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Management of Surgical Site Infection

Workshop on Prevention of Surgical Site Infection, AADO
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CDC Definition of SSI



Superficial Incisional SSI

- Infection occurs within 30 days after the operation *and* infection involves only skin or subcutaneous tissue of the incision *and* at least *one* of the following:
 1. Purulent drainage, with or without laboratory confirmation, from the superficial incision
 2. Organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision
 3. At least one of the following signs or symptoms of infection: pain or tenderness, localized swelling, redness, or heat *and* superficial incision is deliberately opened by surgeon, *unless* incision is culture-negative
 4. Diagnosis of superficial incisional SSI by the surgeon or attending physician
- Do *not* report the following conditions as SSI:
 1. Stitch abscess (minimal inflammation and discharge confined to the points of suture penetration).
 2. Infection of an episiotomy or newborn circumcision site.
 3. Infected burn wound.
 4. Incisional SSI that extends into the fascial and muscle layers (see deep incisional SSI)



Deep Incisional SSI

- Infection occurs within 30 days after the operation if no implant is left in place or within 1 year if implant is in place and the infection appears to be related to the operation *and* infection involves deep soft tissues (e.g., fascial and muscle layers) of the incision *and* at least *one* of the following:
 1. Purulent drainage from the deep incision but not from the organ/space component of the surgical site
 2. A deep incision spontaneously dehisces or is deliberately opened by a surgeon when the patient has at least one of the following signs or symptoms: fever ($>38^{\circ}\text{C}$), localized pain, or tenderness, unless site is culture-negative
 3. An abscess or other evidence of infection involving the deep incision is found on direct examination, during reoperation, or by histopathologic or radiologic examination
 4. Diagnosis of a deep incisional SSI by a surgeon or attending physician



Organ/space SSI

- Infection occurs within 30 days after the operation if no implant† is left in place or within 1 year if implant is in place and the infection appears to be related to the operation *and* infection involves any part of the anatomy (e.g., organs or spaces), other than the incision, which was opened or manipulated during an operation *and* at least *one* of the following:
 - 1. Purulent drainage from a drain that is placed through a stab wound‡ into the organ/space.
 - 2. Organisms isolated from an aseptically obtained culture of fluid or tissue in the organ/space.
 - 3. An abscess or other evidence of infection involving the organ/space that is found on direct examination, during reoperation, or by histopathologic or radiologic examination.
 - 4. Diagnosis of an organ/space SSI by a surgeon or attending physician



Microbiology of SSI

- *Staphylococcus aureus*
- Coagulase-negative staphylococci
- *Enterococcus* spp
- *Escherichia coli*
- Methicillin-resistant *Staph. aureus* (MRSA)
- *Candida albicans* (increasing numbers in severely ill & immunocompromised surgical patients and the impact of widespread use of broad-spectrum antimicrobial agents)



Source of pathogen

- Endogenous
 - flora of the patient's skin, mucous membranes, or hollow viscera
- Exogenous
 - Surgical personnel (especially members of the surgical team)
 - Operating room environment (including air)
 - All tools, instruments, and materials brought to the sterile field during an operation



Pathogenesis

- Microorganisms may contain or produce toxins and other substances that increase their ability to invade a host produce damage within the host, or survive on or in host tissue
- Many gram-negative bacteria produce endotoxin, which stimulates cytokine production & trigger the systemic inflammatory response syndrome that sometimes leads to multiple system organ failure
- Some bacterial surface components, notably polysaccharide capsules, inhibit phagocytosis
- Gram-positive bacteria such as coagulase negative staphylococci, produce glycocalyx and an associated component called “slime” which physically shields bacteria from phagocytes or inhibits the binding or penetration of antimicrobial agents



Risk factors of SSI

- Patient factor
 - coincident remote site infections or colonization
 - diabetes
 - cigarette smoking
 - systemic steroid usage
 - obesity (>20% ideal body weight)
 - Extremes of age
 - poor nutritional status
 - Perioperative transfusion of blood products



Risk factors of SSI

- Intra-op
 - Poor soft tissue handling technique
 - Prolong wound retraction
- Post-op
 - Too early wound exposure to surrounding environment (wound usually seal off at 48 hrs post-op)
 - Cross-infection (wash hand and use surgical glove while handling surgical wound)

Management of SSI





Superficial SSI

- Local
 - Wound dressing
 - Release wound tension (remove part or all stitches/staples)
- Systemic
 - IV antibiotics
- Patient factors
 - Patient nutrition
 - Albumin level
 - Lymphocyte count
 - Proper DM control



Surgical Management of deep incisional SSI



Problems of deep incisional SSI

- Lots of orthopaedic patients had implant in-situ
- Blood supply to bone and joint is much less than viscera
- Increase chance of infection when bacteraemia or septicaemia occur
- Joint prosthesis (septic arthritis) more prone to infection than long bone (osteomyelitis) because of poor blood supply
- Once infection occur, need prolong IV antibiotics (at least 6/52) + surgical drainage



Deep SSI in long bone (osteomyelitis)

- Acute osteomyelitis seldom occur, chronic osteomyelitis is the usual presentation especially after open fracture
- Open fracture more prone to infection (contamination in type III compound fracture)
- Deep SSI occur mostly because of disrupted blood supply to the fracture site
- Unstable fracture fixation prone to non-union



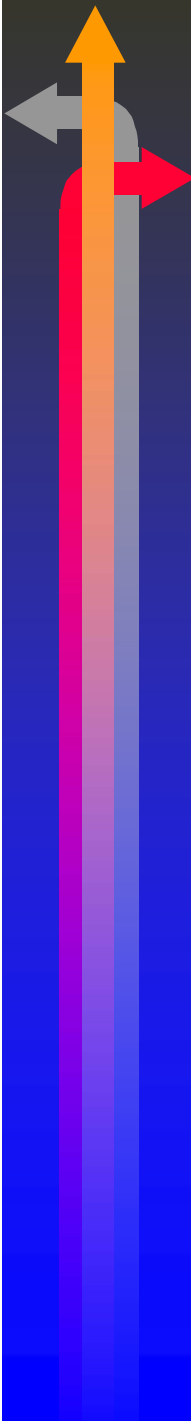
How to manage osteomyelitis?

- Bring in new blood supply
 - IM reaming stimulate new vessel ingrowth from periosteum to endo-osteum
 - Bone transport
 - Muscle flap coverage
- Rigid and stable fracture fixation

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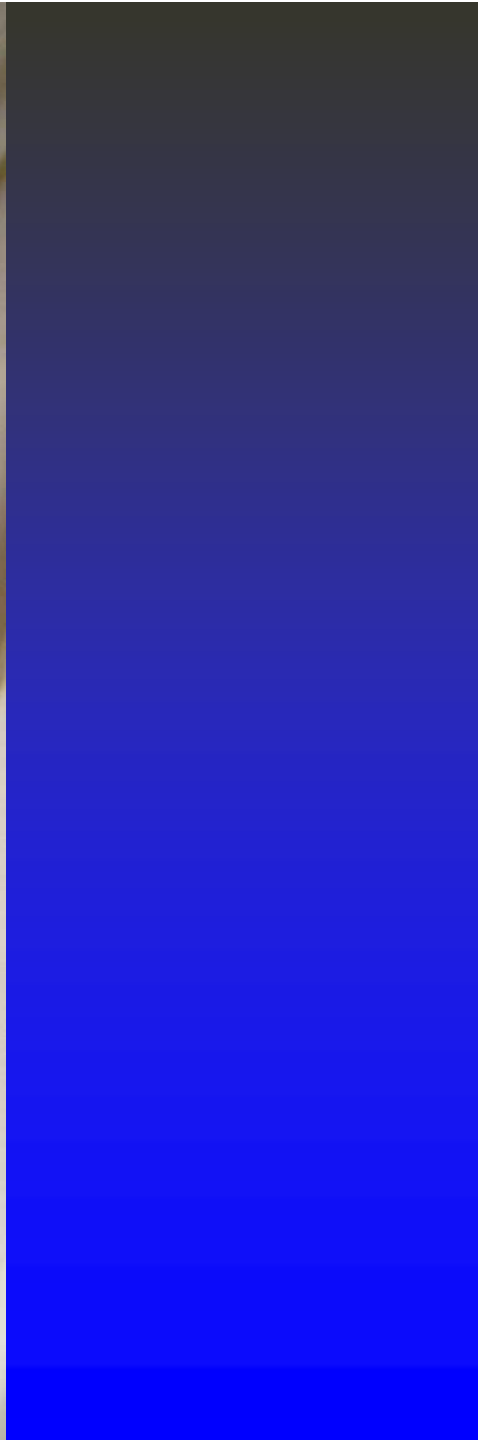
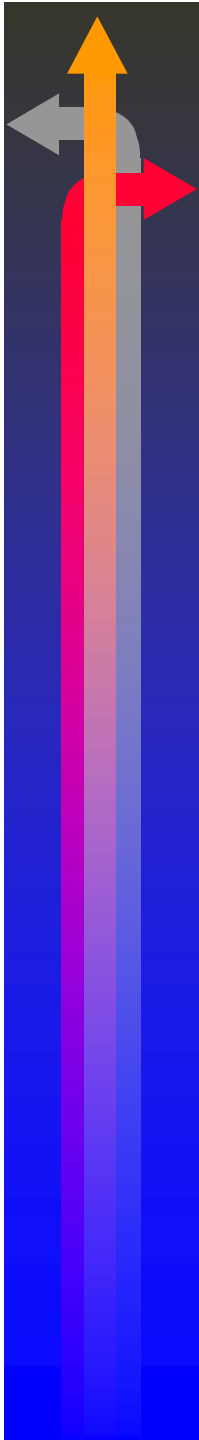
Deep SSI of joint (septic arthritis)

- Occur after prosthetic joint replacement
- Early infection (< 4 weeks after index operation), usually < 1%
- Late infection (> 4 weeks after index operation), 1-2%, more common
 - Usually occur ~ 1 year after the index operation

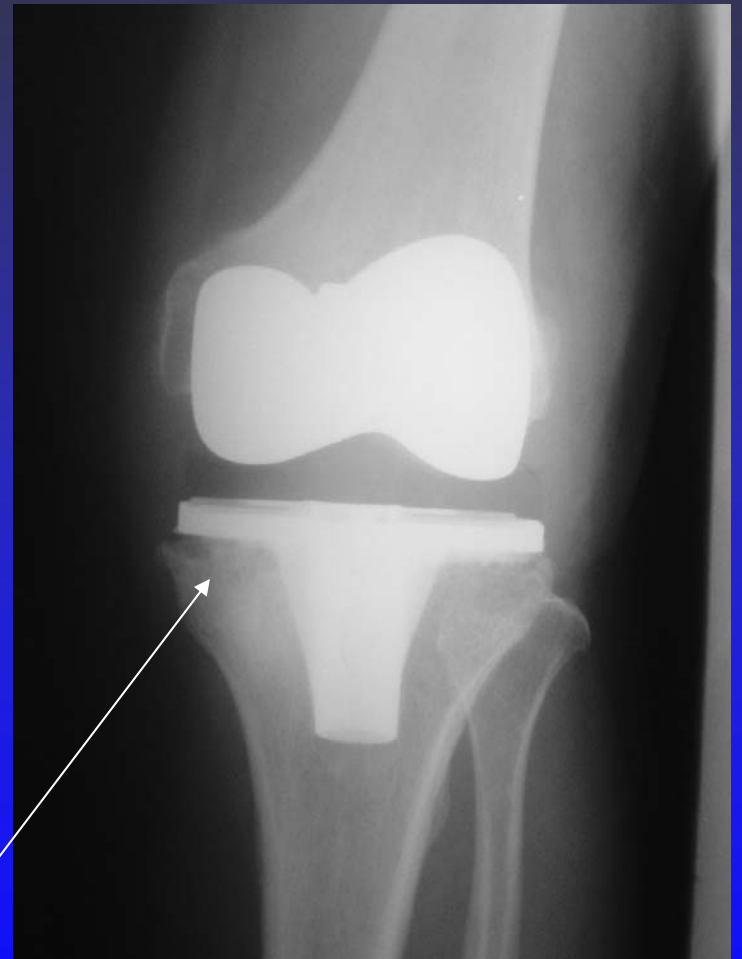
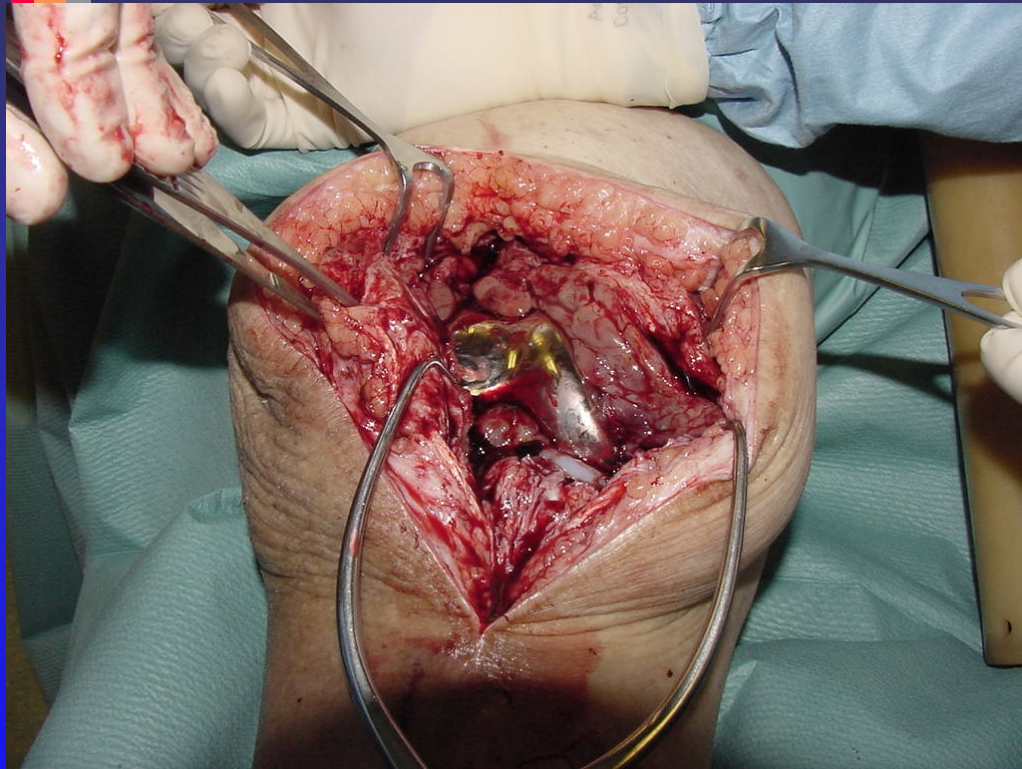
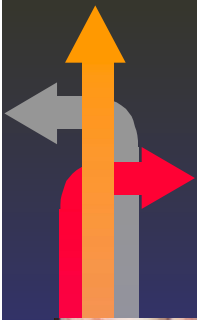


How to diagnose infected joint prosthesis?

- Clinical
 - Pain 100%
 - Fever 27%
 - Discharge 27-33%
- Blood test
 - WCC, ESR, CRP
- Radiological
 - Xray: Loosening, periosteal new bone formation
 - Combined bone scan and white cell scan







Osteolysis



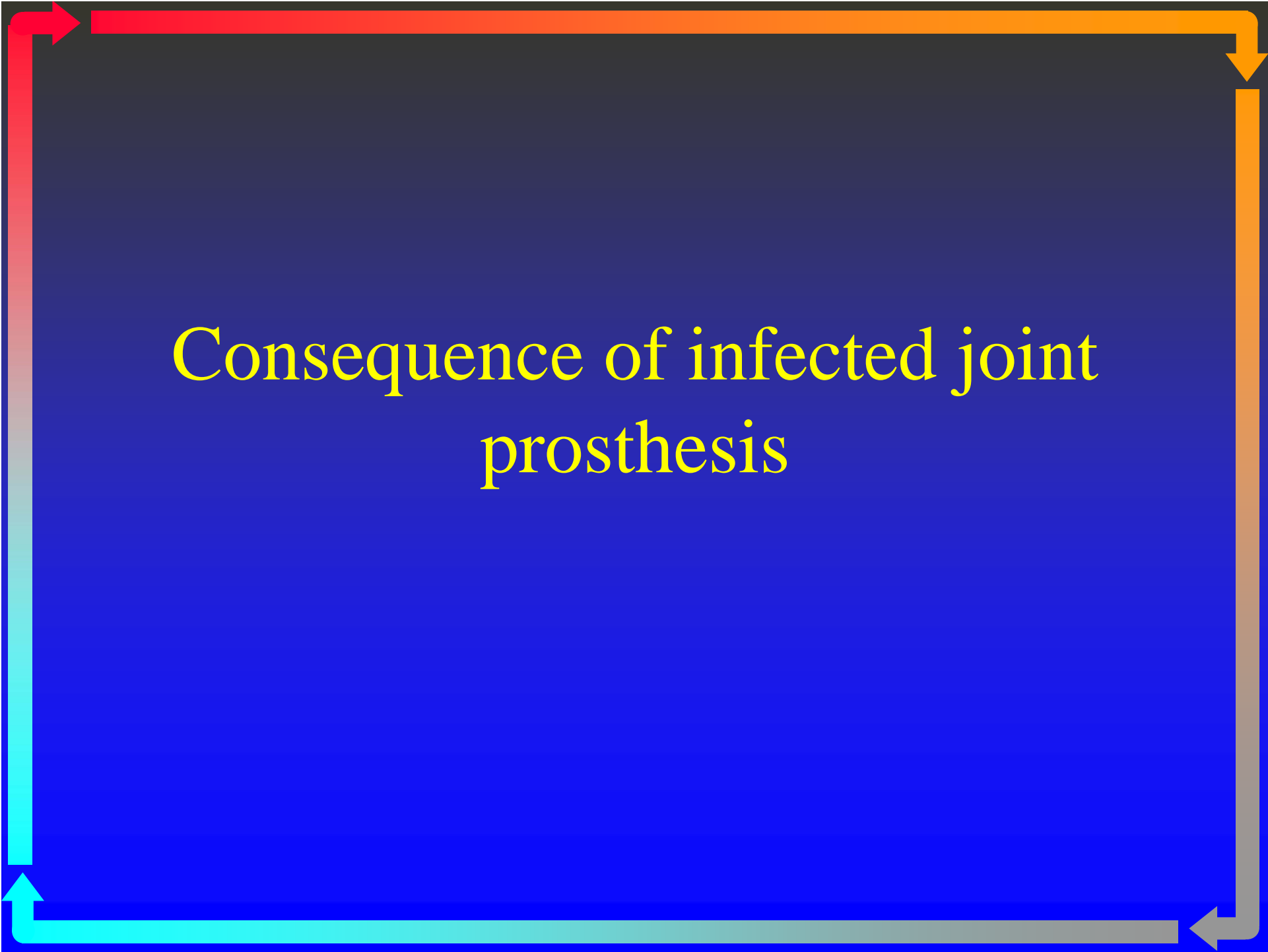
- **Joint Aspiration**

- Most specific (0.82 to 0.97)
- WBC >25,000, >75% polymorph
- Increased protein, decreases glucose, poor mucin clot formation
- If antibiotics started before aspiration, culture may be negative



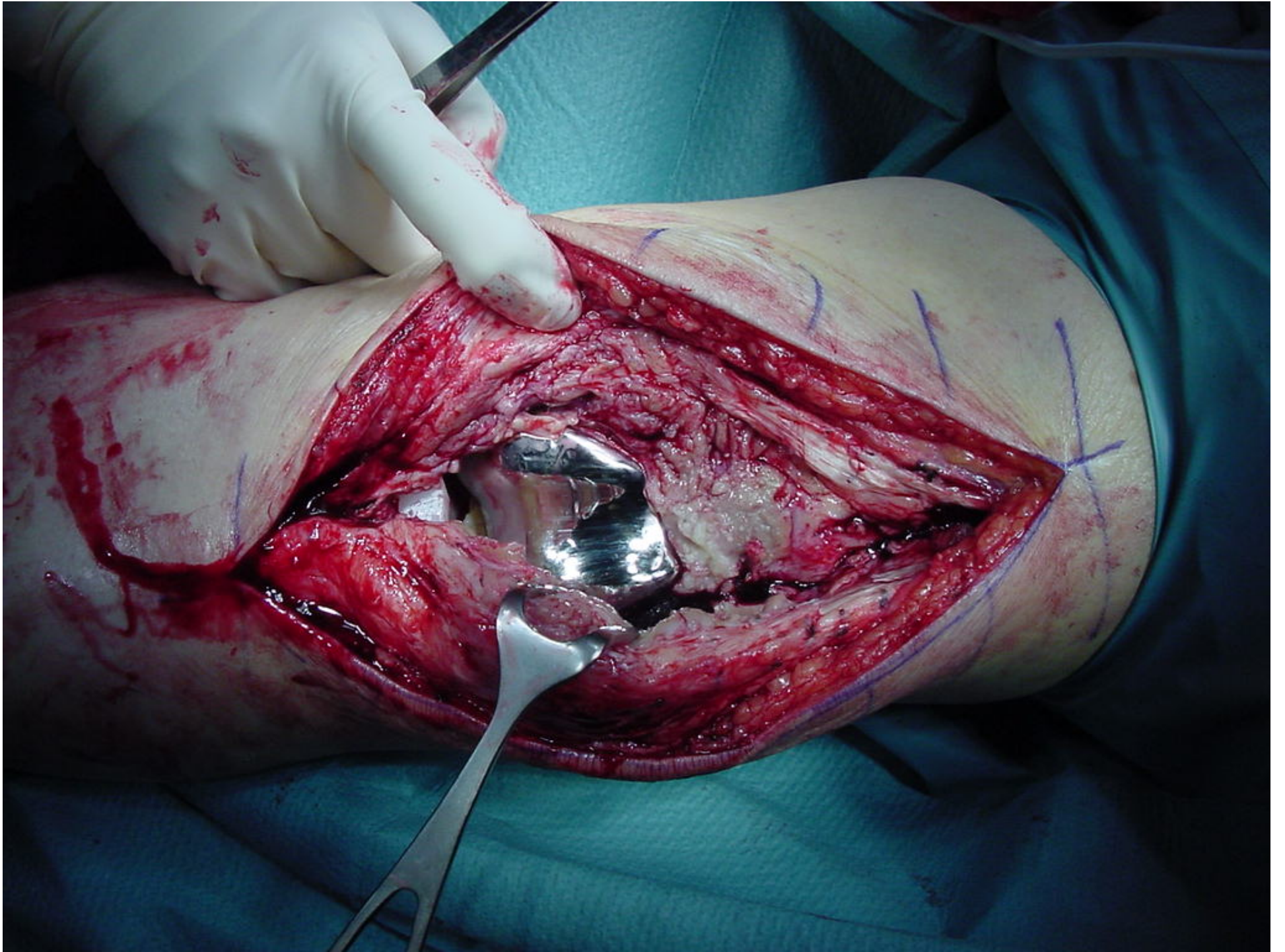
- **Intra-op Frozen Section**

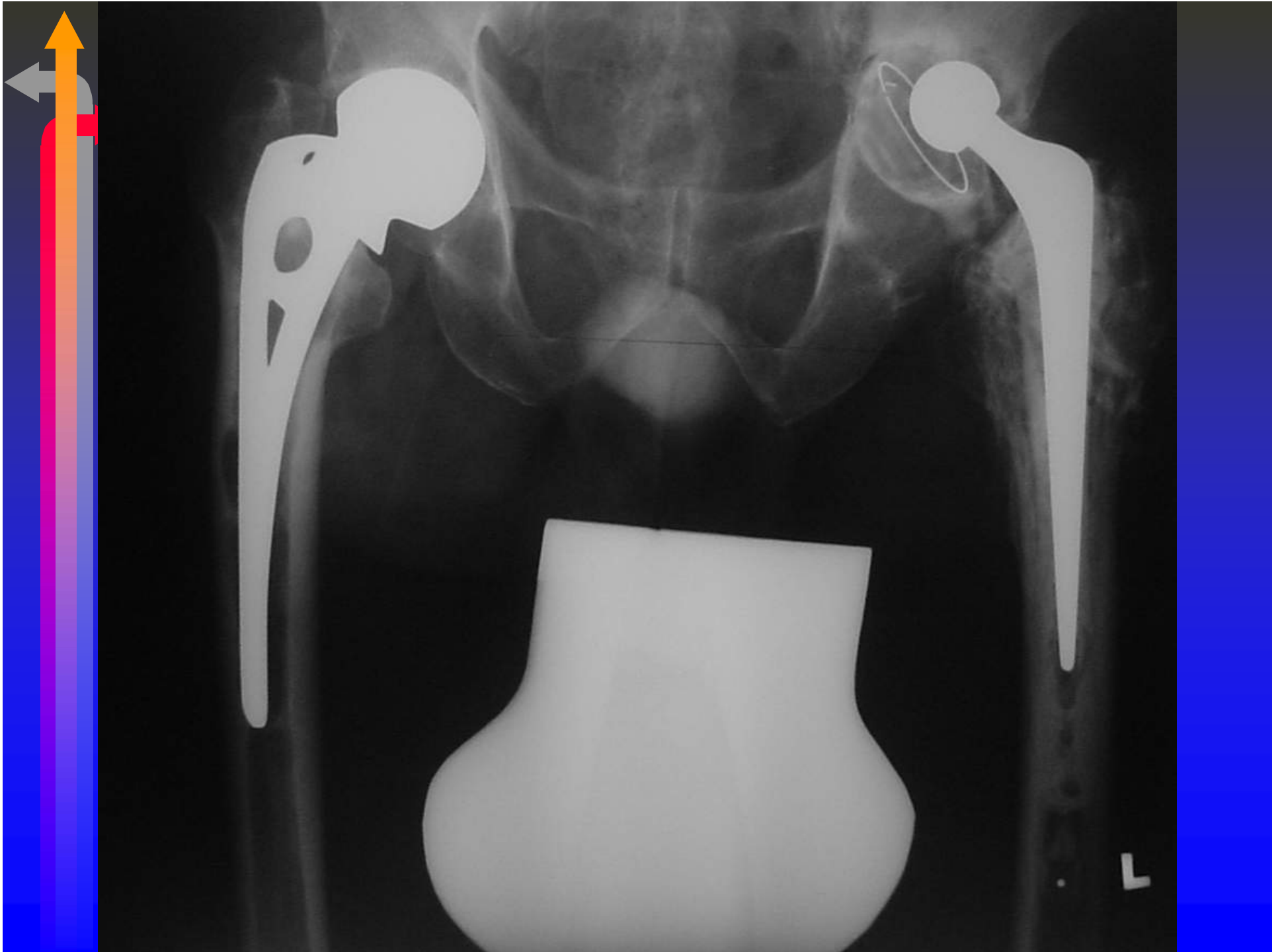
- Take peri-prosthetic tissue at bone-cement interface or pseudocapsule
- If >5 polymorph/field in 5 distinct high power fields --> 100% sensitive, 96% specific

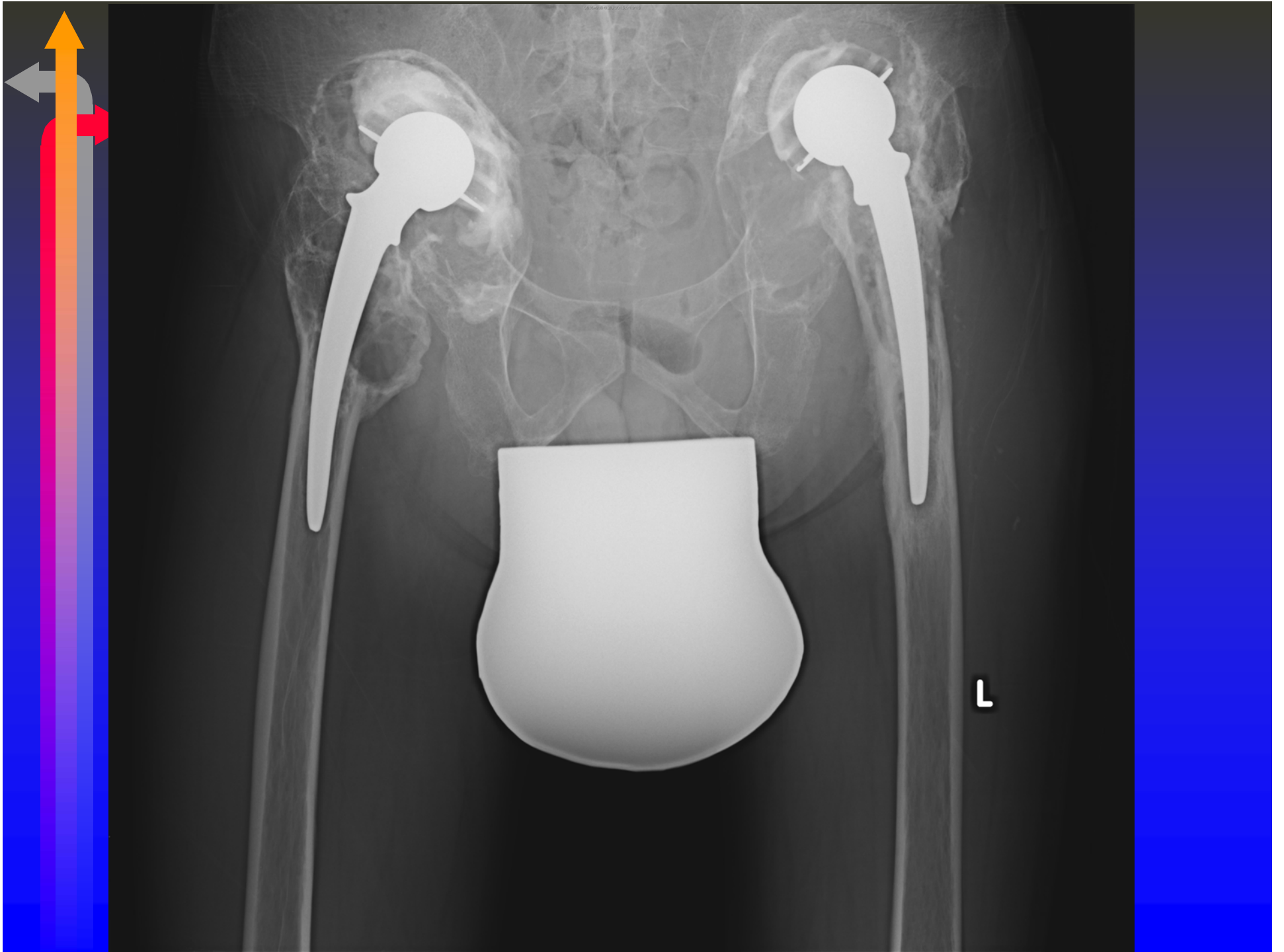


Consequence of infected joint prosthesis





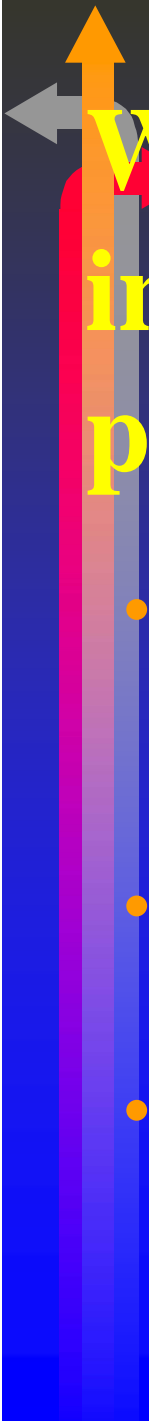






Problems encountered in infected joint prosthesis

- How to eradicate infection ?
- How to minimize soft tissue contracture ?
- How to minimize bone loss ?
- Reimplantation or not ?
- Risk of re-infection

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Why is it so difficult to eradicate infection with presence of joint prosthesis ?

- Bacteria produces exopolysaccharide glycocalyx, together with debris to form "biofilm"
- Biofilm is resistant to antibiotics and host defenses
- Need antibiotic concentration above systemic level or surgical removal of biofilm in order to treat infected joint prosthesis

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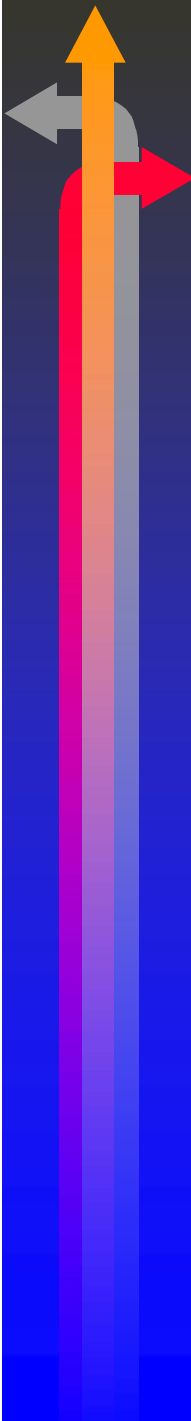
What are the treatment options ?

1. Antibiotics suppression
2. Debridement with retention of prosthesis
3. One stage reimplantation
4. Two stage reimplantation
5. Excision arthroplasty
6. Arthrodesis
7. Amputation (infected TKA)



(I) Antibiotics Suppression

- Brause, Orth Clin N Am, 1982
 - 5 criteria
 - Low virulence organism
 - Microorganism susceptible to oral antibiotics
 - Pt. compliance to oral antibiotics
 - Prosthesis well fixed
 - Contraindication to surgery and anesthesia
 - "Last resort in a medically debilitated patient with a fixed, infected prosthesis"

- 
- Need life-long oral antibiotics
 - Overall success rate 27%
 - Insall, Wilson, Bengston, Grogan



(II) Debridement With Retention of Prosthesis

- Overall success rate 33%
 - Higher success rate in early infection (<4/52 post-op) 64-100% (Borden, Rand, Schoifet)
 - Late infection 0-25% success rate (Rand, Borden)
- Prognostic factors
 - Young patient
 - Well fixed prosthesis
 - Low virulence organism (gram +ve)
 - Minimal drainage



(III) One Stage Reimplantation

- Advantages :
 - Minimize no. of operations
 - Minimize soft tissue contracture
- More commonly used in Europe than USA
- Keys to success :
 - Low virulence organism e.g. Gram +ve
 - Thorough debridement
 - Antibiotic cement
 - Prolong post-op antibiotics

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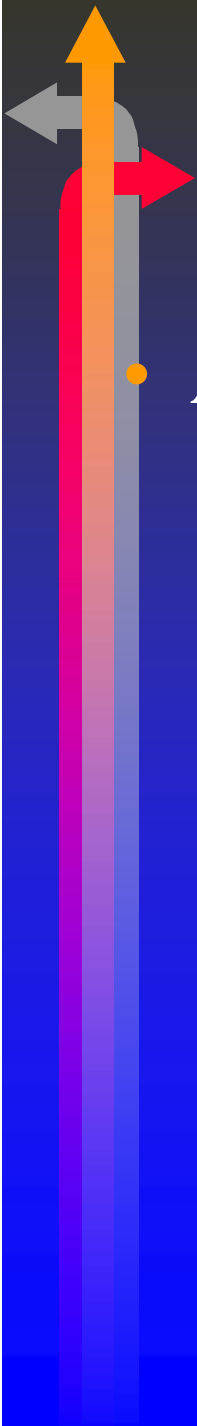
Variable results

- Success rate 30-80%
 - Bucholz, 77% success rate (JBJS, 1981)
 - Goskan and freeman 80% success (JBJS, 1992)
Together with 3 months post-op antibiotics
 - Rand, 64% failure rate (JBJS,1983)
 - Scott, Getty, 30% success rate (JBJS, 1992)
- Bengston, 385 infected TKA (CORR, 1989)
 - No significant difference between 1 and 2 stage reimplantation

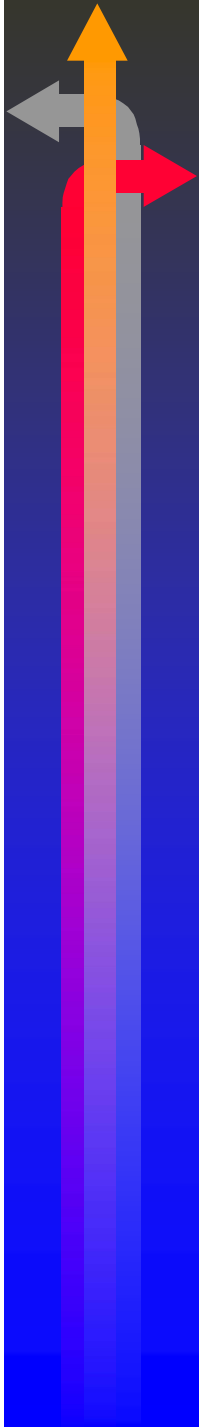
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(IV) Two Stage Reimplantation

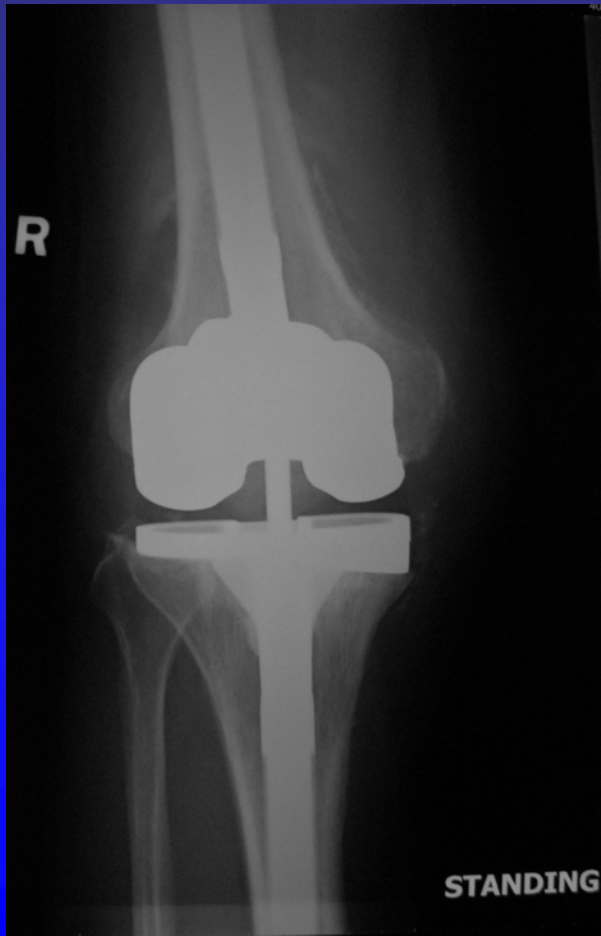
- Most commonly used
- Proposed by Insall in TKA (JBJS, 1983)
 - 100% success in 11 patients
- 3 phase protocols
 - (I) debridement + removal of prosthesis
 - (Ii) 6 weeks IV antibiotics
 - (Iii) reimplantation of new prosthesis



- Advantages :
 - Accurate identification of infecting organism
 - Provide adequate antimicrobial treatment in absence of foreign body
 - Can determine efficacy of antibiotics treatment
 - Can perform a second debridement prior to reimplantation



- Disadvantages
 - Increase morbidity
 - Increase scarring
 - Increase hospital stay
- Modification nowadays
 - Antibiotics impregnated cement spacer





PWH experience

- 25 infected TKA with 2 stages revision TKA
 - 6 weeks IV antibiotics
 - 2 weeks observation then 2nd stage revision TKA
- 2 re-infection, 92% success rate

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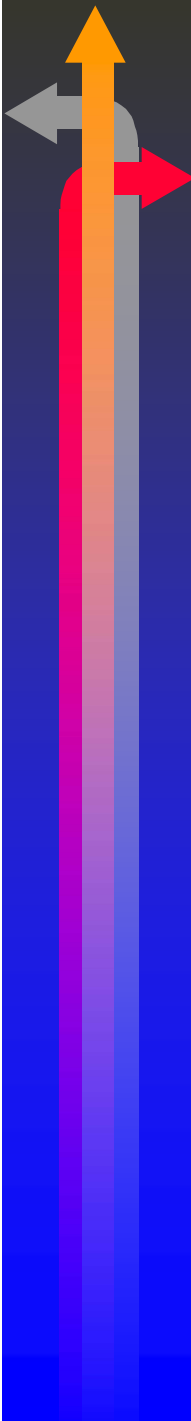
Role of antibiotics impregnated cement spacer

- PROSTALAC (PROSthesis of Antibiotic Loaded Acrylic Cement)
- Advantages
 - Maintenance of soft tissue tension and balance --> facilitate later reimplantation
 - Maintain limb alignment
 - Increase local antibiotic delivery



• Disadvantages

- More difficult to eradicate infection in the presence of foreign body
- Improper technique lead to ↑ bone loss
 - Calton , CORR, 1997
 - Block should be as wide as tibia and femur in AP and lateral
 - Block with IM extension to prevent migration
 - Adequate thickness to tension collateral
- Soft tissue scarring & shortening may still present

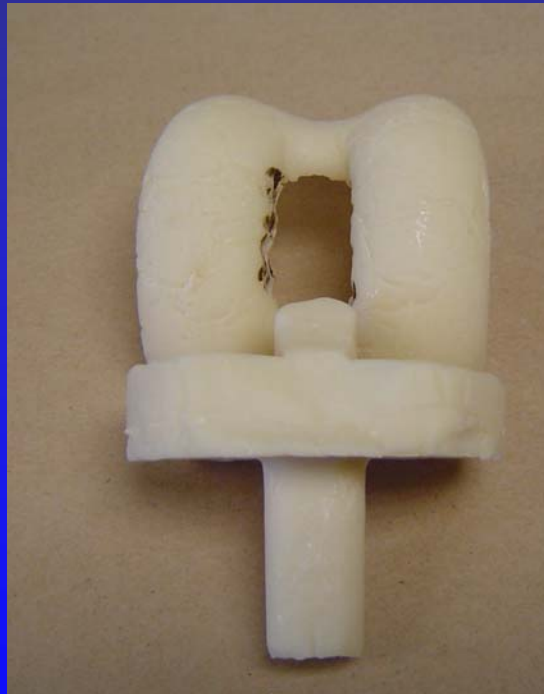
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- Common preparations
 - Gentamycin or tobramycin cement
 - Recommended dosage
 - 3-4g vancomycin or tobramycin per batch cement powder (40g) for PROSTALAC
 - Too high the dose may weaken cement
 - < 2g per batch of cement used for fixing the prosthesis at 2nd stage revision

PROSTALAC of TKA

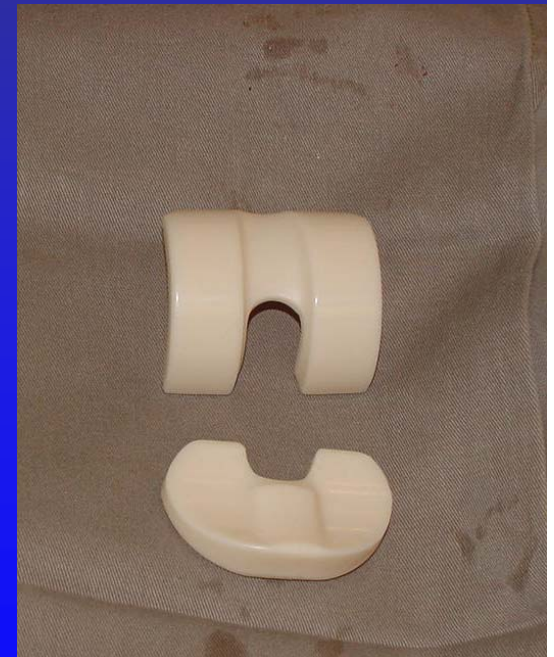
Non-articulating
PROSTALAC



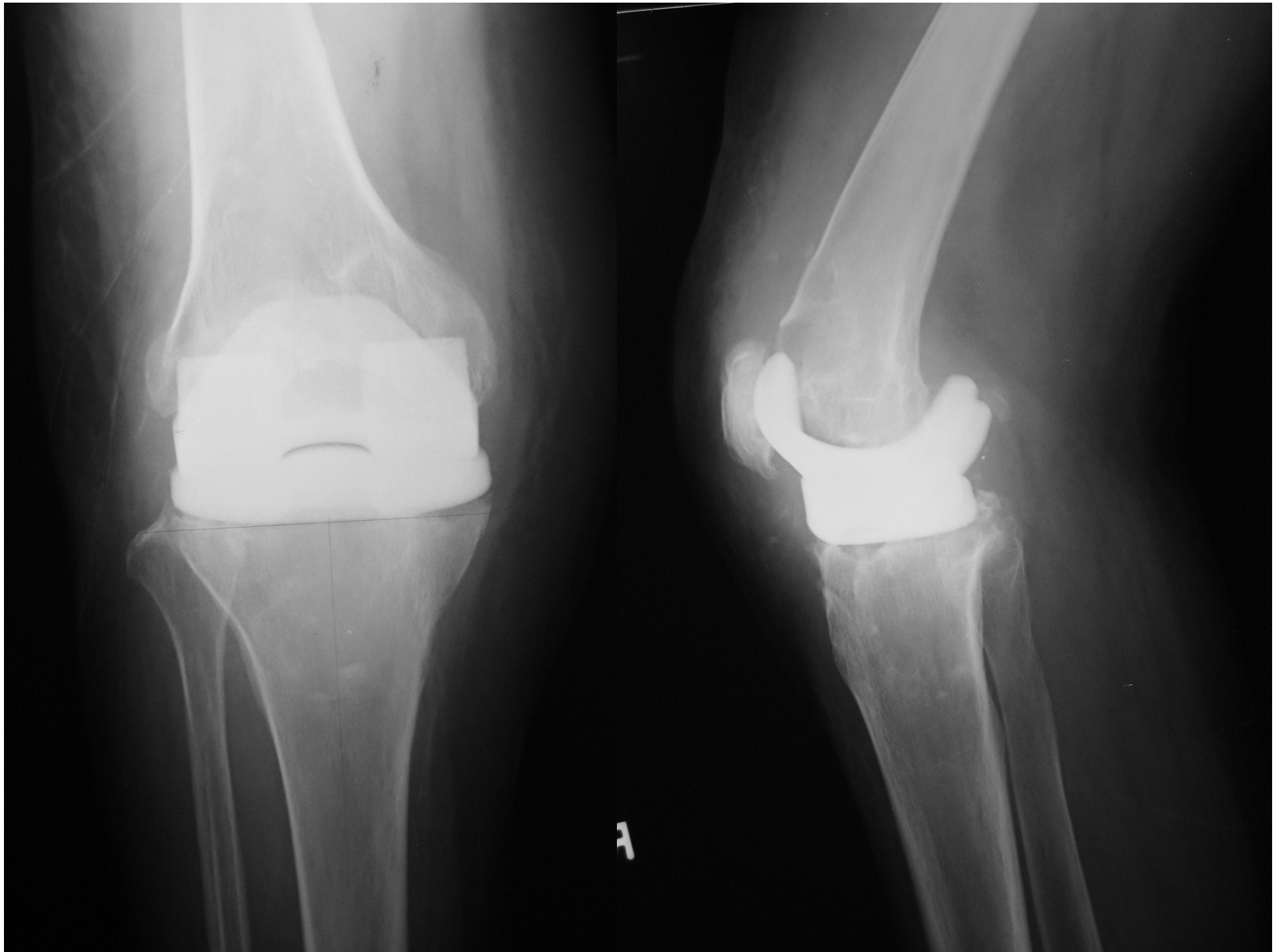
Articulating
PROSTALAC
(Home made)



Articulating
PROSTALAC
(Ready made)









Articulating vs. static cement spacer (infected TKA)

- Fehring TK et al *CORR* 380: 9 – 16, 2000
 - 1.2 g tobramycin in 40g Palacos as PROSTALAC
 - 25 cases of static block
 - 60% had measurable bone loss on X-Ray
 - Correlate with duration of interim period
 - 30 cases of articulating spacer
 - No appreciable bone loss
 - No significant different in post-op ROM & need of extensile exposure technique during re-implantation

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- Results

- Insall, CORR, 1996

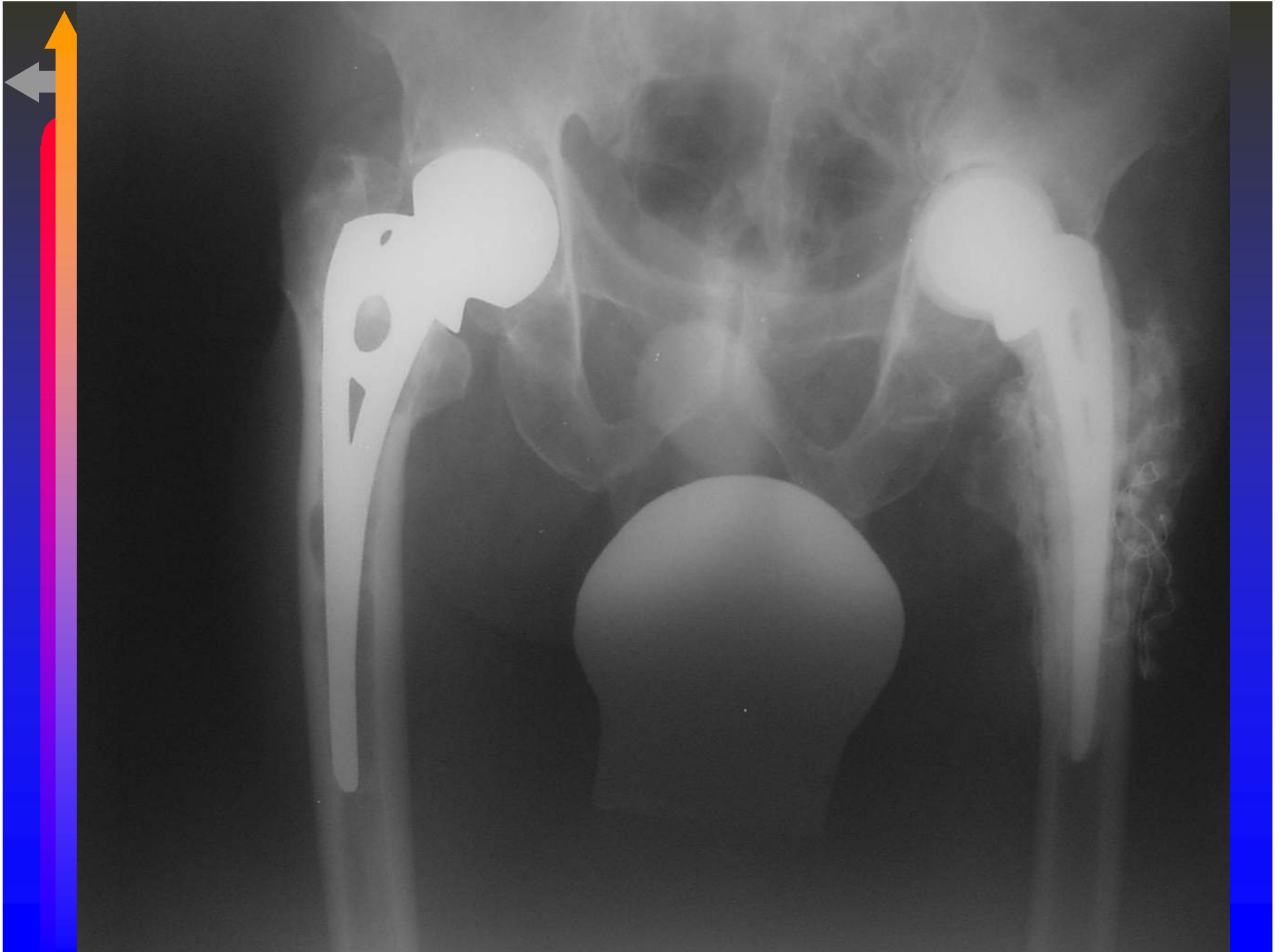
- 90% success rate
- 64 infected TKR, av. FU 7.5 years
- 3% reinfection with same organism
- Projected 10 year survival is 77.4%
- Comparable with result of revision of aseptic loosening
- Antibiotic cement spacer did not decrease reinfection rate

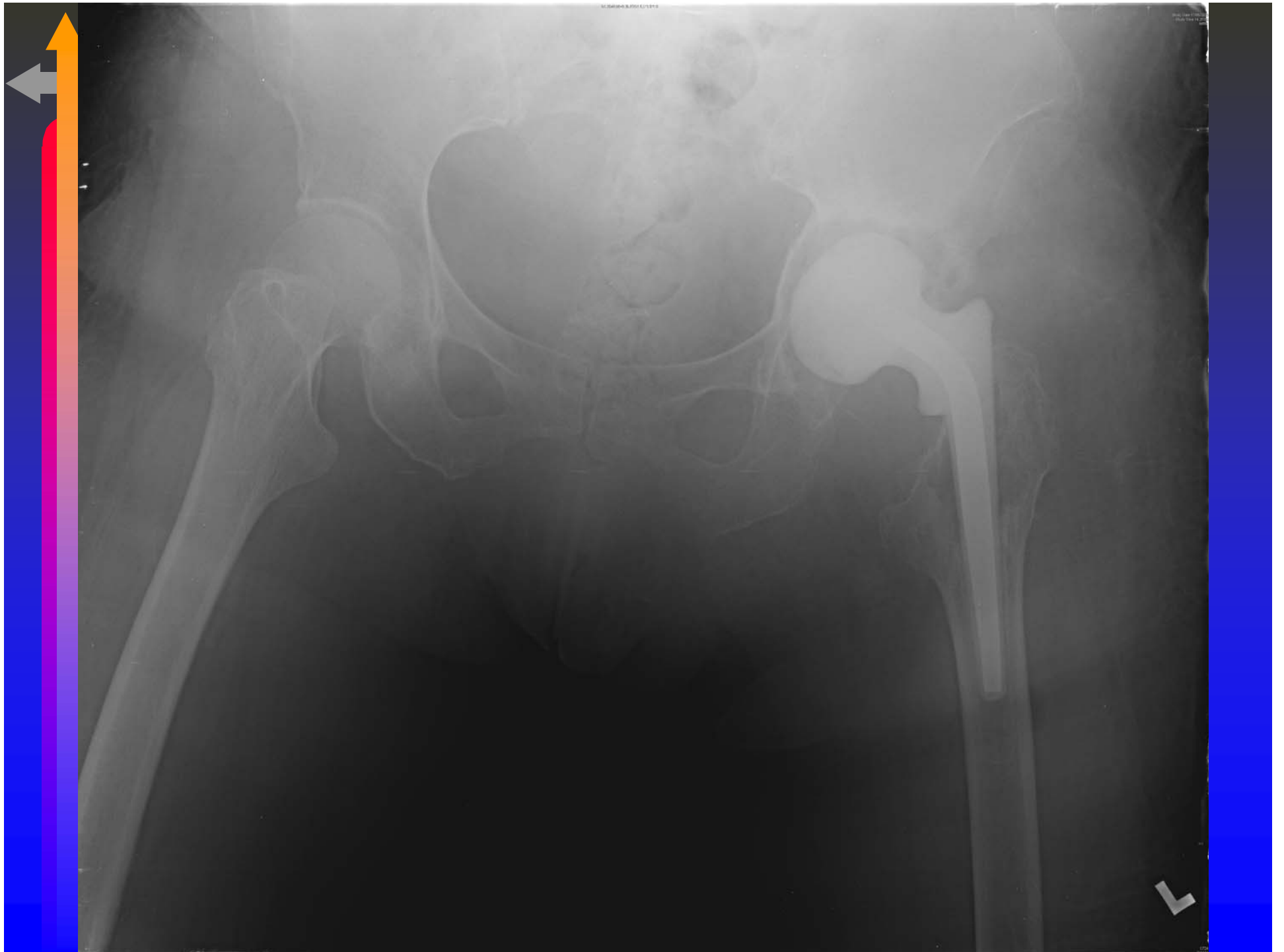
- Morrey & Rand CORR, 1989

- 80% success rate

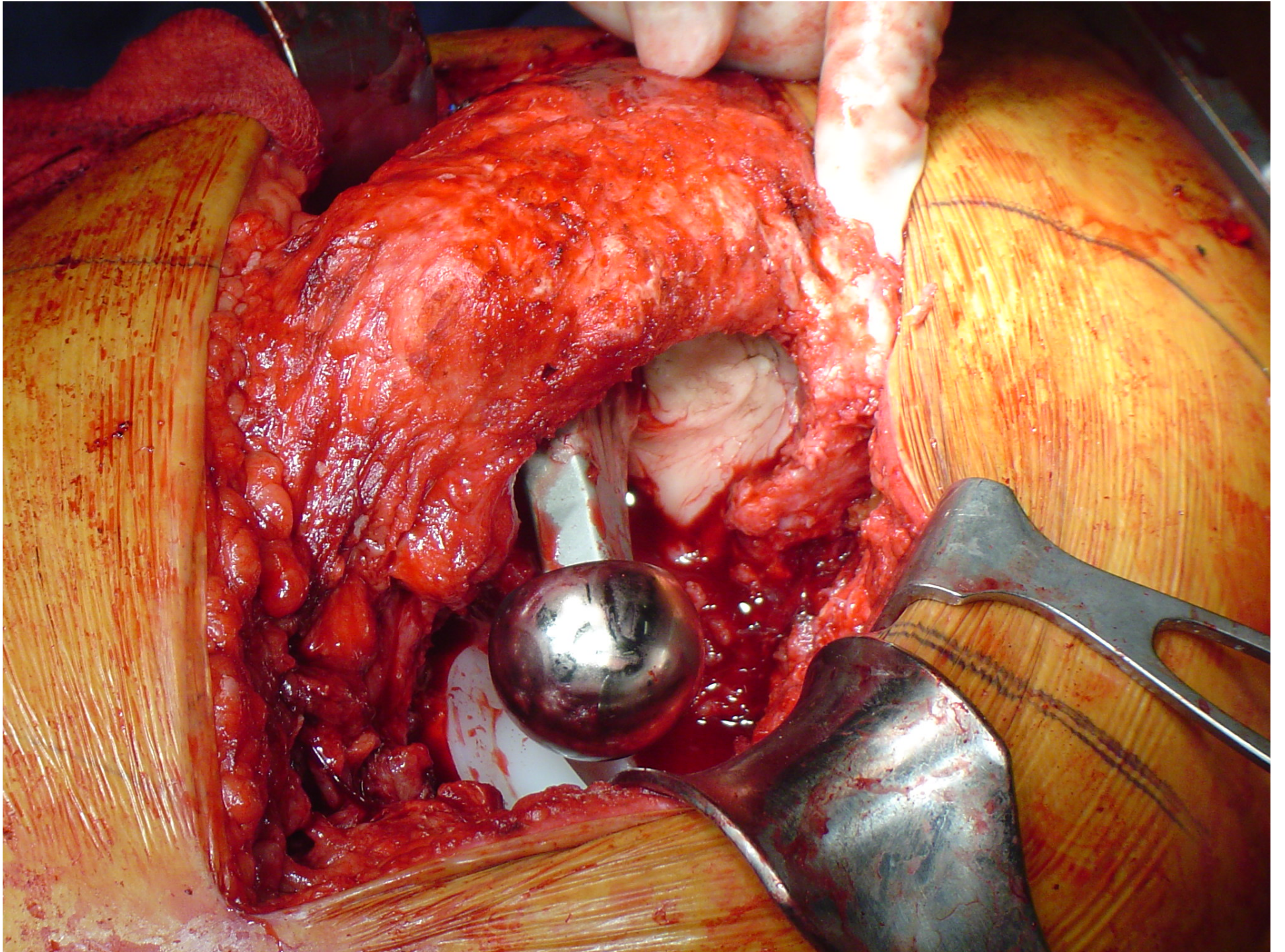
PROSTALAC of THA

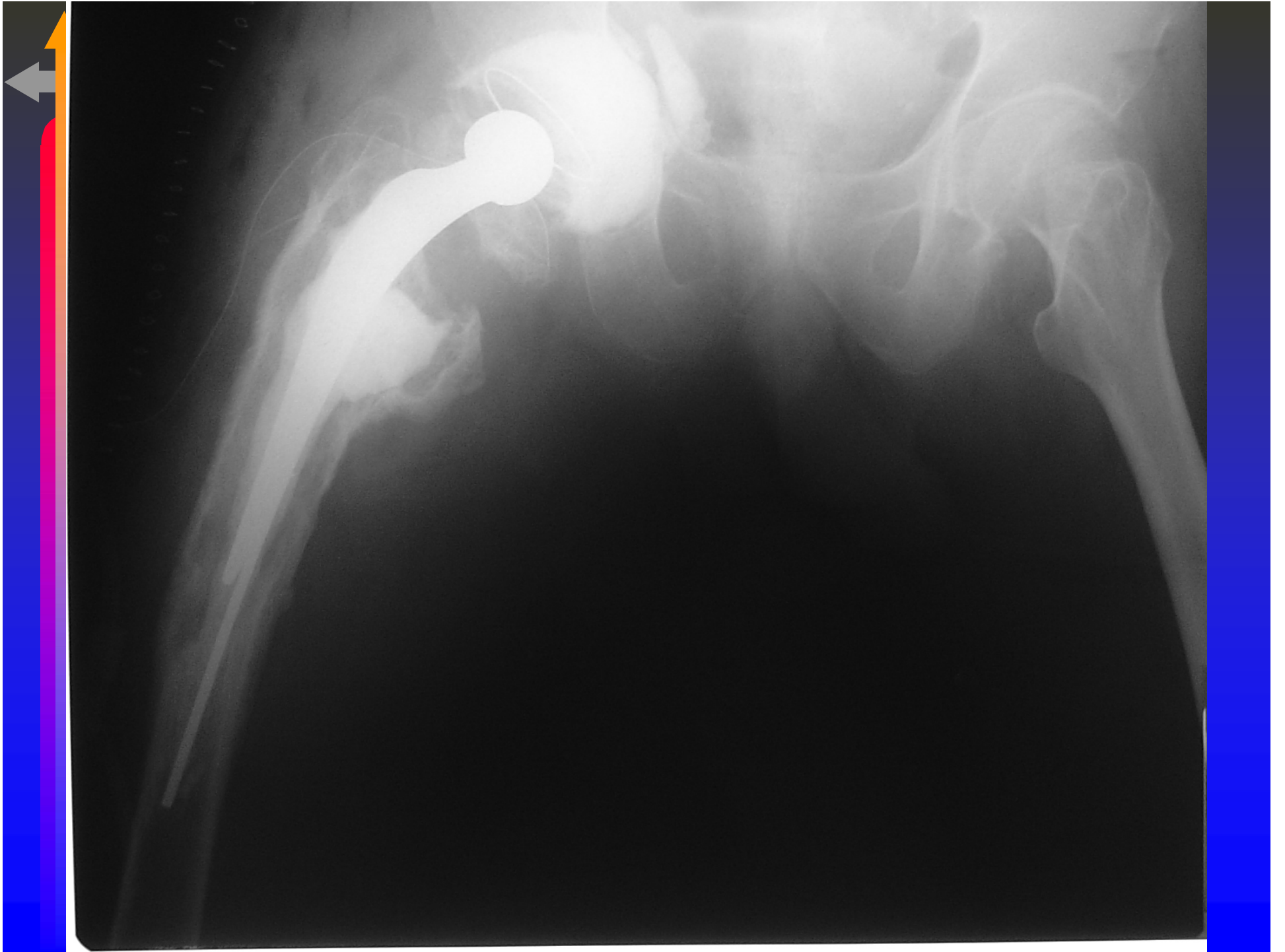














(V) Resection Arthroplasty

- Poor functional outcome
 - Pain, instability
 - Falahee, JBJS, 1983
 - Only 50% can ambulate (28 patients)
- Reserved for
 - Debilitated with low functional demand and polyarticular disease
 - Failed prior reimplantation



(VI) Arthrodesis (in TKA)

- Nearly "golden standard" in 70s
- Advantages
 - high chance to eradicate infection
 - pain-free stable joint
- Contraindication
 - contralateral knee disease
 - ipsilateral hip/ankle disease
 - contralateral amputation



Methods of arthrodesis

- Intramedullary nails
- Biplanar external fixators
- Biplanar plating
- Overall 75-90% fusion rate



- Indication

- Deficient extensor mechanism (TKA) or abductor function (THA)
- Poor soft tissue status
- High-demand patient
- Virulent organism
- Single joint disease
- Immunocompromised



(VII) Amputation (in TKA)

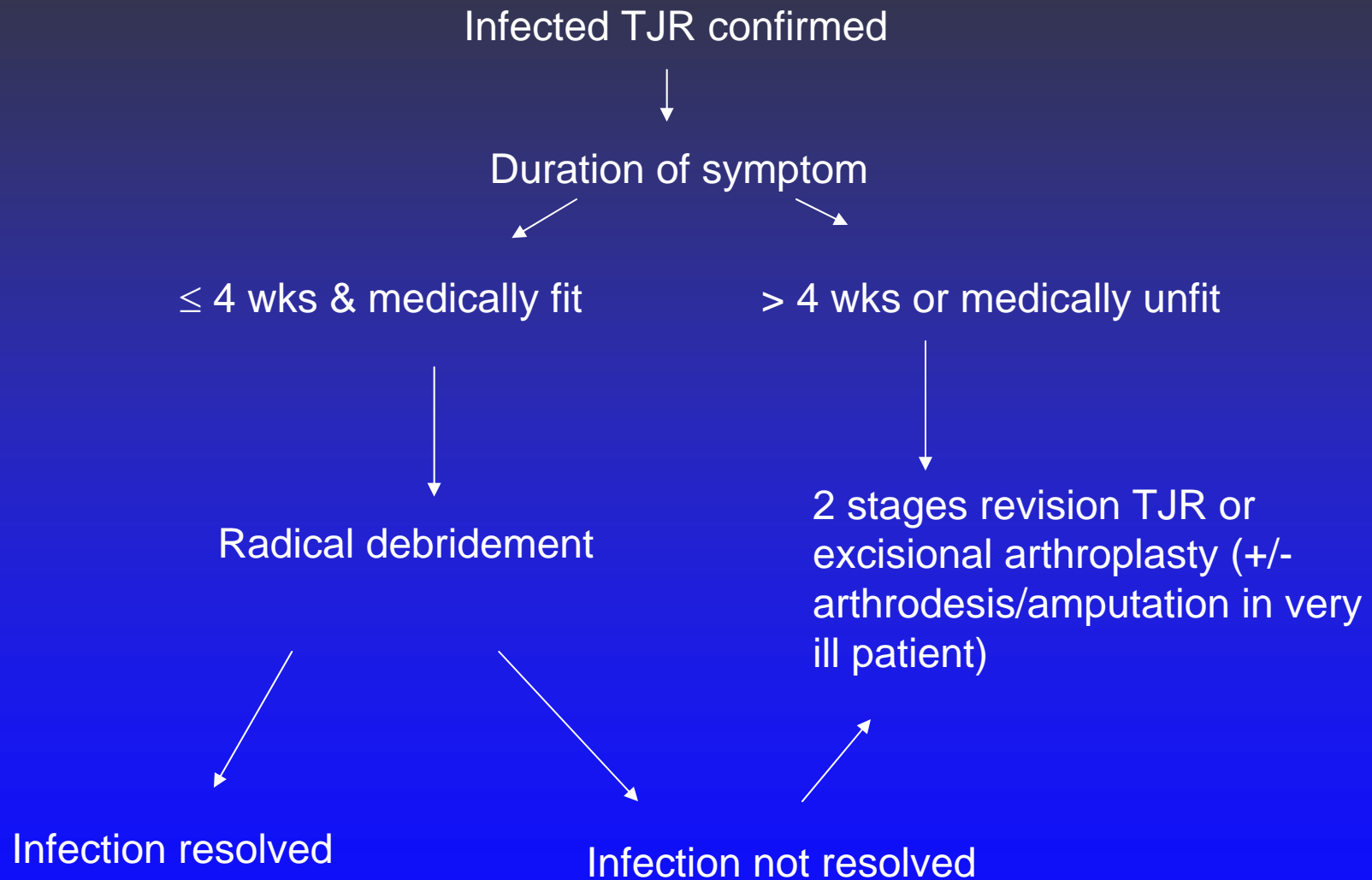
- 5.5% amputation rate (combined studies of 1014 patients)
- AKA patients spend 140% more energy on ambulation than non-amputees
- 30% can ambulate afterwards
 - Pring, JBJS, 1988



Prevention is always better than treatment !!

- Patient selection
- Prophylactic antibiotic
- Clean environment
- Surgical technique
- Act early if there's sign of infection

Algorithm for management of infected TJR





Thank you