Prevention and Management of Surgical Site Infections

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University of Alabama at Birmingham

DISCLOSURES

Paid consultant:

Aesculap

Zimmer/Biomet

Corin

Onkos

None of these products will be discussed in this presentation.

My interest/ experience

- LAC/USC orthopaedic residency ; dedicated service to bone and soft tissue infections, lead by a multi-specialty team. Experienced tertiary infection treatment in necrotizing fasciitis, as well as soft tissue management for shot gun blasts, and traumatic extremity amputations.
- Research: Surgical outcomes in limb salvage procedures for patients with chronic osteomyelitis

My interest/ experience

- Mayo Clinic Fellowship: Orthopaedic Oncology & Adult Reconstruction
- Performed limb salvage procedures, complex joint revisions and pelvic resections on patients with bone sarcomas, soft tissue sarcomas and aggressive infections.

My interest/ experience

- UAB Orthopaedic Surgery; orthopaedic oncology and adult reconstruction (2002-present)
- Bone and soft tissue sarcomas/tumors, metastatic disease to bone, lymphoma, myeloma
- Complex primary and revision total joints of hip, knee, shoulder and elbow.
- Over 800 surgical cases per year and referral base is from Gulf Coast to Nashville.

There is so much to learn

- We know very little about preventing infections
- Much of what we practice is based on theory, non scientific opinion and speculation.
- It is very difficult to identify the specific cause of infection… "Why did this happen?"
- There is a tremendous health care cost to treat infection.
- The treatment for infections is often morbid, mentally detrimental (depression), and disabling (loss of job, home, insurance, spouse)
- Success is often unpredictable and recurrence is possible.
- Placing a strain on the doctor patient relationship and results in poor patient satisfaction and in some cases malpractice claims

Orthopaedic Surgery

- Highest risk patients:
  - Ortho Oncology- metastatic/primary sarcoma
  - Joint implant revisions; especially if > 2
  - End stage organ failure, liver/renal
  - Immunosuppressed/ chemo, transplant, AIDS
  - Long term nursing home resident
  - Prior history of local infection
  - Chronic anticoagulation
  - Dialysis
  - Poorly controlled medical conditions ie. diabetes
  - Morbid Obesity (BMI>40), Super Morbid (BMI>50)
  - Depression, smokers, IV drug users, chronic narcotic users

PREVENTION- PRE OP

- optimization of patient co-morbidities
  - Diabetes, hypertension, anemia, cardiovascular
- Pre antibiotic prophylaxis- appropriate timing of dosage
- Skin condition at surgical site/ cellulitis
- Other areas of potential infection, decubitus sores, skin ulcerations, poor dentition, UTI
- Chlorhexidine scrub- topical antiseptic
- Mupirocin (Bactroban) useful against impetigo, MRSA, folliculitis- nasal application for decolonization

PREVENTION-Intra op

- Minimize soft tissue trauma/surgical technique
- Minimize operative time
- Reduce OR traffic/ anesthesia, OR staff, reps, students, imaging tech…
- Reduce usage of tourniquets/ ischemia
- Adhesive dressing coverage of exposed skin
- Foley only when absolutely necessary
- Hair removal at operative site
- Minimize blood loss and transfusion
  - TXA, meticulous hemostasis, coagulants

PREVENTION-Post op

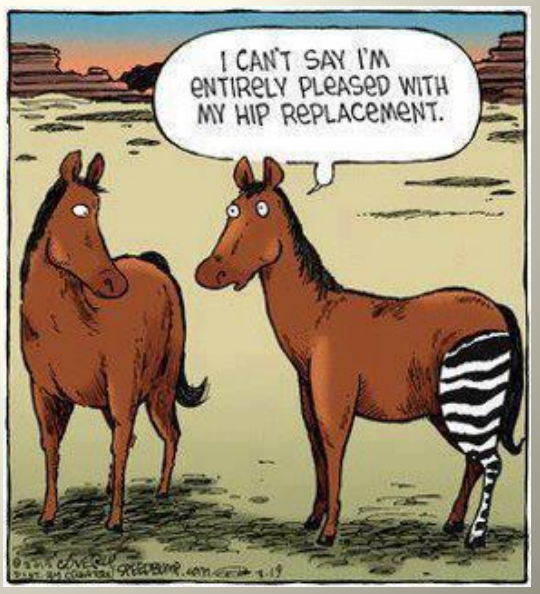
- Minimize hospitalization, nosocomial infection
- Decrease use of rehab/skilled nursing
- Sealant dressings over incision to reduce exposure/contamination
- Aggressive early surgical intervention for infection
- Pulmonary toilet/ early mobility, anticoagulation: reduce risk of pneumonia and DVT

Patient Education

Most Important Step

- Personal hygiene
- Home hygiene/ restrict access to pets, clean home thoroughly
- Pre op surgical antiseptic scrub
- Arrange for assistance at home
- Discuss bathing post op and incision care
- Encourage primary care doctor check up
- Discuss risks of surgery including infection and possible need for early intervention if one occurs. Don’t quote infection risk… Nobody really knows… Overall for total joints in the literature 1-2%.
- No surprises… “you didn’t tell me I could get an infection.”

PHYSICAL EXAM



RECOGNIZING INFECTION

Knees are easier (superficial, easy to aspirate)

HISTORY & PHYSICAL EXAM, LABS (CRP, ESR, CBC with diff); ASPIRATION (Cx & cell ct)

RISK ASSESSMENT

CHONDROSARCOMA PATIENT

NEUROFIBROMATOSIS PATIENT

Pre op optimization

- Co-morbidities
  - Obesity, diabetes, cardiac disease, vascular disease, vasculitis, smoking, chronic anemia, rheumatoid arthritis, immunosuppressed
- Hb level: Iron infusion
- Antibiotics: ie. MRSA exposure
- Shaving/ skin prep
- Infections elsewhere: UTI, URI, foot ulcers
- Dental hygiene

Intraoperative variables

- Organization/planning
- Instrumentation available and working
- Soft tissue injury
- Operative time
- Blood loss
- Room traffic

Post operative variables

- Topical dressings: antimicrobial, sealant
- Hematoma management/ for dead space management drains only when necessary; morbidly obese
- Blood transfusions: drains may increase transfusion incidence
- Shorten Hospitalization: outpatient or 1 day stay for simple primary joints, likely soon to be standard.

Early vs Late Total Joint Infections

- Early vs Late
  - Early (within 4 weeks): Retention of components, washout, head/liner exchange: IV antibiotics
  - Late (after 4 weeks): 2 stage revision reconstruction
    - Component removal/ spacer placement/IV antibiotics
    - Second stage reimplantation/ length of treatment/organism & patient dependent

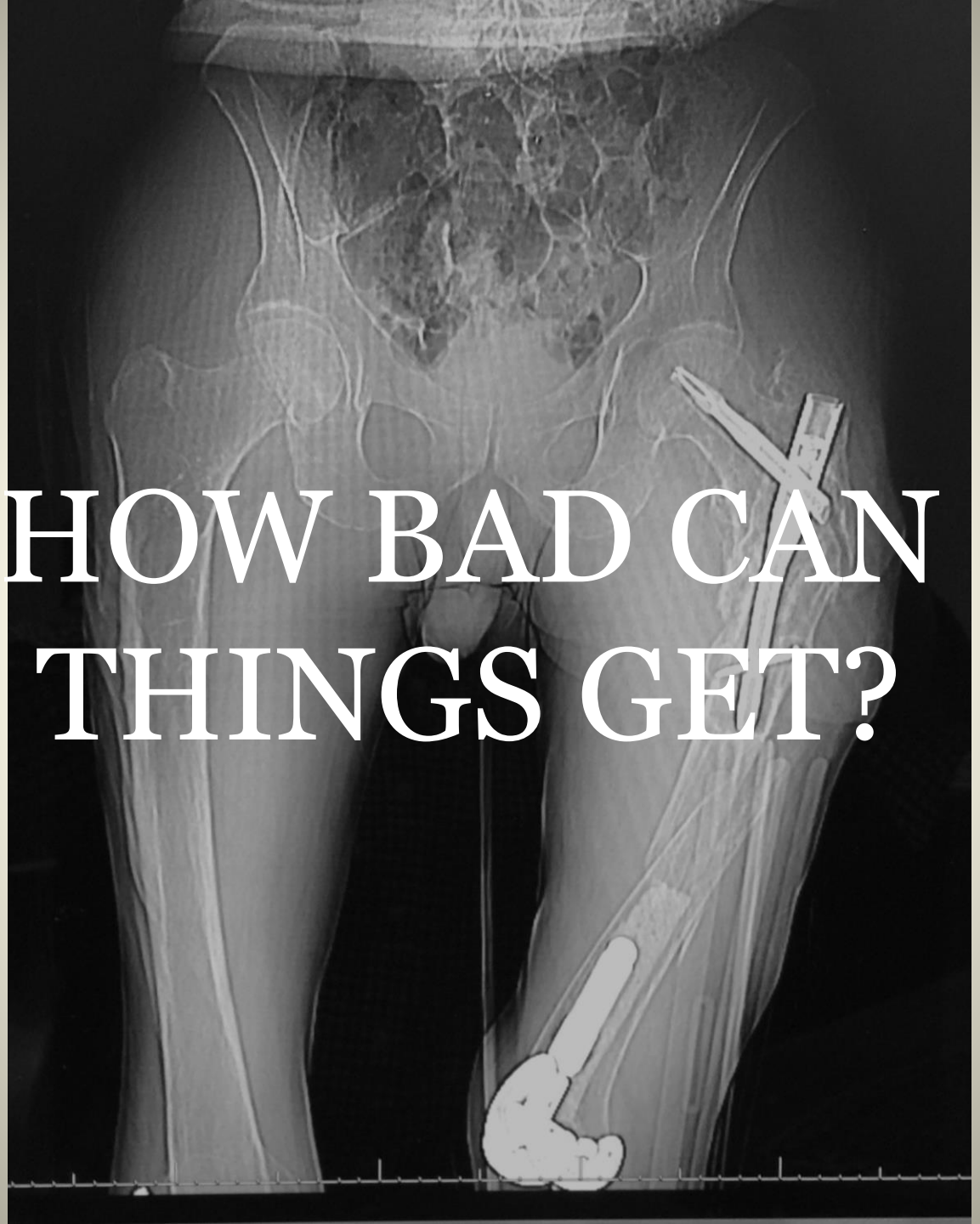
    - BIG DIFFERENCE IN TERMS OF MORIBIDITY OF PROCEDURE

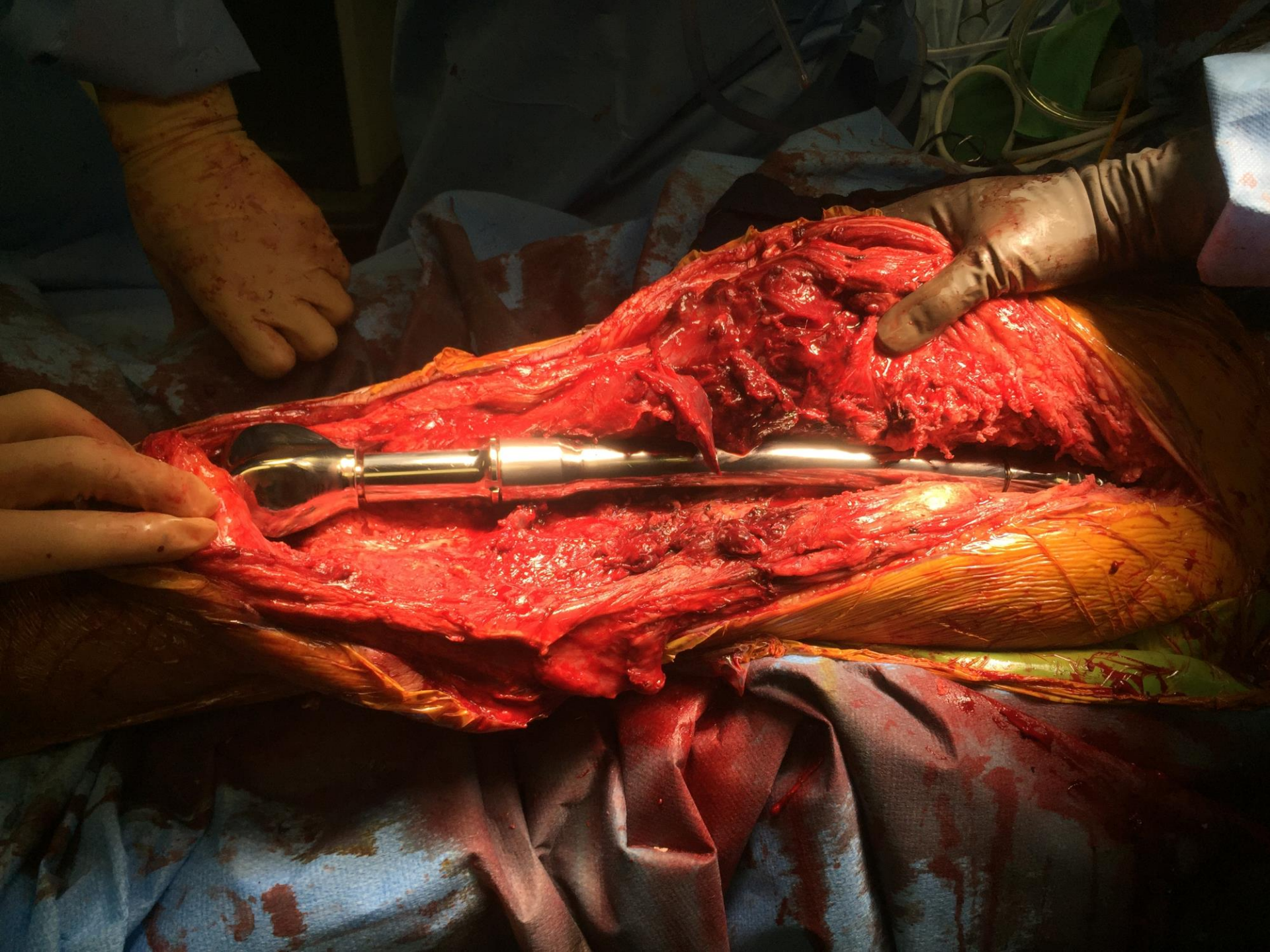
Local environment

Patient selection: Who is too high risk? And Who decides?

- Document Exam
- Record History
- Imaging studies: x rays, CT, MRI, bone scan

- Ultimately, surgeon has to decide is this something that I am comfortable treating and if something goes wrong can I take care of it?

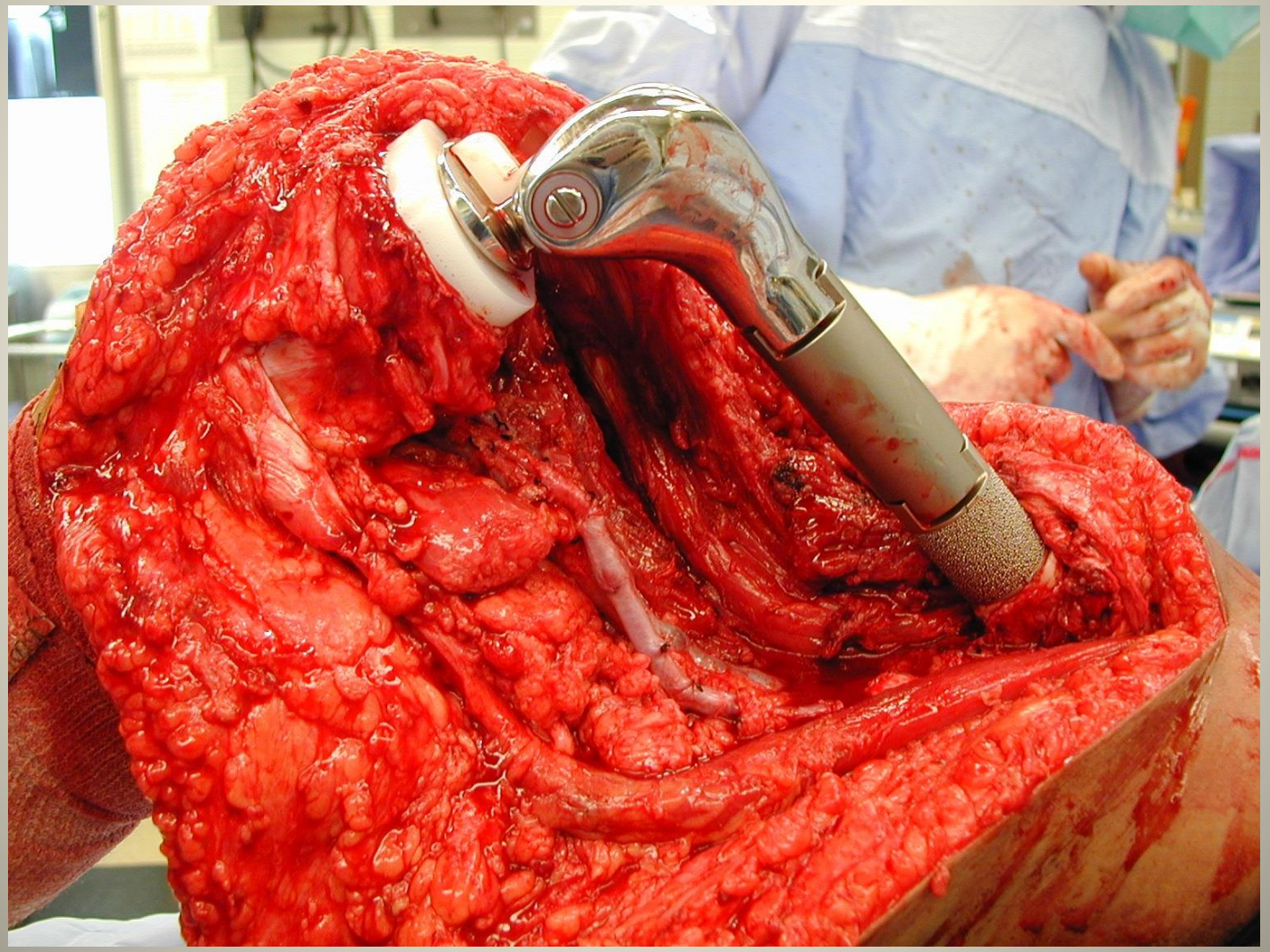

HOW BAD CAN
THINGS GET?



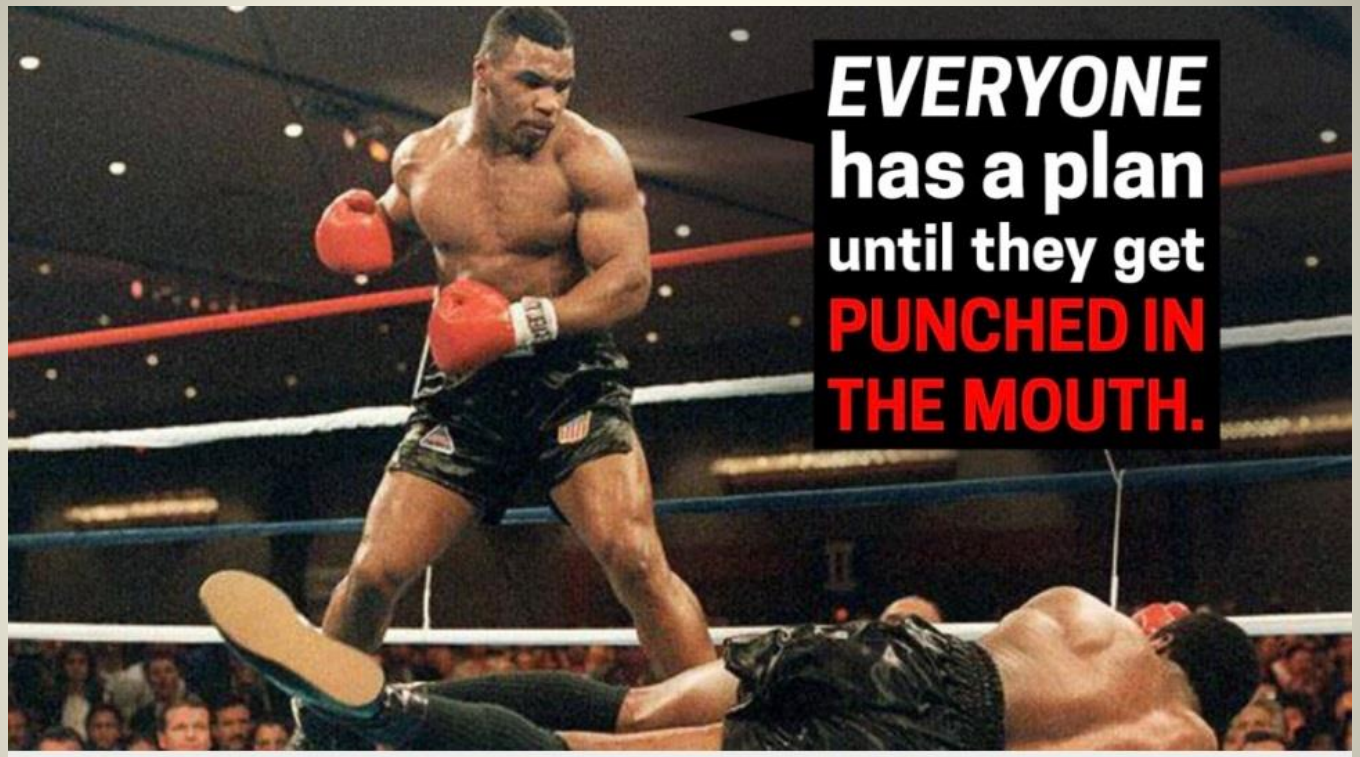
Natural history: allograft, cadaver bone

20 YEARS POST OP

Vascular bypass



Plan



Everybody has a plan until they get punched in the face" - Mike ...

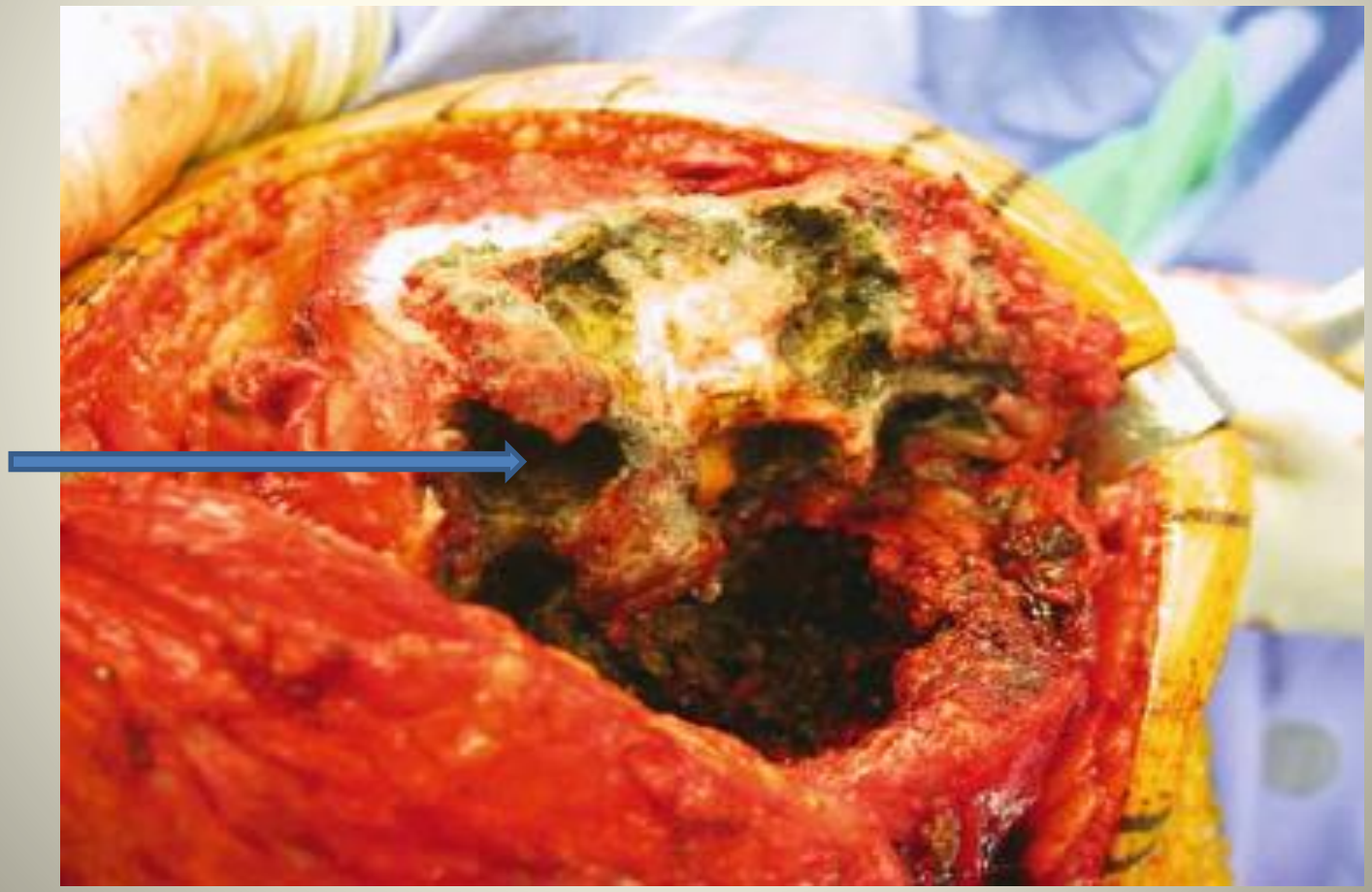
Mechanical Complications

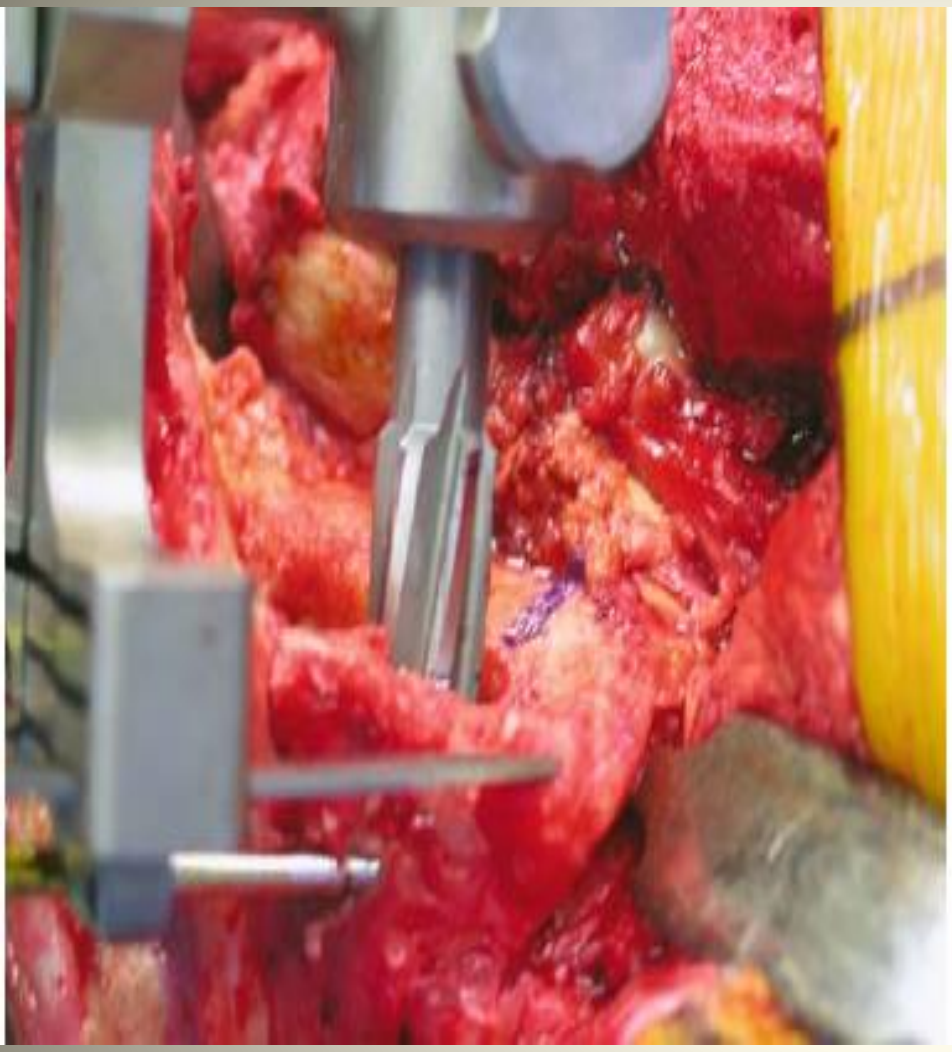
Metallosis

Destroys soft tissues and bone… May increase risk of infection. MAY MIMIC INFECTION

THE KNEE WITH COMPONENTS REMOVED

Black-stained tissue





"Our known infection rates of 1% after primary and 5.8% after revision TKA are comparable with published reports."

The Infected Total Knee Arthroplasty

Just When You Thought It Was Over

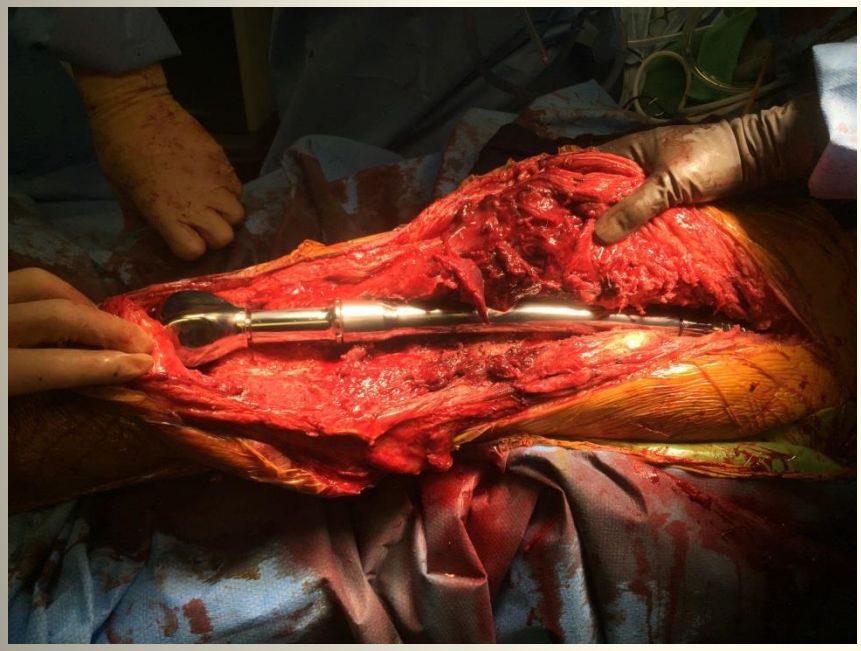
Frederick F. Buechel, MD, FACS

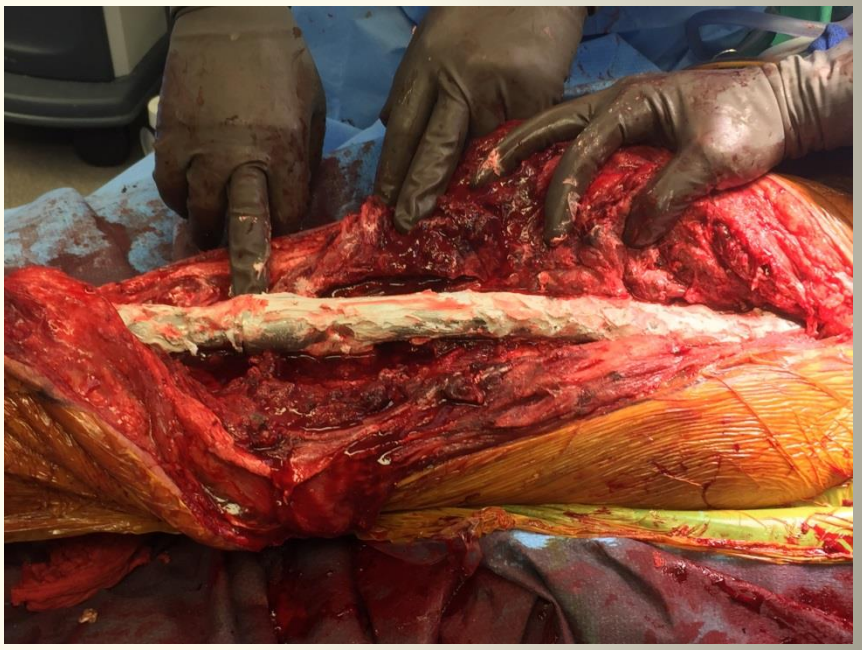
Table 1. Organisms Involved in 22 Consecutive TKA Infections

Organism	N	Percent
Staph epidermidis (Coagulase −)	9	41.0
Staph aureus (Coagulase +)	4	18.5
Pseudomonas aeruginosa	1	4.5
E. coli	1	4.5
Enterobacter aggiomerans	1	4.5
Group G *Streptococcus*	1	4.5
morganella morgani	1	4.5
Pseudomonas aeruginosa, Staph epi	1	4.5
Proteus mirabillis, Staph epi	1	4.5
Shigella-sonnei, Staph epi	1	4.5
Candida albicans, Streptococcus	1	4.5
Total	22	100

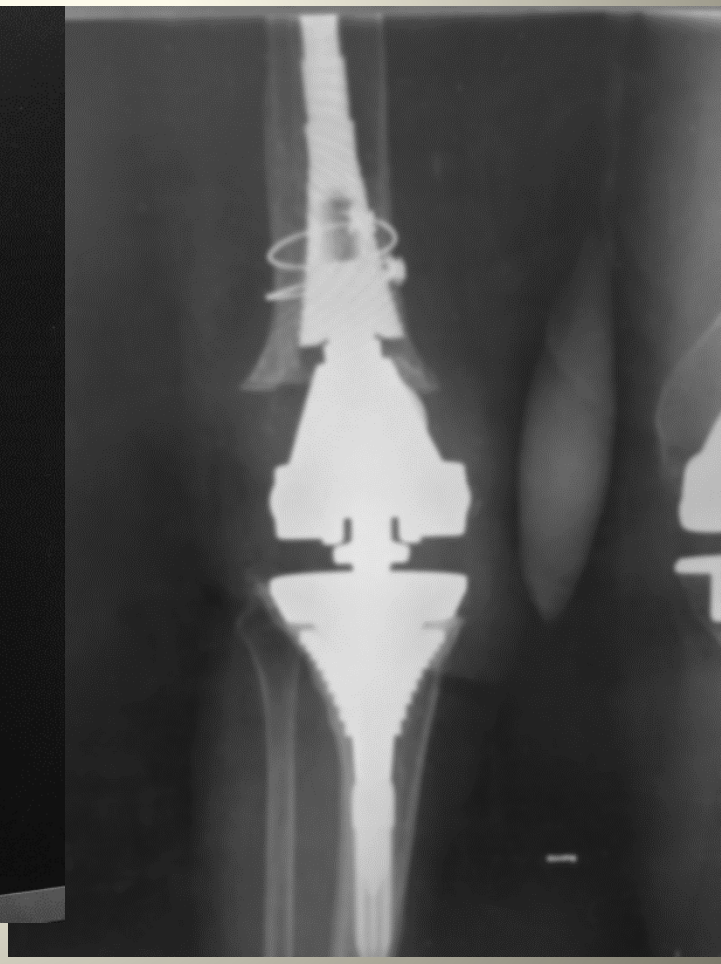
Soft tissue envelope

Antibiotic impregnated paste





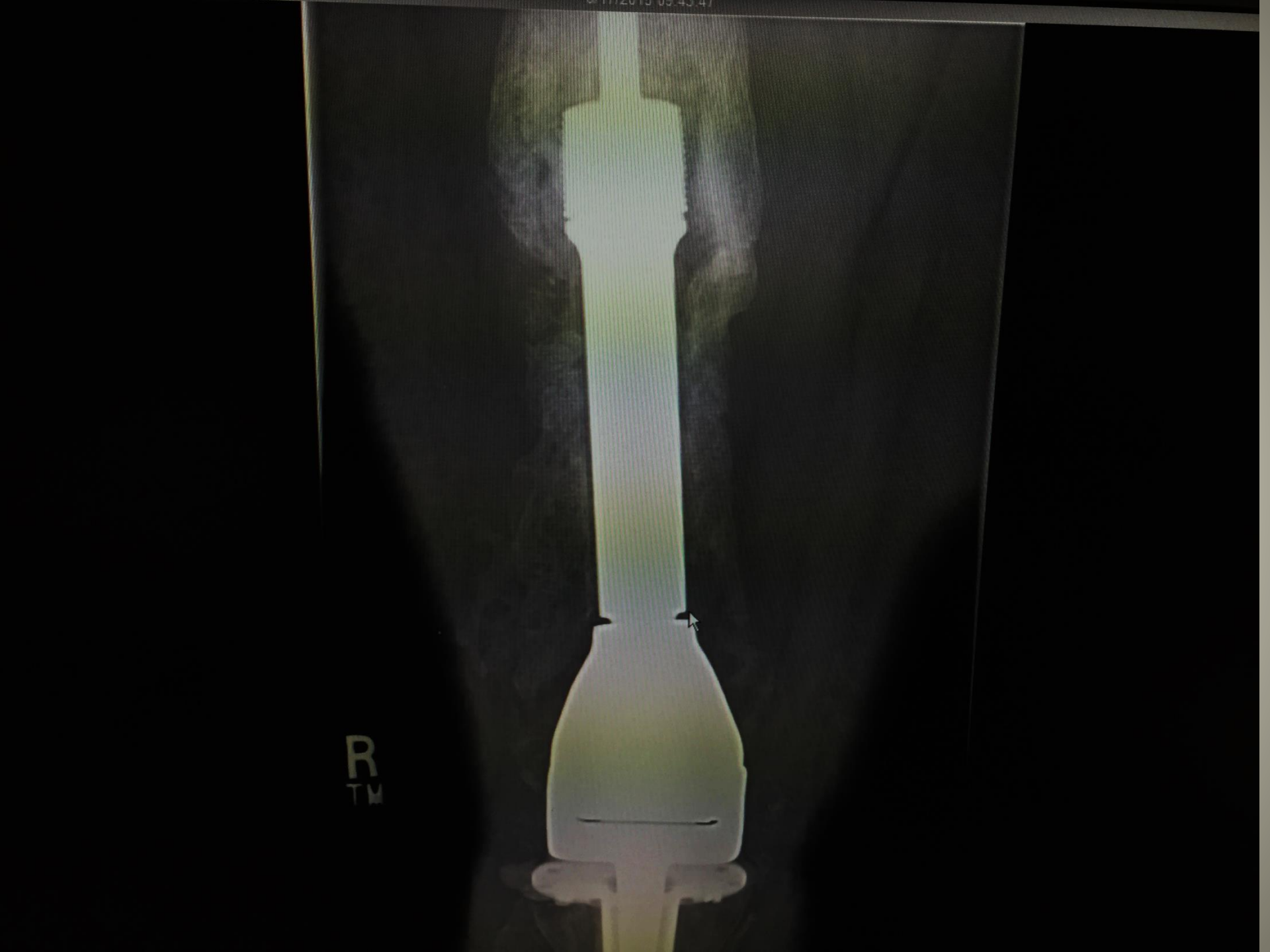
Distal femur replacement: good option for elderly patient with comminuted distal femur fracture or periprosthetic fracture with loose implant



Proximal tibia replacement:

High risk of wound complications

Never perform for trauma in acute setting


R
TM

Periprosthetic Joint Infection

- Common cause of early revision, ER visits and readmission
- Primary TKA 1-2%, Revision 5-6%
- PJI is on the rise. Better documentation vs actual
- Treatment is is variable and surgeon dependent; what is the standard of care?

PJI- CONTROVERSIES

- Drainage at 7 days? return to OR vs compressive wrap. PO antibiotics vs observe
- Infection before 4 weeks postop?
- Infection after 4 weeks? Acute, late infection?
- Chronic, late infection?
- Unexpected positive culture, standard revision TKA?

Time of onset

- Acute: < 3-6 weeks from surgery
  - CDC definition: <90 days

  Chronic: > 3- 6 weeks from surgery

  CDC definition: > 90 days

  BIOFILM: created by all bacteria on implant within 4 weeks!

  GLYCOCALYX: allows biofilm to adhere to prosthesis and sealoff infection and protects bacteria from host immune system.

Consequence of biofilm

- No method exists to safely remove biofilm and eradication of infection is difficult (however, products with potential are currently being introduced)
- Prosthetic explant is indicated with infection > 4 weeks due to biofilm.

Modifiable Risks

Malnutrition: albumin <3.5, total serum leukocytes<800

- HIV < 800 t cells
- HbA1C > 7
- Social: Smoking, excessive alcohol consumption, drug abuse
- Chronic narcotic use
- Poor hygience, especially dental/ staph colonization
- Morbid Obesity, BMI>40

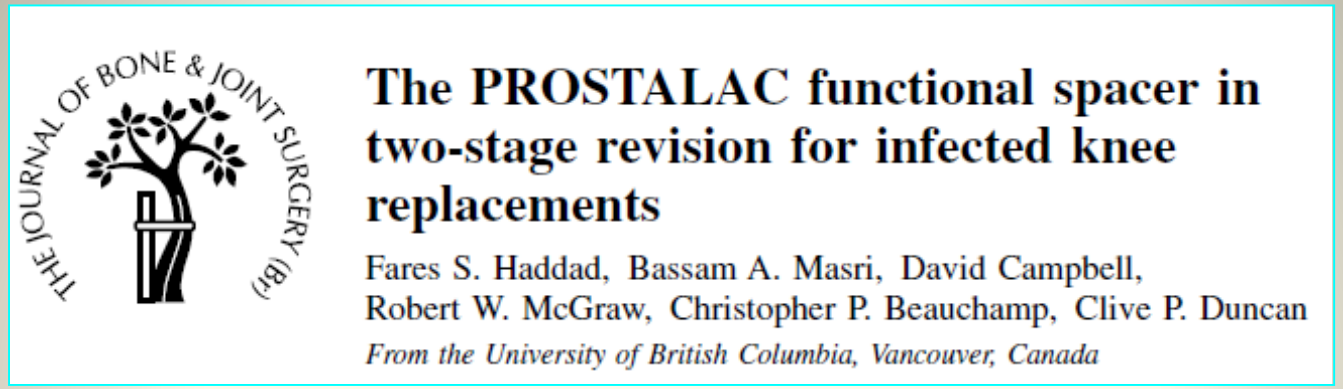
Non modifiable risks

- Liver disease
- Chronic dialysis
- Chronic anti-coagulation or coagulopathy
- Chronic Anemia, sickle cell anemia
- Autoimmune diseases
- Cancer/ chemotherapy
- Prior surgery, prior local radiation

Most common organisms

- Staphyloccus Aureus (MSSA, MRSA)
- Staphylococcus Epidermidis (SSE, VRE)
- Coag negative Staph (chronic infections)

- --Most common fungal: Candida Albicans



The best results of treatment of an infected TKR have been reported by Windsor et al in which no spacer was used between stages

Windsor RE, Insall JN, Urs WK, Miller DV, Brause BD. Two-stage reimplantation for the salvage of total knee arthroplasty complicated by infection: further follow-up and refinement of indications. J Bone Joint Surg [Am] 1990.

Treatment of knee prosthesis infections: evaluation of 15 patients over a 5-year period

Katrin Kösters · Reinout van Crevel ·
Patrick D. J. Sturm · B. Willem Schreurs ·
Maarten C. de Waal Malefijt · Albert van Kampen ·
Bart Jan Kullberg

Treatment of TKA infection with a 2 stage exchange had a significantly better outcome than debridement with retention of the prosthesis.

International Orthopaedics (SICOT) 2008

Two-stage Revision of Infected Total Knee Arthroplasty Using an Antibiotic-impregnated Static Cement-spacer

Chi-Shiung Hsu, MD; Chia-Chen Hsu[1], MD; Jun-Wen Wang, MD; Po-Chun Lin, MD

Two-stage reimplantation remains the most effective and common treatment for eradication of infection in a chronically infected TKA. The success rate of infection eradication after the two-stage procedure is between 85% and 95%.

Chang Gung Med J Vol. 31 No. 6
November-December 2008

Two-stage reimplantation of an infected total knee arthroplasty using a static antibiotic-cement spacer achieved an infection control rate of 86% and improvement in the clinical results.

Prophylaxis

- Nasal Mupirocin for decolonization of nasal MSSA/MRSA
- Routine urine cultures (no symptoms)- not warranted
- Stop DMARDs 4 weeks pre op
- Normal CRP and ESR off antibiotics for minimum of 2 weeks.
- Pre op skin cleansing with chlorohexidine
- Cephalosporin IV administered 30 min before incision and continued for 24 hrs post op

Prophylaxis- controversial

- Vertical laminar flow operating rooms
- Limit traffic in and out of OR
- Minimize OR time
- Minimize tourniquet use
- Minimize instrument trays
- Minimize use of bear hugger/ warmer
- Wear space suit/ventilated helmet

Recommendations

Do not hold or delay antibiotics before revision total joint arthroplasty --considered only in cases of clinical infection when the pathogen has not yet been identified.

Hyperglycemia: increased morbidity, mortality, hospital costs, and length of hospital stay.

48% of patients with hyperglycemia do not have a diagnosis of diabetes mellitus.

CONSIDER: DELAY SURGERY

- Patients with a BMI 50 kg/m2
- compromised skin/ ipsilateral ulcerations
- poor dentition
- active infection
- poorly controlled HIV/AIDS (CD4 #200 cells/mm3)
- Poorly controlled diabetes
- Continued use of tobacco

There is an association of modifiable risk factors with PJI and readmission after TKA

However…

No prognostic studies have shown that modifying these risk factors will decrease PJI and/or reduce the risk of readmission.

To be determined

- Does delaying surgery by addressing modifiable risk factors reduce infections?
- Does it decrease overall readmission rates?
- Do these interventions improve the outcomes in high-risk patients who have been optimized?
- Is it cost-effective to delay the surgery to optimize?

Easy to advise, tough to enforce

- Tobacco use increases one's risk of postoperative complications, both current and past smokers.
- Preoperative tobacco cessation programs begun 6 to 8 weeks before surgery reduce postoperative complications.
- Most evident in reduction of wound related complications for current smoker.
- It's not enough to just warn the patient of increased risk, we will need to check blood nicotine prior to surgery.

Drugs and alcohol

Alcohol and drug abusers have trouble with pain control and can develop complications (pneumonia, sepsis, pulmonary embolism, and PJI) that delay discharge and limit rehabilitation.

DIABETES

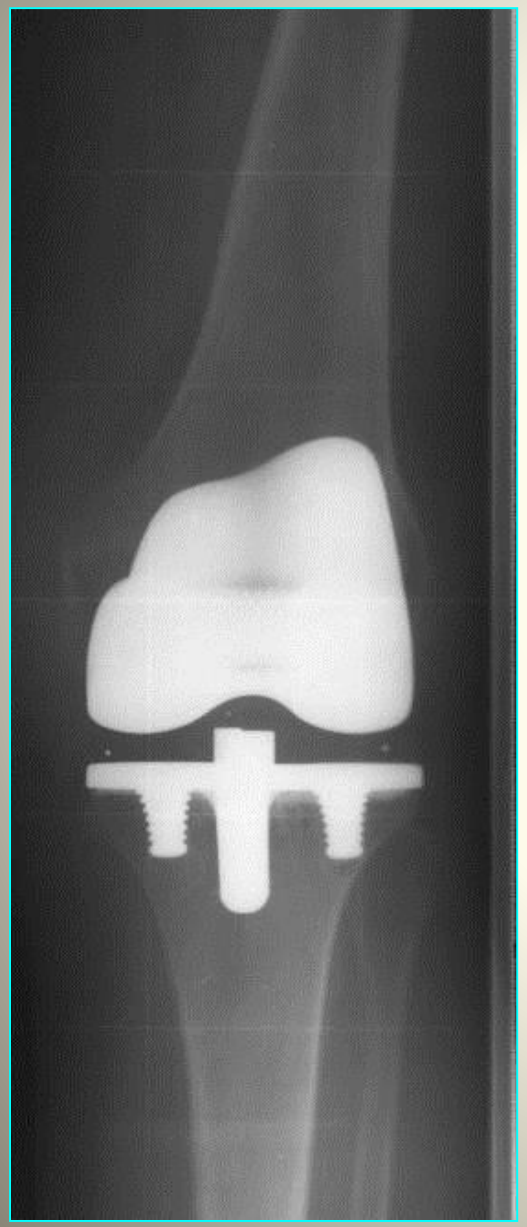
- Perioperative hyperglycemia is a more accurate predictor of complication risk, specifically postoperative infection.
- Postoperative infections are more common in patients with increased blood glucose levels preoperatively and one day postoperatively.

Infection remains a challenging problem.

- Cost, readmissions, return to OR, and extensive rehab…. Unsustainable in bundle payment system.
- Prevention is key; however contraindications for surgery and delay for optimization may become the standard of care for Medicare and private insurance carriers.
- Modifiable risk factors will need to be addressed; BMI cutoff, advanced cardiovascular, renal or liver disease, history of joint infection, poorly controlled diabetes, smoking.

- Two stage revision surgery remains the gold standard; however there may be reasonable exceptions.
- One stage revision is growing in popularity in Europe; however more studies need to be done. It may be an acceptable option for some patients.
- Is there a role for chronic antibiotic suppression? Is there a role for I & D and retention of components?

#1



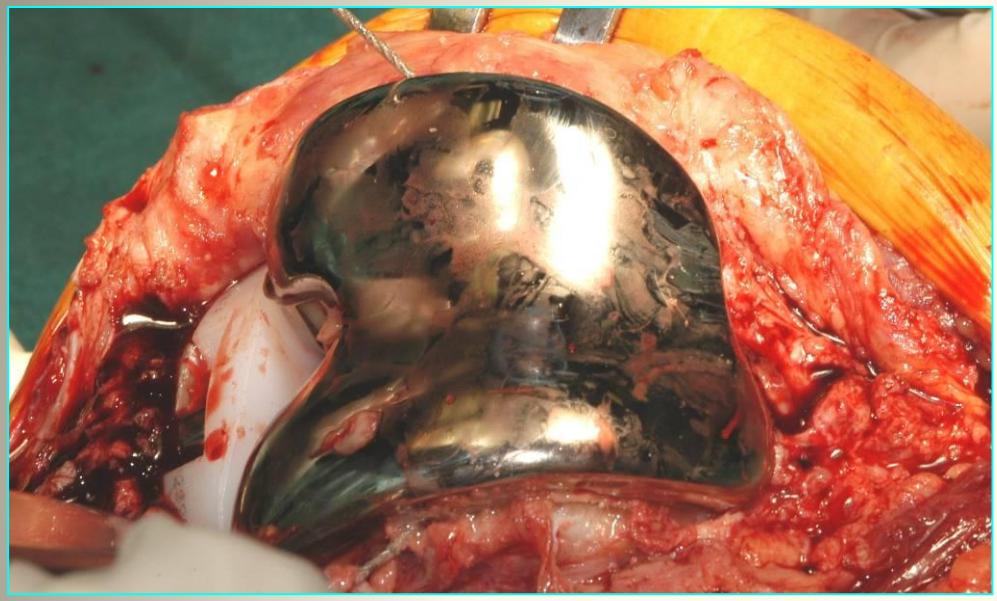
F, 75

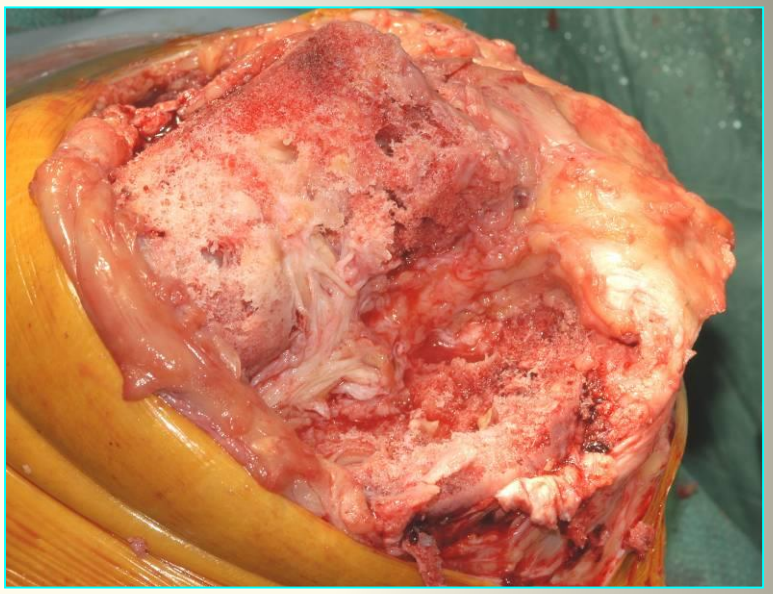
S. Aureus

PREOP

1

F, 75





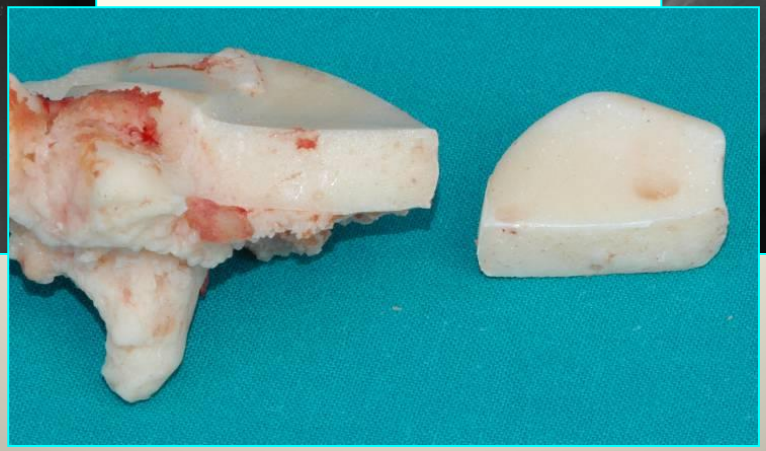
S. Aureus
ESP

1

F, 75

S. Aureus

ESP



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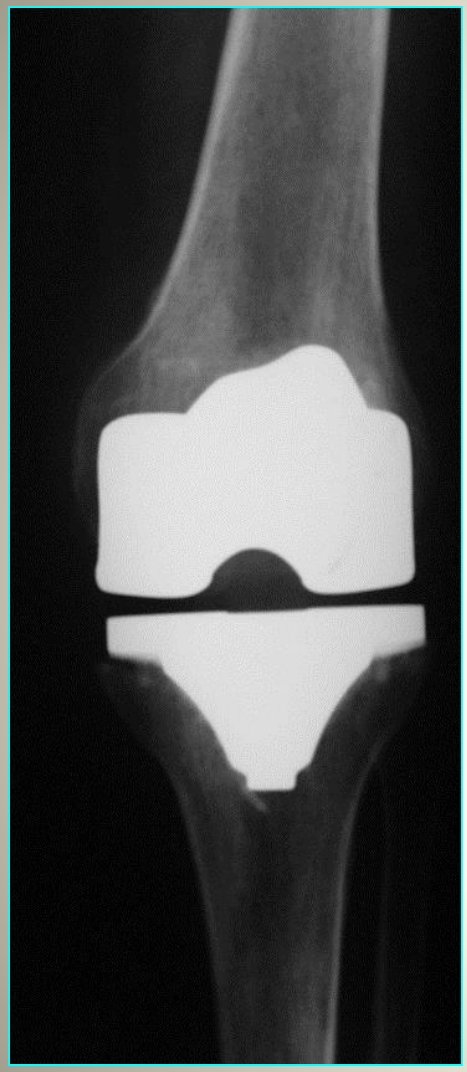


F, 78

Serratia marcescens

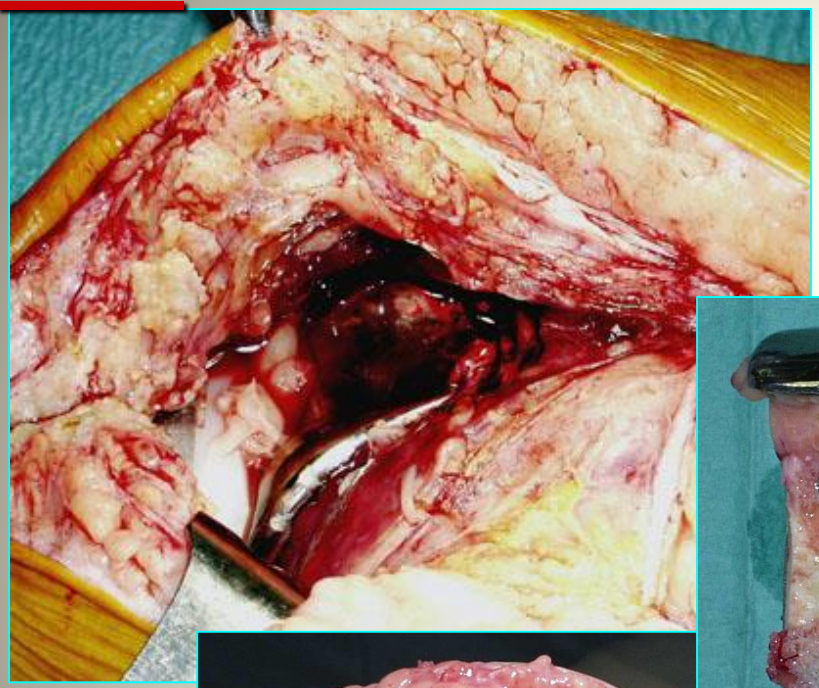
PREOP

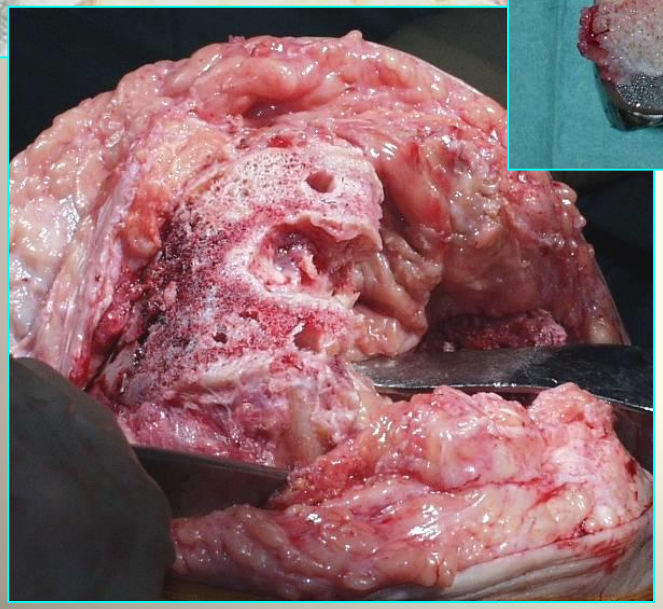
2

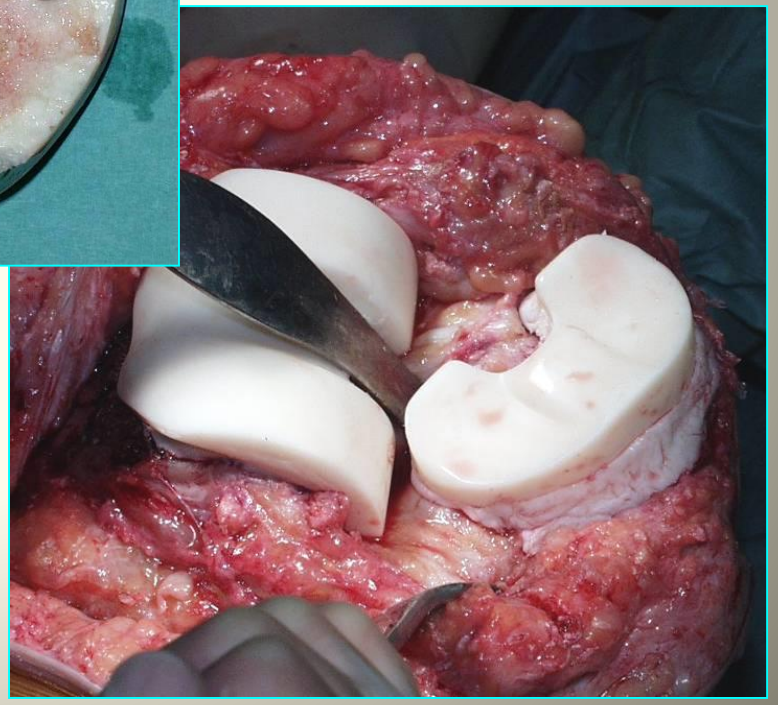
F, 78

Serratia marcescens

ESP







2

F, 78

Serratia marcescens
ESP

Local antibiotic carriers or antibiotic impregnated bioabsorbable beads, may be beneficial and extend indications for retention

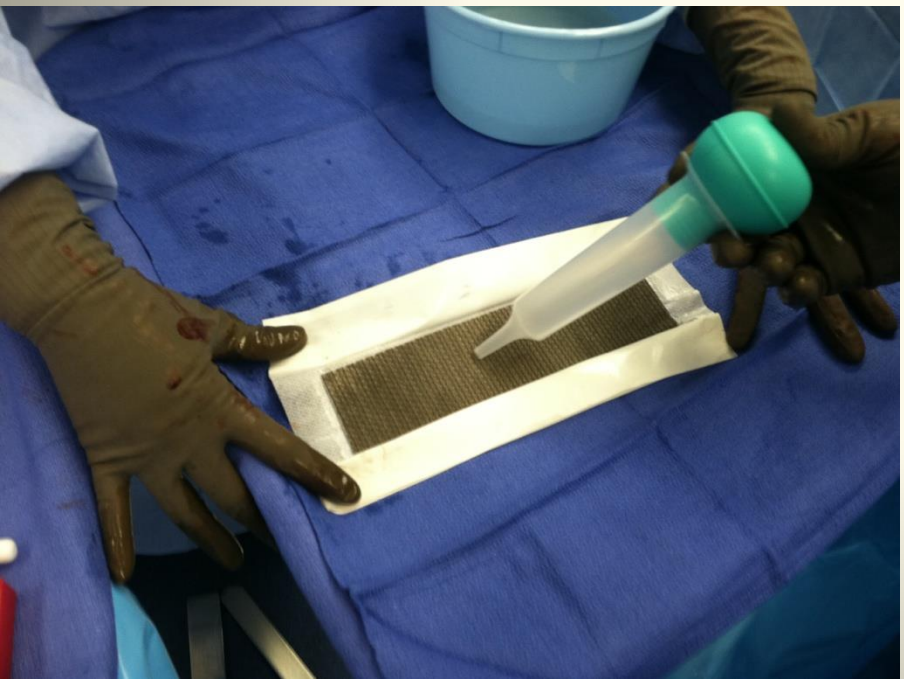
Topical anti-glycocalyx solutions may be used to extend the indication for implant retention. However, more experience and study is needed to see the impacts of these detergents.

Goal of treatment

- The goal is eradication of the infection with limb preservation
- Preservation of bone stock and soft tissue envelope
- The patella tendon is highly vulnerable for post operative contracture, rupture and fibrosis. Handle with care
- Early referral to plastic surgery and/or wound care specialist is advisable in complex cases especially infected revision TKAs.

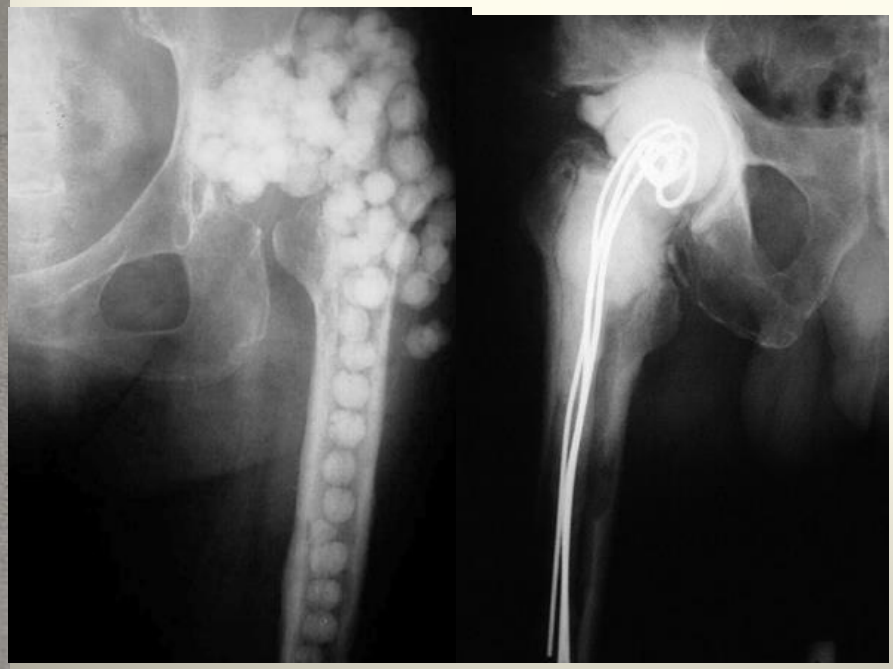
While the goal is limb preservation, patients with multiple prior infections, end stage co-morbidities, persistent sinus tracts and/or loss of extensor mechanisms may be more suited for amputation.

DIRECT ANTERIOR HIP- TOTAL HIP ARTHROPLASTY



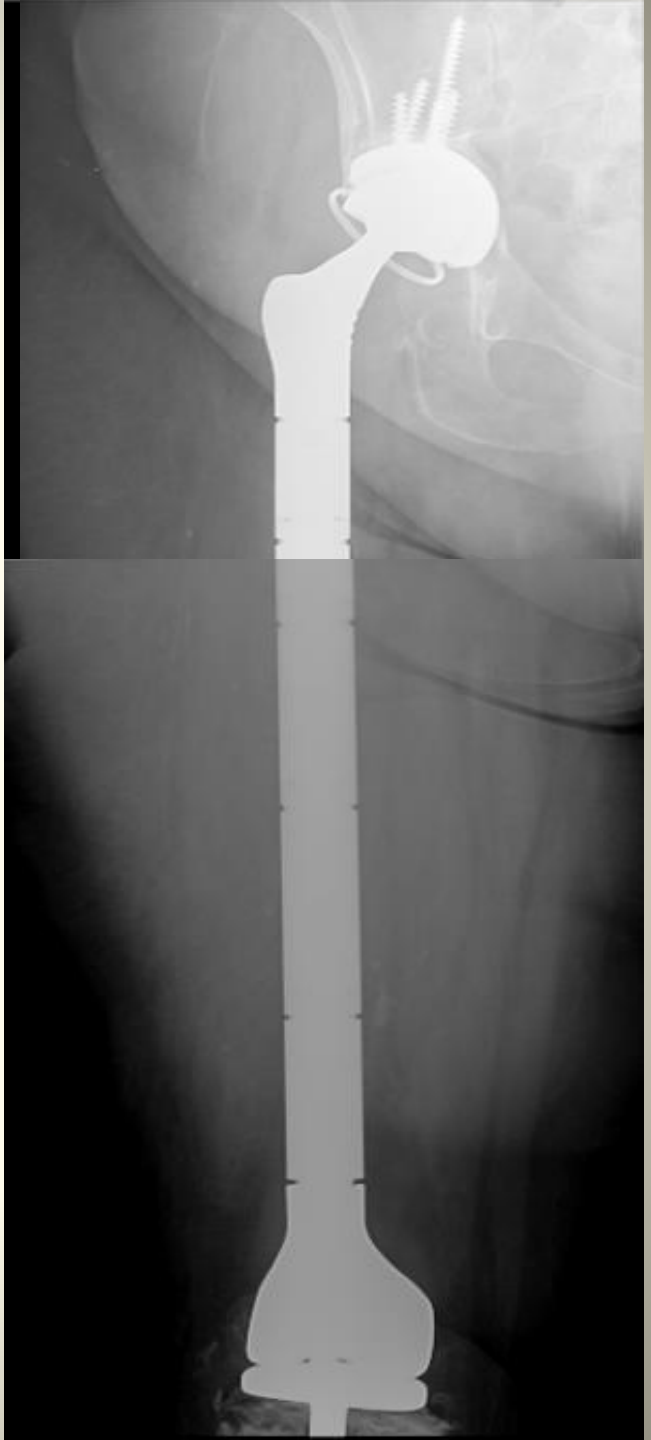
Cement spacers

"Free Hand"



"Prefabricated"

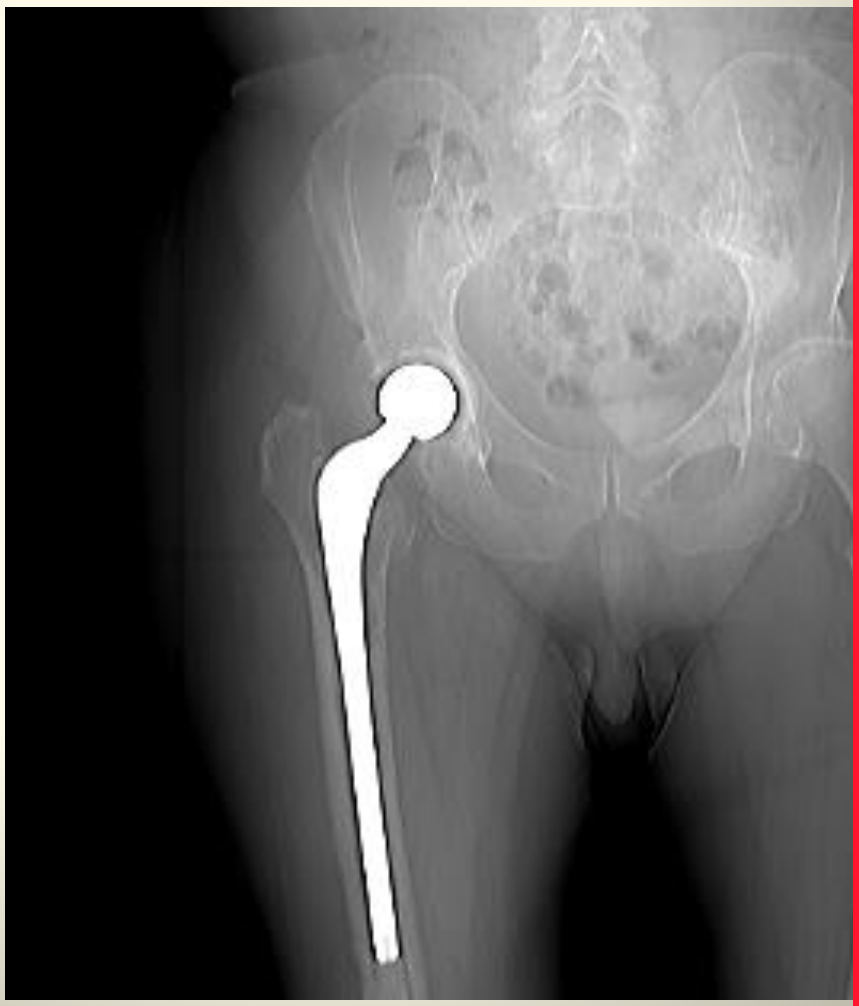
- Creative spacers



Cement spacer/ Prostala

Can you get this long
Straight stem spacer
In through the direct
anterior approach?

Yes, but it may take a more
Extensile exposure.



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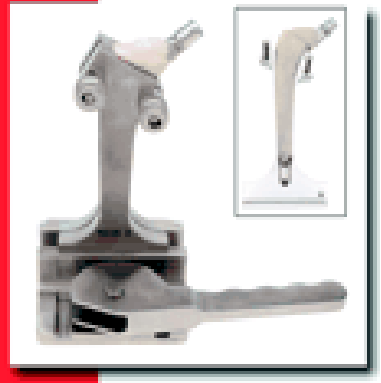

B

C

Bad spacers

Soft tissue injury
Dead Space
Shortening
Contracture

MINIMIZE BLOOD TRANSFUSION

- PRE OP ERYTHROPOITIN & IRON INFUSION
- AQUAMANTYS (TRANSCOLLATOR)
- TRANEXAMIC ACID (TXA)

ERYTHROPOITIN & IRON INFUSION

- Minimizing the need for surgical blood transfusion has physiologic and economic benefits.
- Preoperative treatment of anemia with recombinant human erythropoietin (rHuEPO) and intravenous iron (IV Fe) has been advocated to reduce the need for allogeneic transfusion.
- Covered by the Center for Medicare & Medicaid Services (CMS) and commercial payers.

TRANEXAMIC ACID (TXA)

- PROTOCOL
  - 1 g IV prior to incision (within 60 min)
  - 1 g IV just prior to closure

  Optional:
  - 1 g IV ~2 hrs post op (arrival to patient's room)

  - Does **not** appear to impact incidence of DVT or PTE
  - Use cautiously (*relative contraindication*) in patients with recent cardiac stents (<2 yrs) or recently diagnosed with thromboembolic event within past 2 yrs.
  - Use cautiously (*relative contraindication*) in patients with atrial fibrillation and patients with cardiac valve replacement

EARLY INTERVENTION

- HEMATOMA, DRAINAGE, FLUCTUANCE, ECCHYMOSIS

- ULTRASOUND OR CT
- HEMATOMA EVACUATION
- CULTURES
- CONTINUE IV ABX UNTIL CULTURES FINAL

RECOMMENDATIONS

- OPTIMIZE CO-MORBIDITIES
- TOPICAL SILVER DRESSING
- TAKE MEASURES TO MINIMIZE BLOOD LOSS
- PRESERVE TLF
- EARLY INTERVENTION FOR HEMATOMA
- CONSIDER EARLY POST OP VISIT @ 2 WEEKS
- INCREASED BLEEDING RISK: PATIENTS ON PLAVIX, PRADAXA & COUMADIN, PAGET'S DISEASE, TUMOR (MYELOMA, RENAL CELL),

(LEARN EXTENSILE APPROACHES TO PERFORM 2 STAGE REVISION)

FUTURE

- Coated implants to prevent glycocalyx
- Antimicrobial coated implants: silver, iodine
- Detergent solutions to dissolve glycocalyx
- Local antibiotic delivery: Stimulan
- Sensitive and specific markers for early infections
    - D-dimer, leukocyte esterase, PCR

TEAM APPROACH
infection prevention

- Surgeon
- Primary care doctors
- Infectious disease
- OR nursing/administration
- Pre op surgery clinic
- Anesthesia
- Hospitalists/Surgical Home
- Physical therapy/occupational therapy
- Surgical floor nursing