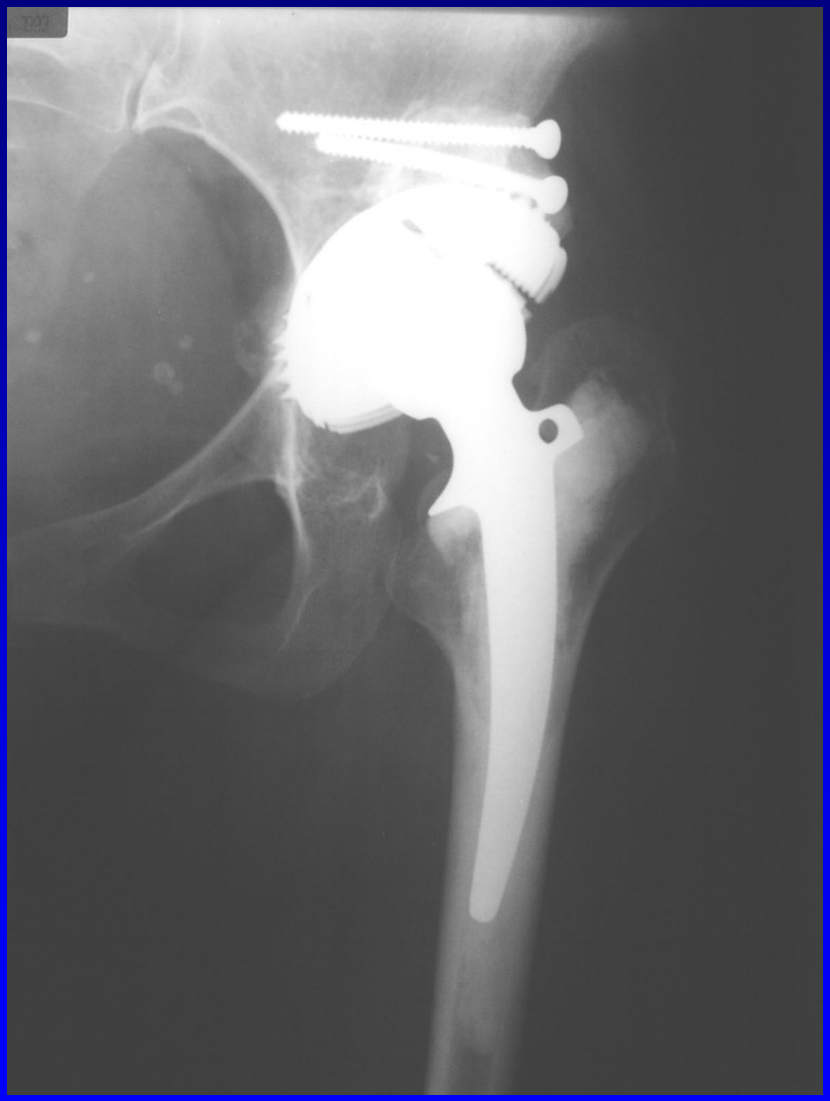
# Revision of the acetabulum

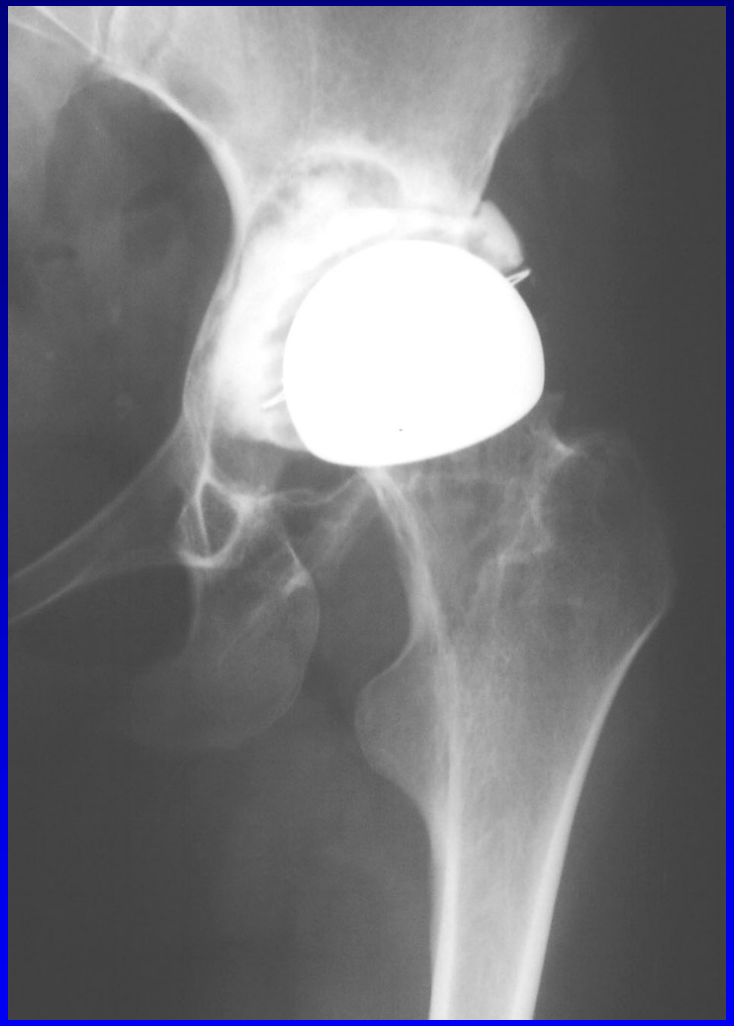




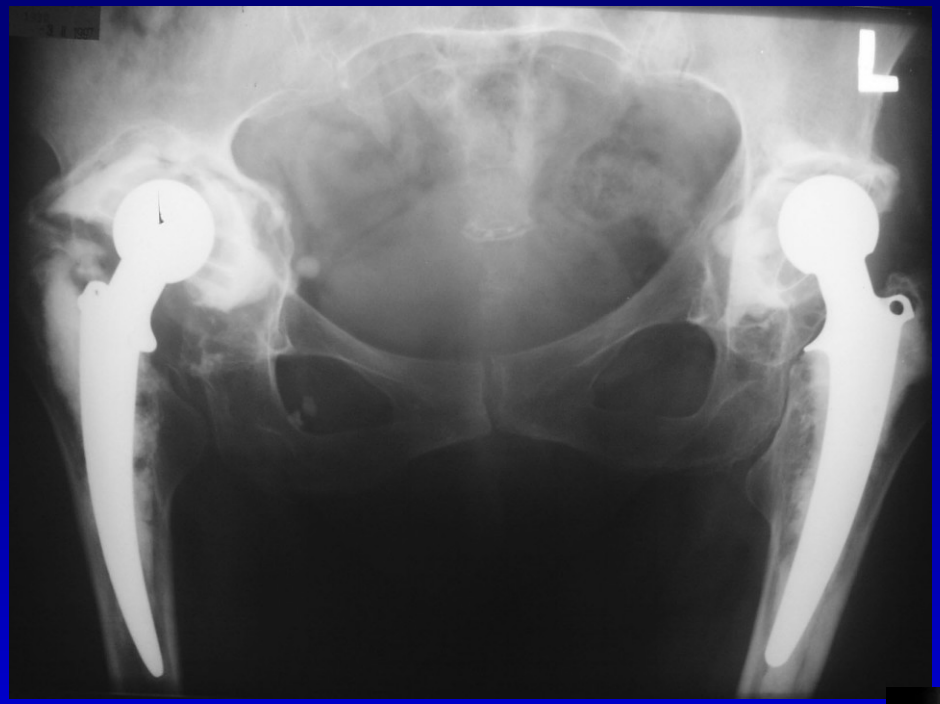
# Revision THA






2006/
08:19


L


L

# Periprosthetic fracture

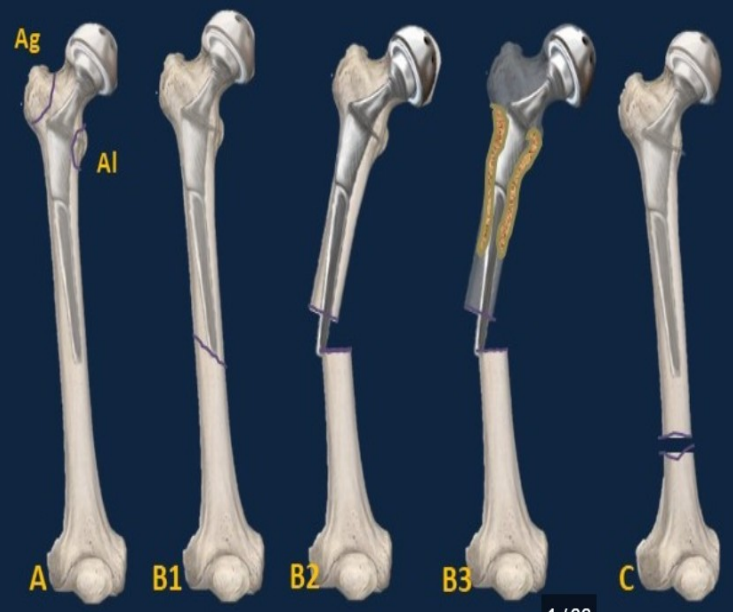
- Relatively frequent complication
- Femur in the most cases, acetabulum rarely
- Older patients, worse general condition
- Osteoporosis, poor implant retention
- High mortality and morbidity rate
- High compliction rate
- Demanding surgeries (experienced surgeon)

# Periprosthetic femoral fracture - classification

## *Vancouver classification of hip periprosthetic fractures*

**Vancouver classification** relies on:

1. The level of the fracture
2. If the prosthesis is stable or not
3. the quality of the bone




| Hip periprosthetic fractures | |
|---|---|
| **Type A** | Peritrochanteric fractures |
| | **AG:** greater trochanter |
| | **AL:** lesser trochanter |
| **Type B** | Around or just below the tip of the femoral stem |
| | **B1:** stable stem |
| | **B2:** loose stem |
| | **B3:** loose implant with substantial bone loss |
| **Type C** | fractures occur well below the implant |

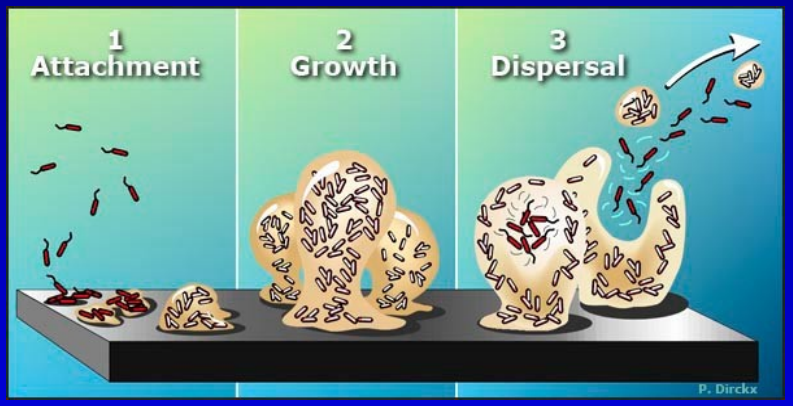
# Periprosthetic femoral fracture - therapy

# Periprosthetic femoral fracture - therapy

- OS (LCP, control cable )

# Periprosthetic infection

St. aureus
St. coagulase negative
Streptococci
Enterococci, others
MRSA, MRSE
Polyresistant G- bacteria




Sessile form and planctonic
Race for surface
They produce glycocalyx- mucose substance of glycoproteins
It leads to high resistence to antibodies and antibiotics

Biofilm

# Biofilm


Adhesion of bacteria
- reversible

Exopolymers
- glycolalyx
- extracelular matrix
irreversible

Releas to surrounding tissue

# Periprostetic infection- diagnostics

Clinicly
Labor: CRP, leu, ESR
aspiration of pus
X-ray- osteolysis, loosening
USG (abscesus)
Scintigraphy
Sonication of the implant
Bacteriological examination
Long cultivation

# Periprostetic infection- PPI

Acute PPI

Chronic PPI

Late haematogenic PPI

# Management

To start treatment as soon as possible:
10-14 days  from the onset of symptoms

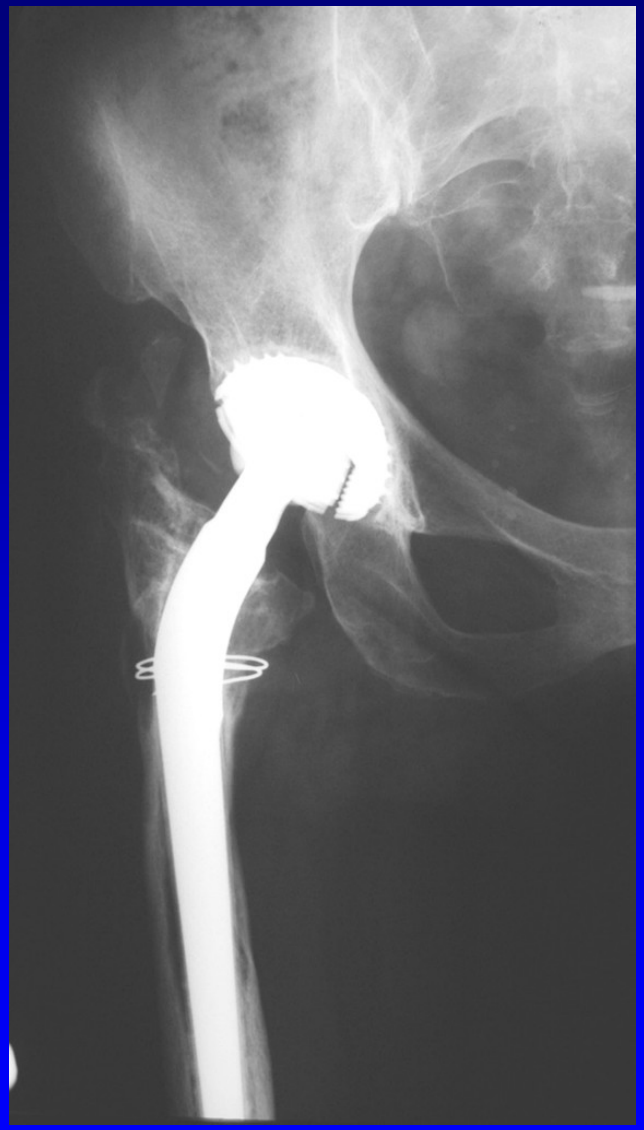
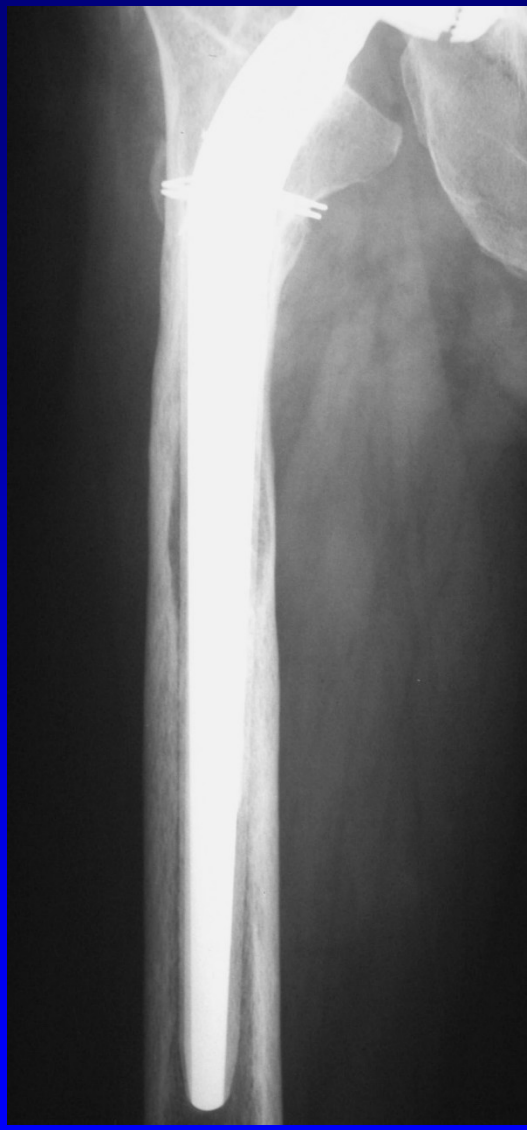
Prerequisity: cooperation of the patient

informed physician

# Periprosthetic infection-treatment

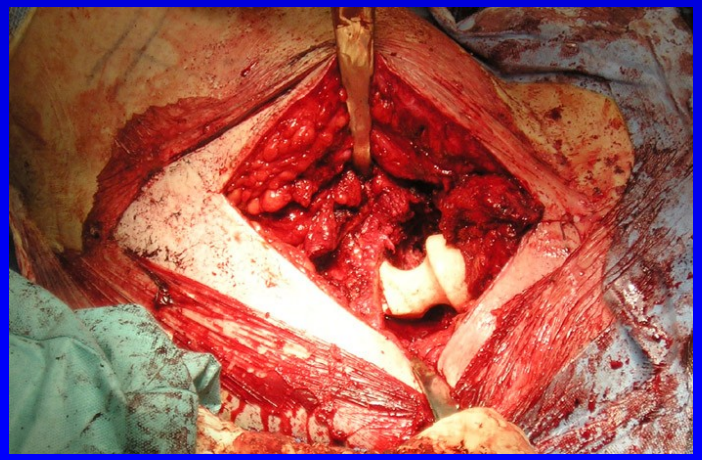
Debridement
One stage surgery
Two stage surgery
Resection artroplasty
Antibiotic suppresion



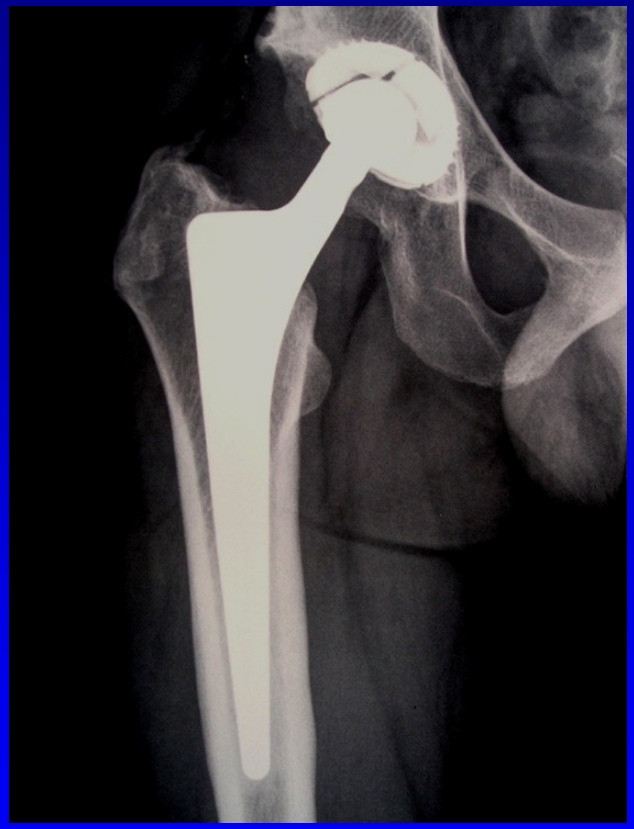
# Hip spacers

Two stage surgery
Better ROM
Better walking
Revision is easier
Local concentration of antibiotics
- Gentamycin a Vancomycin
- Cover 90 % of all pathogens



# Prerequisity for good result

Choise of the patient
Preop. examination
Prevention of infection
Choise of the implant
Operative technique
Postop. management
Activity of the patient
Regular follow- up
Prevetion of infection
Prevention of aseptic loosening
Long term results
National registries



# Daily activity after THA

No lifting and wearing of heavy objects
No strenuous manual labor
Limited running and jumping
No contact sports

Recommeded sports:
swimming, bicycle, tennis
tourism, skiing?