



Periprosthetic Joint Infection

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Disclosure

Consulting/Royalty payments from

- Waldemar Link
- ZimmerBiomet
- Ceramtec,
- Heraeus
- Microport
- De Puy

The author's institution receives research support from:

- WaldemarLink
- ZimmerBiomet
- Heraeus

• Intellectual Property/Ownership

- PSI
- Tangen
- Cleu



1. Maximum 3 sentences answers
2. No answer begins with „Basically...“
3. Only answer, when you are asked
4. No negative comments about the x-rays
- 5. Never oppose the moderator**

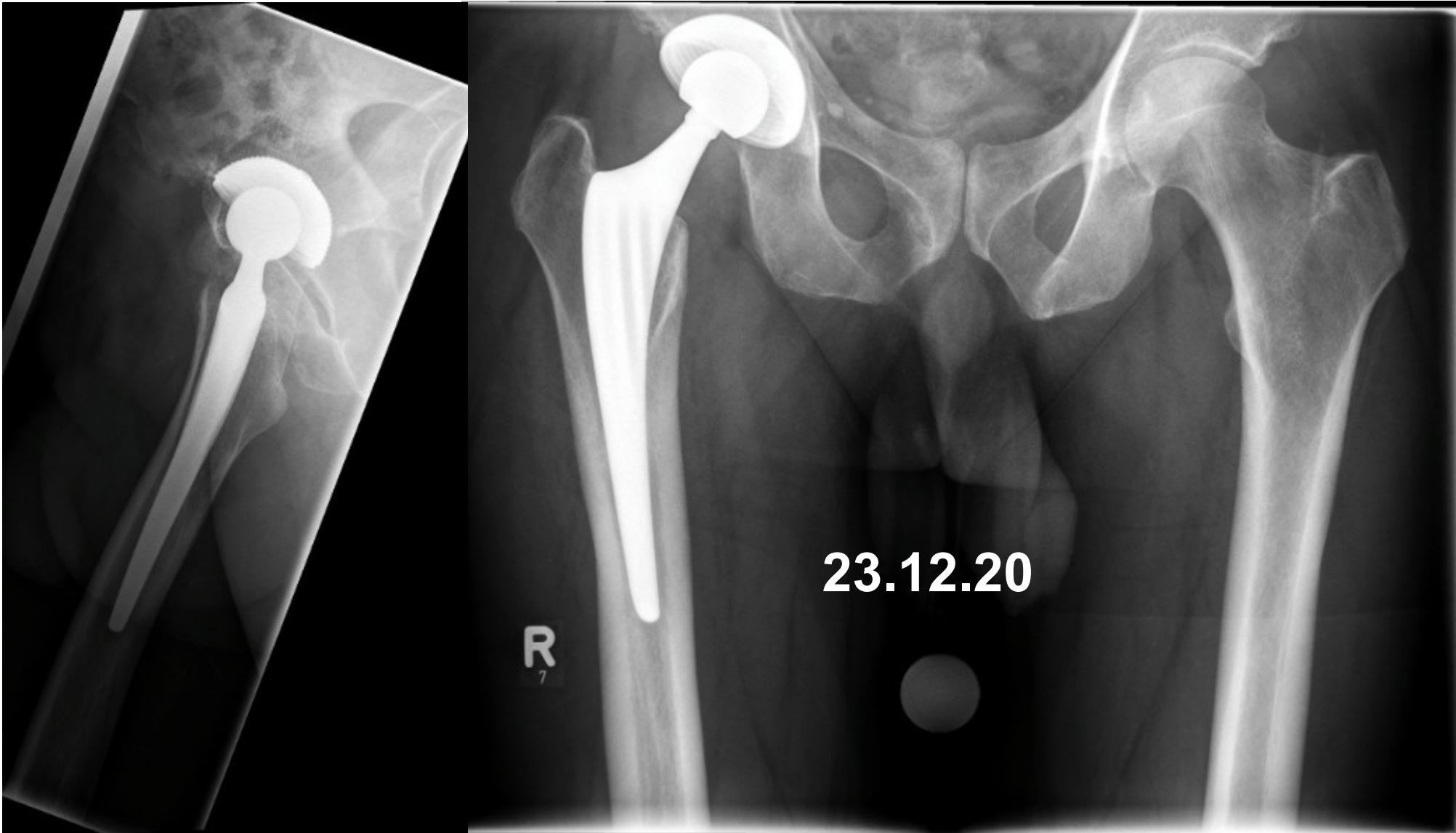
Cristoph, 56 years



6 weeks postop. Painfree and fully mobilised. Resumed to play tennis



Pain right hip and fever, weakness since 3 days (CRP: 280 mg/dl)



Serum

- CRP
- Leukozyten
- IL 6
- D Dimere
- other



Aspiration in Acute Infection?



Acute PJI

- DAIR
- One Stage Exchange ?
- Two Stage Exchange ?
- Girdlestone ?
- Fistula Persistence ?
- Nothing ?



Acute PJI

- DAIR
- One Stage Exchange ?
- Two Stage Exchange ?
- Girdlestone ?
- Fistula Persistence ?
- Nothing ?



Indication for DAIR

- < 3 weeks after implantation
- < 3 weeks after onset of the symptoms
- < 3 month after implantation
- Depending on the clinical symptoms and laboratory
- Gut feeling
- No cutoff



How do you perform a DAIR?

- Complete removal of the implants
- Leave the implants
- Just change the modular components



Irrigation and debridement for periprosthetic infections of the hip and factors determining outcome

Georgios K. Triantafyllopoulos¹ · Lazaros A. Poultides¹ · Vasileios I. Sakellariou¹ ·
Wei Zhang^{2,3} · Peter K. Sculco¹ · Yan Ma^{2,3} · Thomas P. Sculco¹

What kind and how much of irrigation do you use?

1. Saline 0.9%

2. Saline 0.9% + Vancomycin (1mg/mL)

3. Polymyxin-Bacitracin (500,000 U/L – 50,000 U/L, respectively)

4. Povidone-Iodine (Betadine) – 0.35%

5. Povidone-Iodine (Betadine) – 10%

6. Povidone-Iodine (Betadine) – 10% + 4% Hydrogen Peroxide (1:1)

7. Irrisept® (Chlorhexidine gluconate solution 0.05% in sterile water,

Irrimax Corporation, Lawrenceville, GA)

8. Bactisure® (ethanol, acetic acid, sodium acetate, benzalkonium

chloride and water, Zimmer Biomet, Warsaw, IN).



Courtesy Alberto Carli



ICM 2018

- **Recommendation:**
 - We recommend that 6-9L of irrigation solution, including saline or antiseptic solution such as sterile dilute povidoneiodine, is used during DAIR treatment of acute PJI.
- Level of Evidence: Consensus



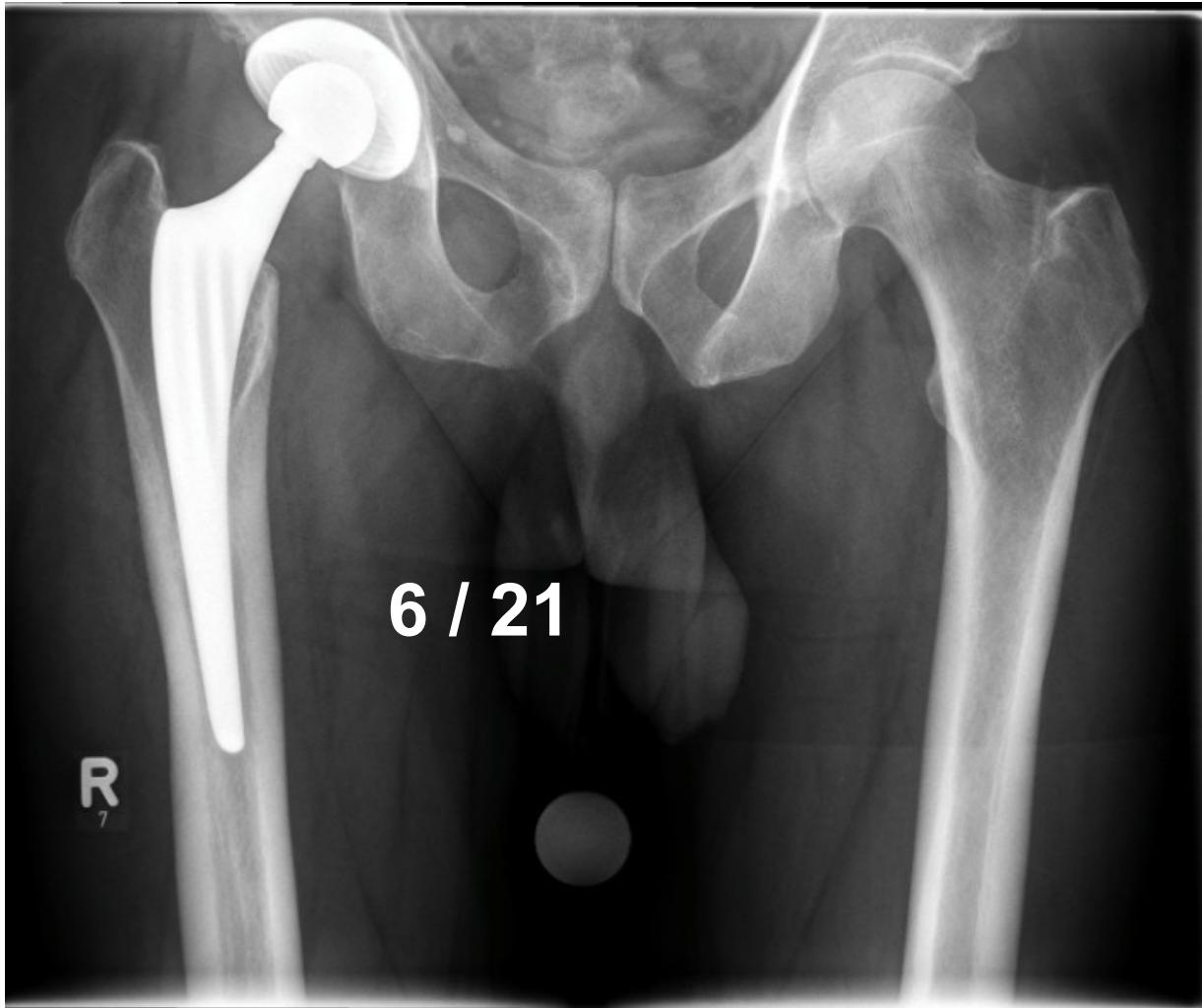
How long Antibiotics?

- **Recommendation**
- The optimal length of antibiotic treatment following DAIR remains relatively unknown as there is considerable heterogeneity regarding the length, dose, and administration of treatment. **Four to six weeks** of antibiotic therapy seems to be sufficient in most cases of PJI managed by DAIR.

Level of Evidence: Moderate



After 6 Month pain and new signs of infection



CRP: 25 mg/dl

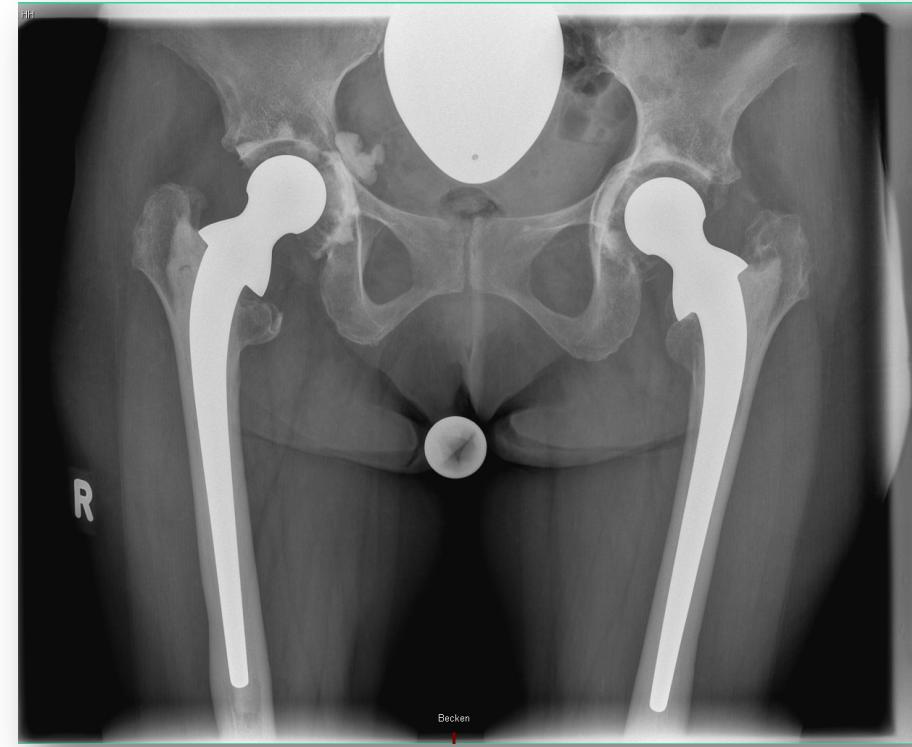
Next Step?



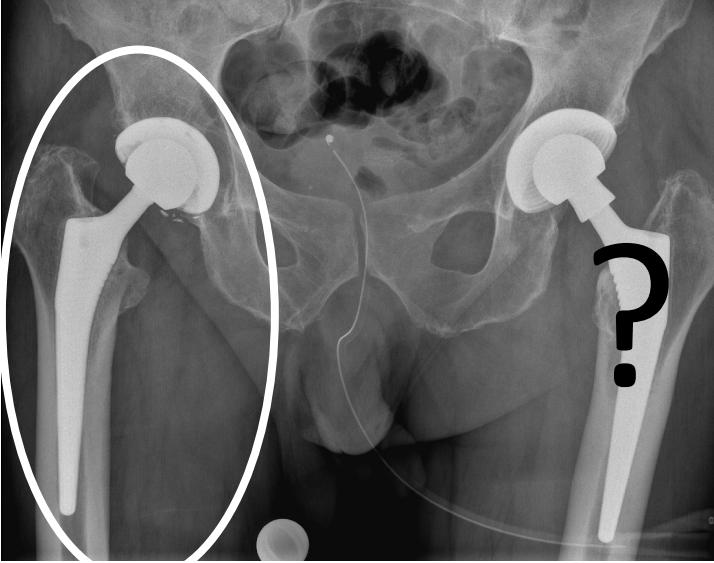
Aspiration

Do you aspirate your patients before any kind of revision

- Always
- Never
- Occasionally
- Just in case
of PJI suspicion



44 years post op.



Do you aspirate all joints?

Methods

Group 1
SAME-SIDE



Group 2
CONTRALATERAL



Group 3
UPPER AND LOWER
LIMB



Results

	Non-Metachronous PJI	Metachronous PJI	p-value
Number of patients	588	73	
Average age at first septic revision (SD)	68.6 (12.4)	73.4 (17.0)	0.27
Average BMI (SD)	29.6 (6.1)	28.6 (5.7)	0.30
>2 prosthesis (%)	128 (19.4)	19 (26)	0.10
Difficult to treat primary PJI	10.5 %	8.2 %	0.54
History of neoplasia	0.7 %	1.4 %	0.52
Immune-modulating therapy	0.4 %	1.4 %	0.22
Rheumatoid arthritis	6.1 %	5.5 %	0.49
Renal Insufficiency	8.3 %	8.2 %	0.97
Polymicrobial primary PJI	4.6 %	28.8 %	<0.05
Enterobacter	0.3 %	5.5 %	<0.05
Diabetes mellitus	17.9 %	27.4 %	<0.05



Where do you perform the aspiration?



How do you perform the aspiration?



CT-Guided



Ultrasound guided



Fluoroscopy guided

Which parameters are you looking for in the Synovial Fluid?

- Culture
- Cell count
- Leucocyte Esterase
- PMN%
- CRP
- Alpha Defensin
- NGS (Next Gen Sequencing)
- Calprotectin
- Multiplex PCR



Results

Criteria	Aspiration right knee
Sinus tract	-
Culture 2x	-
Cell count	17.020 (3.000)
Neutrophilpercentage %	86,5% (70%)
Leukocyteseserase-Test	+++
Alpha-Defensin	6,7 (1,0)
Histology	
Serum CRP	25
Culture	Neg.
Positive Purulence	-
(Sonication)	
Points (ICM)	7

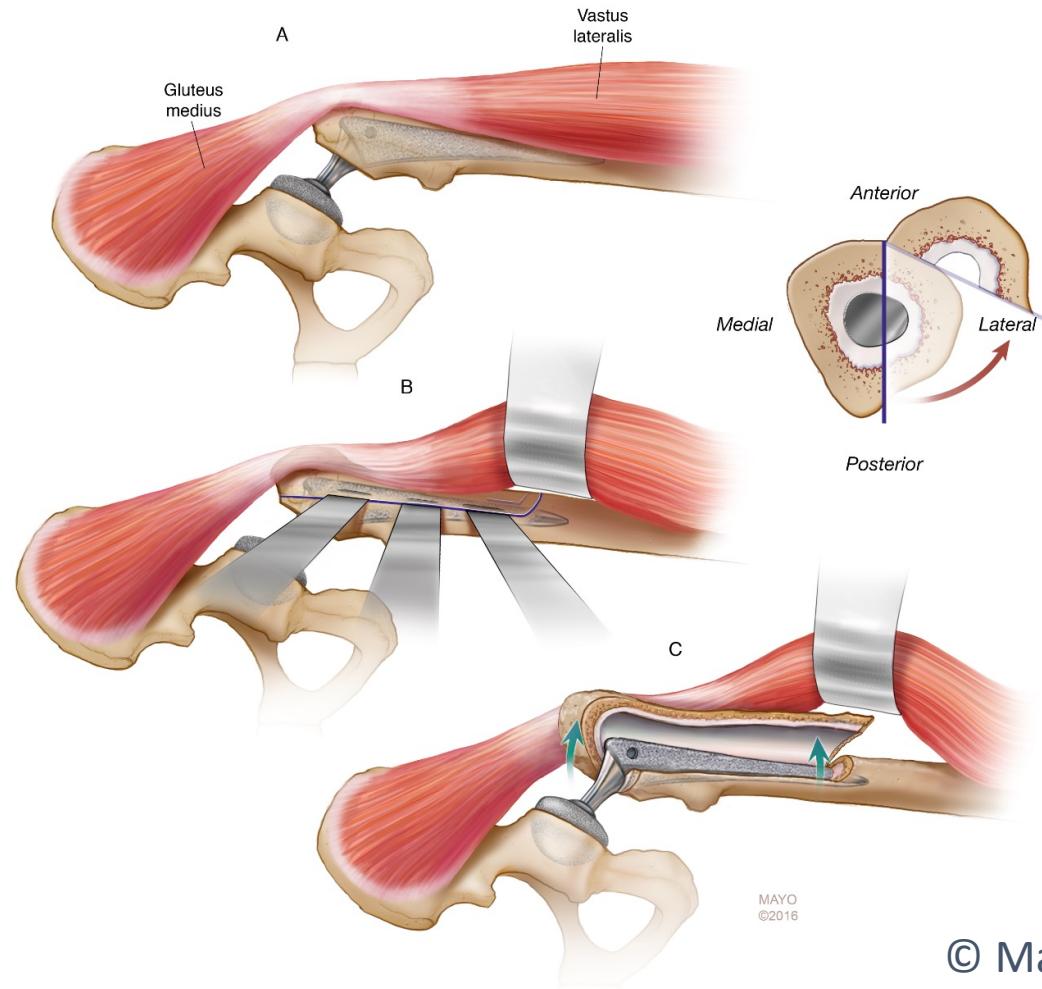




Aspiration:
No growth

Removal of the implant

- Endofemoral
- ETO
- Fenestration
- Transfemoral Approach



MAYO
©2016

© Matthew Abdel

Chronic PJI

- DAIR
- One Stage Exchange
- 1.5 Stage Exchange
- Two Stage Exchange
- Girdlestone
- Fistula Persistence
- Nothing



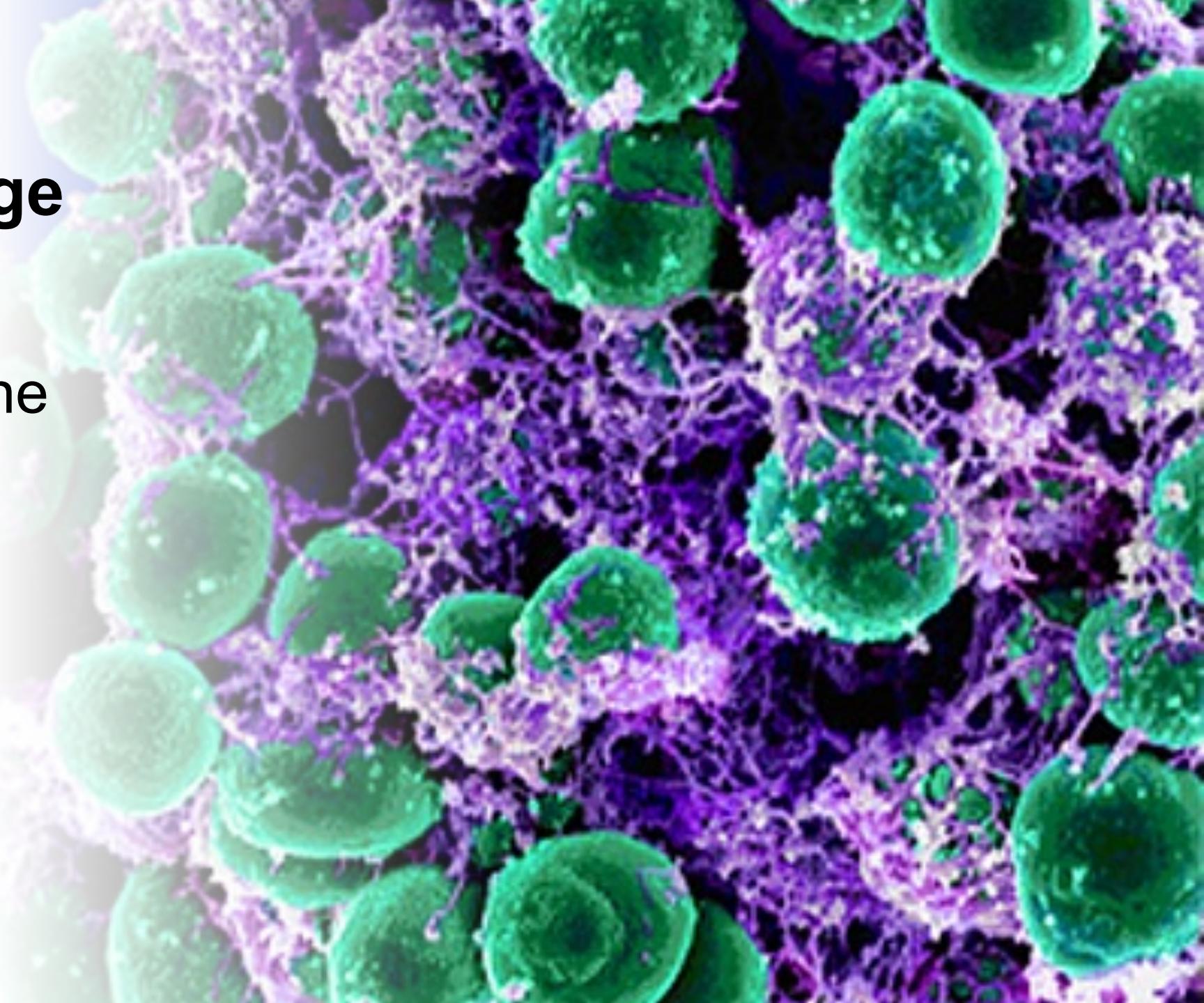
One Stage Exchange

- Prerequisites?
- Always cemented implants?
- What kind of antibiotics do you add to the bone cement?
- How long postop. Antibiotics?



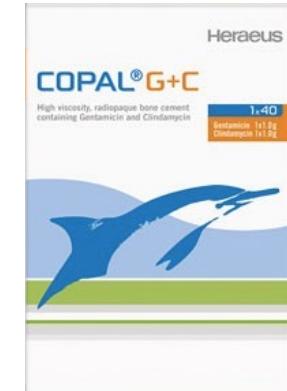
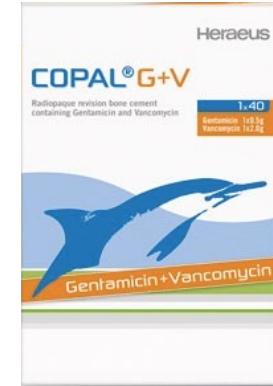
Prerequisites for a One Stage Exchange ?

- Knowledge of the germ
- Sensible germ
- Absence of a fistula
- Multimorbid Patient



Fixation in One Stage

- Antibiotic loaded Bone Cement
- Cementless Revision Stems
- Combination



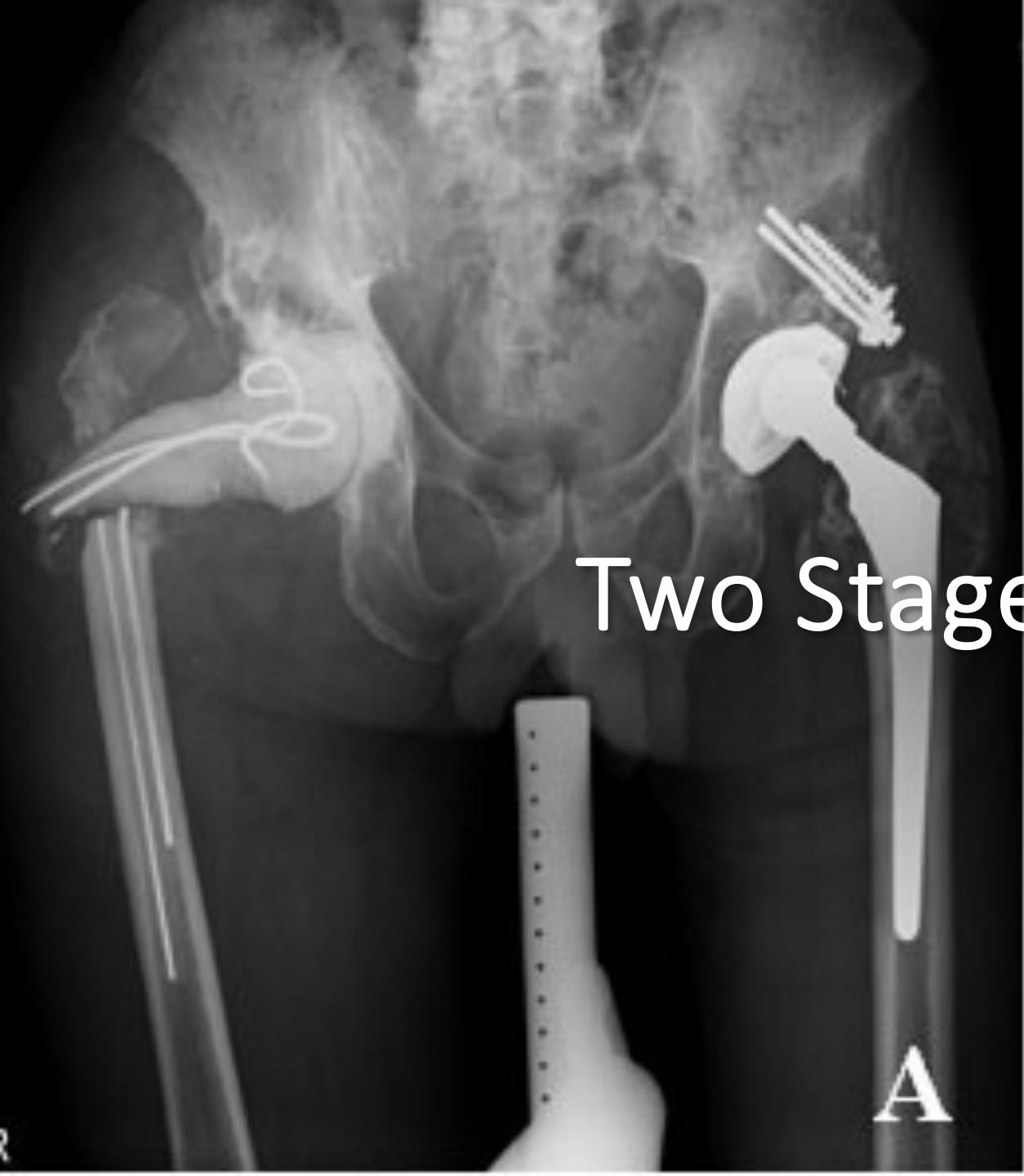
Let's ask Ed



Chronic PJI

- DAIR
- One Stage Exchange
- **1.5 Stage Exchange**
- **Two Stage Exchange**
- Girdlestone
- Fistula Persistence
- Nothing





Two Stage Exchange

A



B

Spacer-Types

1. Hand-made



2. Molds



3. Preformed



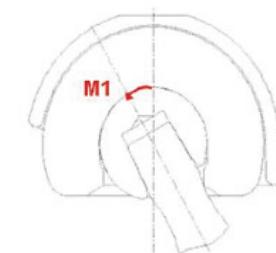
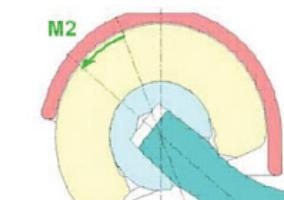
4. Modular



None of them
fulfill all
requirements!



ENDO Spacer



Spacer

How long?

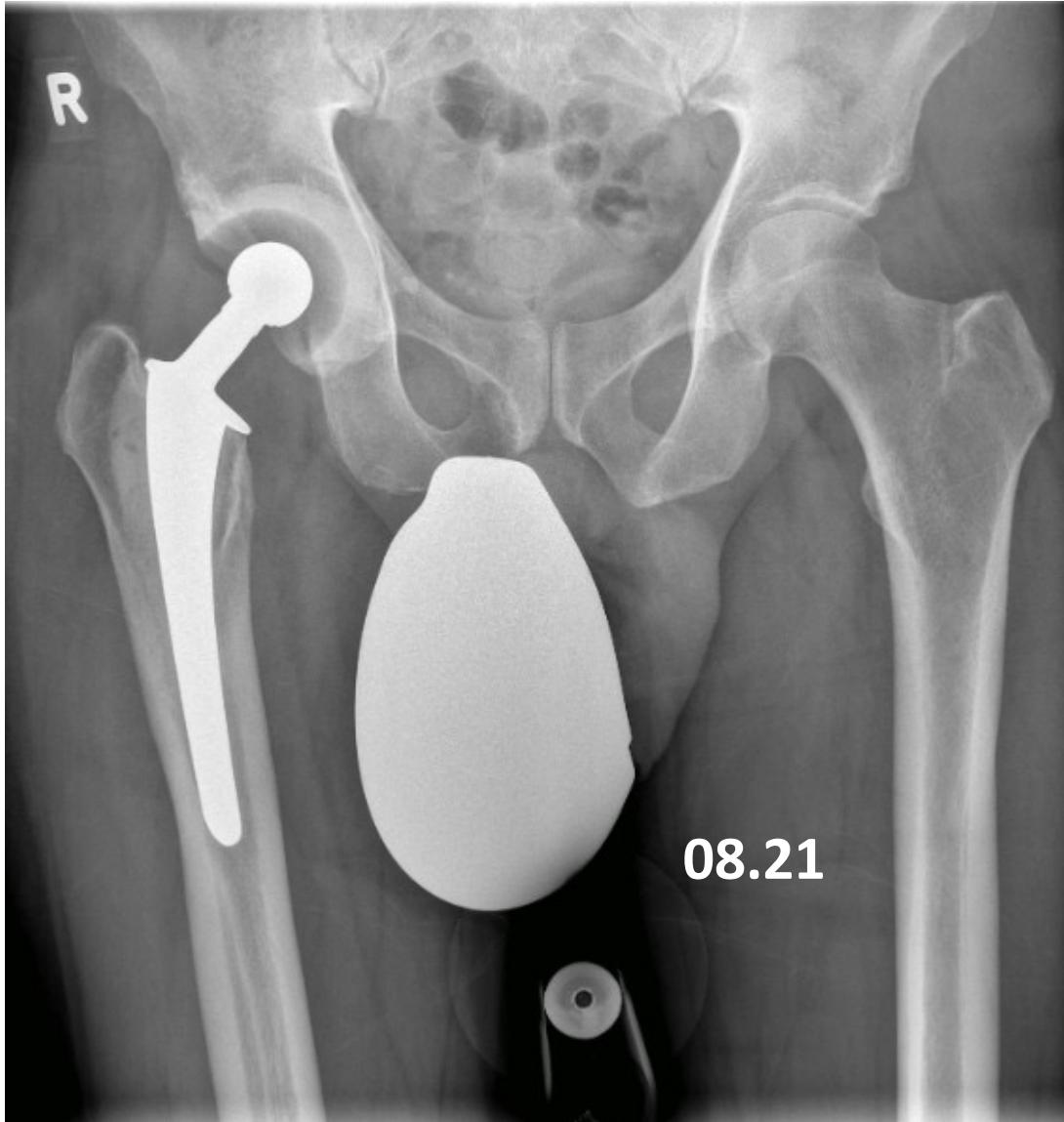
Length of the Intervall?

Length of Antibiotic Therapy?

Antibiotic Holiday?

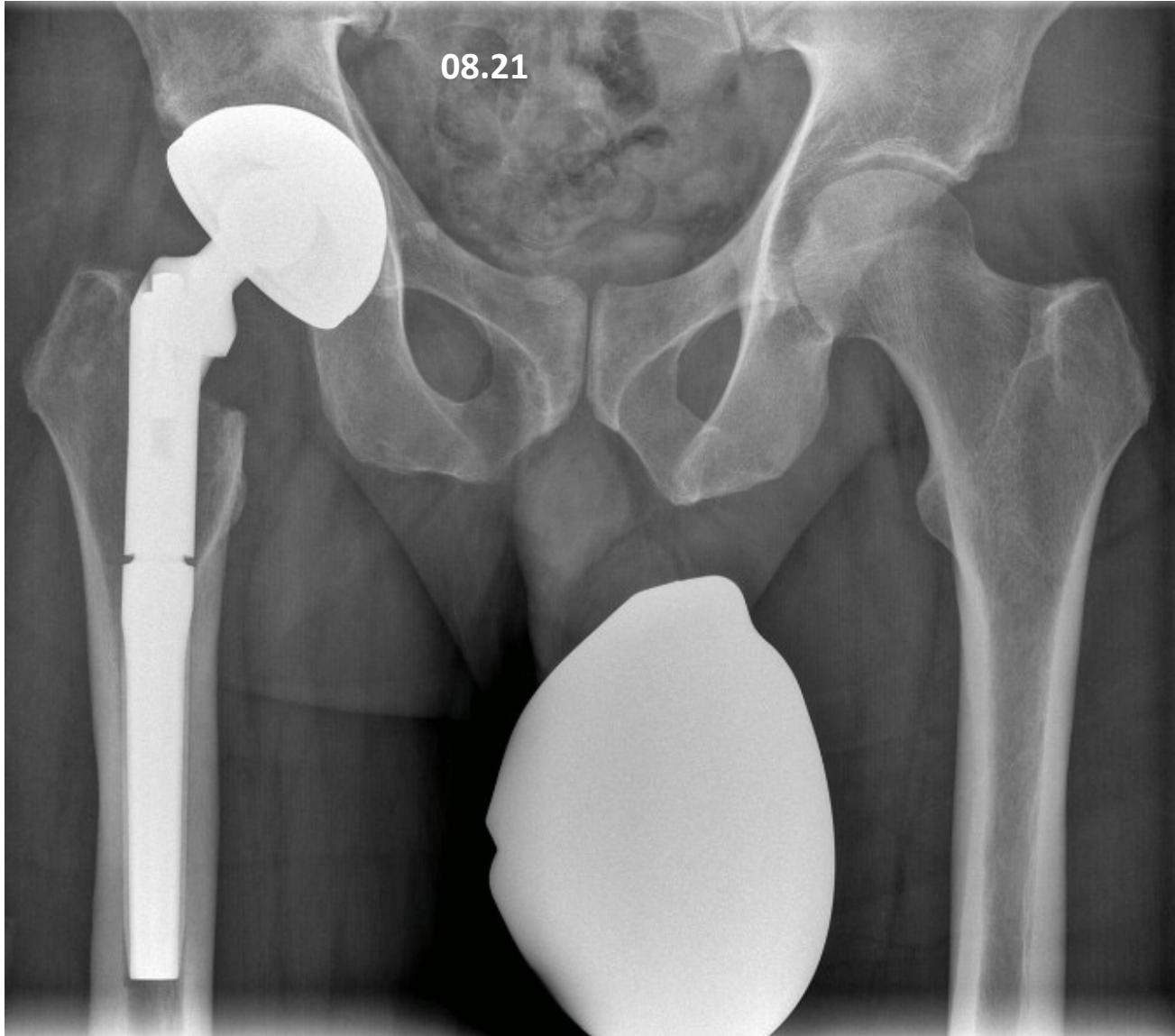
Reaspiration before Reimplantation?





2 month later

**What kind of
implant for
reimplantation?**



Reimplantation with
uncemented modular
Revision Stem and
Dual Mobility Cup



ENDO-Klinik Hamburg

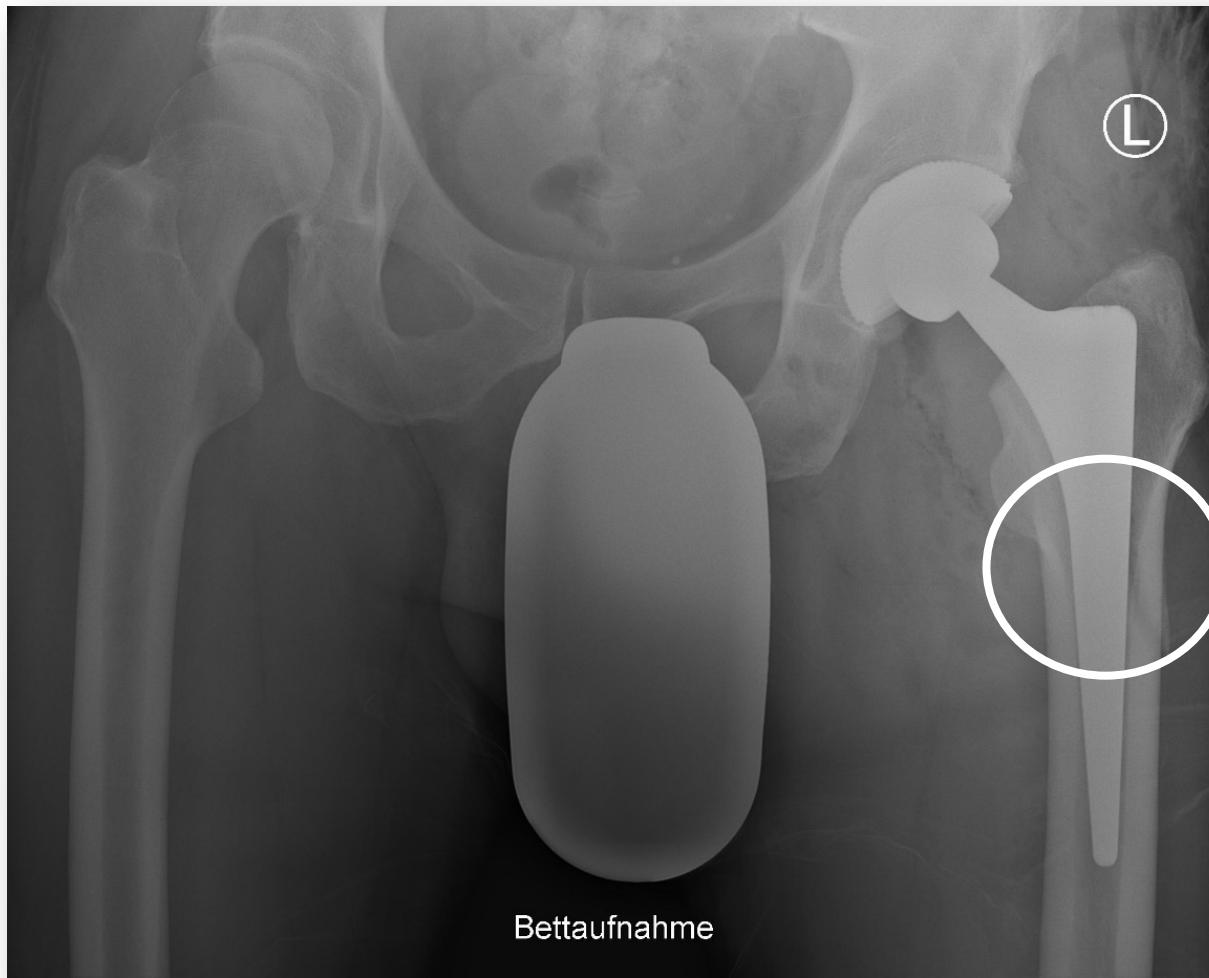


Walter, 56 years, osteoarthritis of the hip (06/19)



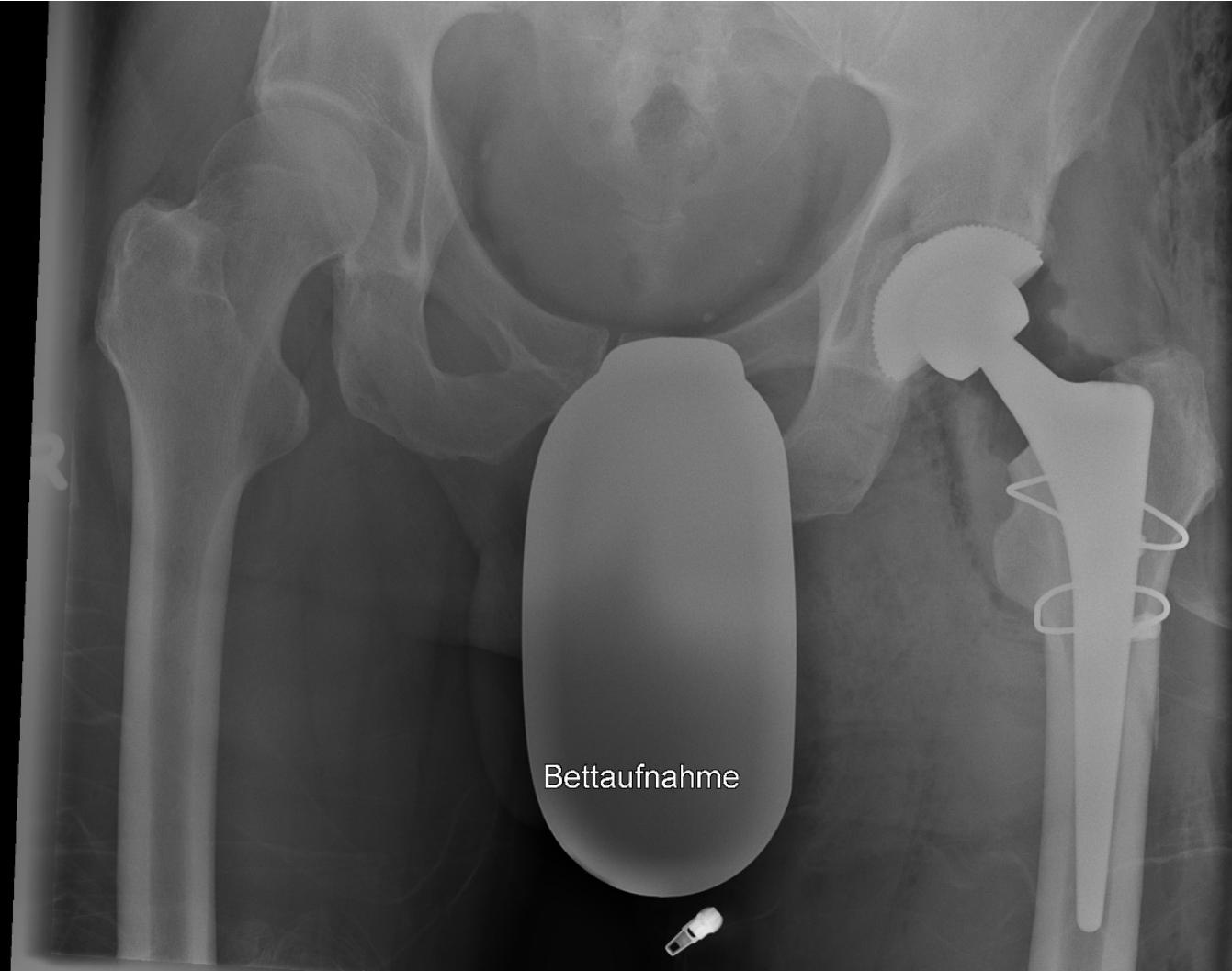
Implant?
Bearing?
Fixation?

Primary THA (left) (CLS-Stem [Zimmer], Allofit Cup [Zimmer]) 06/2019



Any
Criticism?

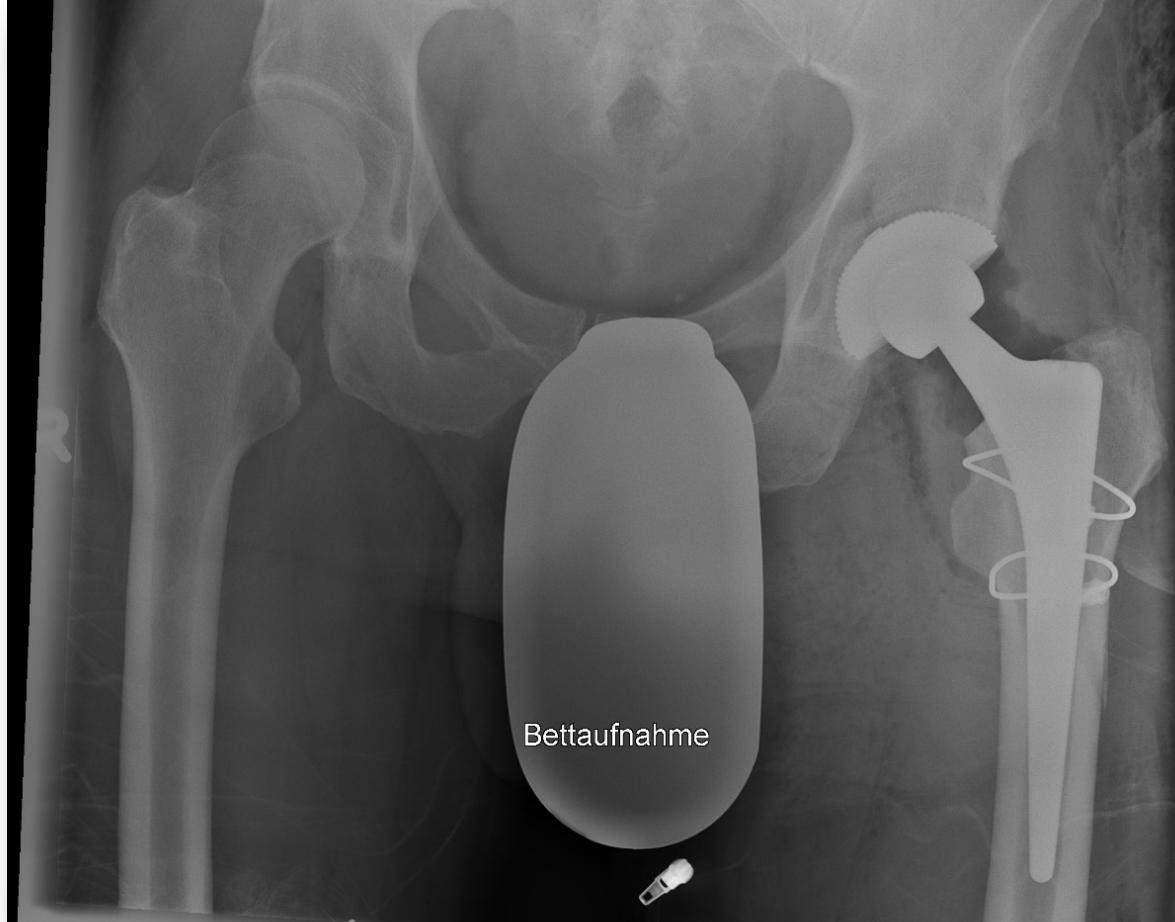
Same-Day-Revision due to periprosthetic fracture of proximal femur
with an internal fixation using a cerclage system 06/2019

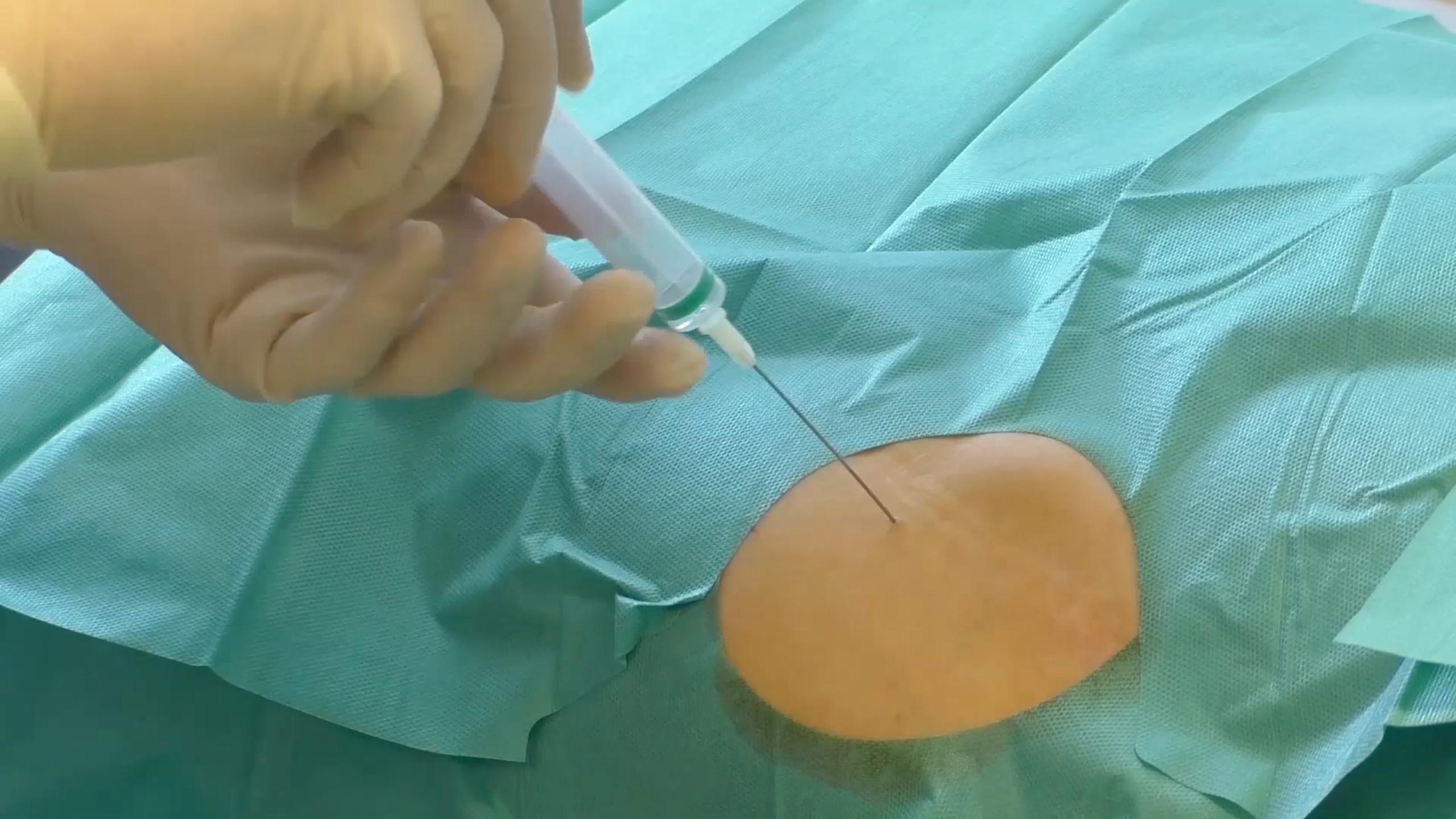


Any
Comment ?



Swelling and redness after rehabilitation associated with a UTI 3 weeks postop





Do we really need the aspiration ?

Major criteria (at least one of the following)	Decision
Two positive cultures of the same organism	Infected
Sinus tract with evidence of communication to the joint or visualization of the prosthesis	

ICM Score
96% Sensitivity

Preoperative Diagnosis	Minor Criteria	Score	Decision
	Elevated CRP <i>or</i> D-Dimer	2	<i>>6 Infected</i> <i>2-5 Possibly Infected ^a</i> <i>0-1 Not Infected</i>
Synovia	Elevated ESR	1	
	Elevated synovial WBC count <i>or</i> LE	3	
	Positive alpha-defensin	3	
	Elevated synovial PMN (%)	2	
	Elevated synovial CRP	1	

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Synchronous Periprosthetic Joint Infections

The Need for All Artificial Joints to Be Aspirated Routinely

Darius M. Thiesen, MD,* Seval Mumin-Gündüz,* Thorsten Gehrke, MD, Iainiv Klaber, MD, Jochen Salber, MD, PhD, Eduardo Suero, MD, and Mustafa Citak, MD, PhD

Investigation performed at Helios ENDO-Klinik Hamburg, Hamburg, Germany 2407201912112019

Intraoperative Diagnosis	Inconclusive pre-op score <i>or</i> dry tap ^a	Score	Decision
Preoperative	Preoperative score	-	<i>>6 Infected</i> <i>4-5 Inconclusive ^b</i> <i>≤3 Not Infected</i>
	Positive histology	3	
	Positive purulence	3	
	Single positive culture	2	

Parvizi J, Tan TL, Goswami K, Higuera C, Della Valle C, Chen AF, Shohat N. The 2018 Definition of Periprosthetic Hip and Knee Infection: An Evidence-Based and Validated Criteria. J Arthroplasty. 2018 May;33(5):1309-1314.e2. doi: 10.1016/j.arth.2018.02.078. Epub 2018 Feb 26. PMID: 29551303.



The Prioritisation?

- Bacteriology (Culture)
- Synovial analysis (CC, PMN etc.)
- Leucocyte esterase
- Alpha Defensin (quantitativ)

If less than 2 cc



Our Patient

CRP <0,5 mg/l

Hip aspiration:

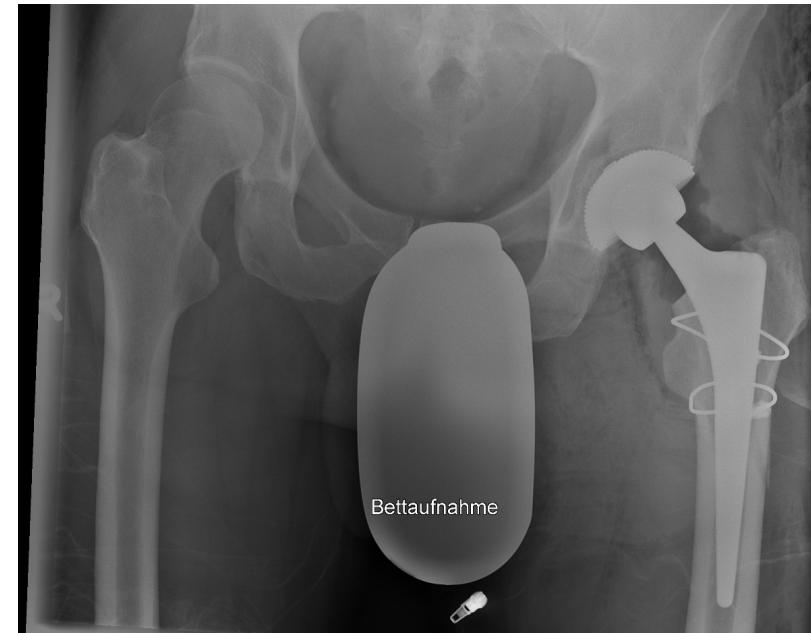
No growth

LE ++

Alpha Defensin 0,8

CC 1200

PMN 65%

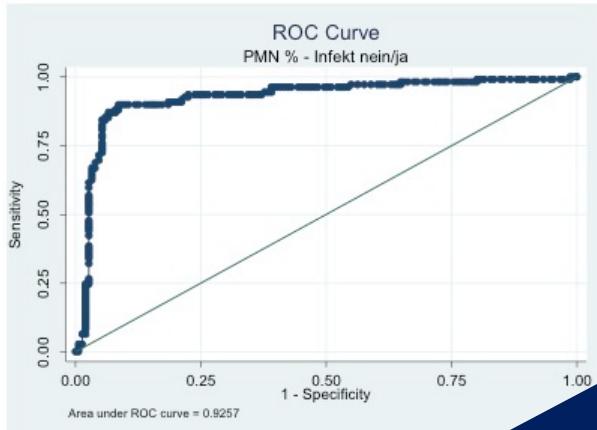


What next?

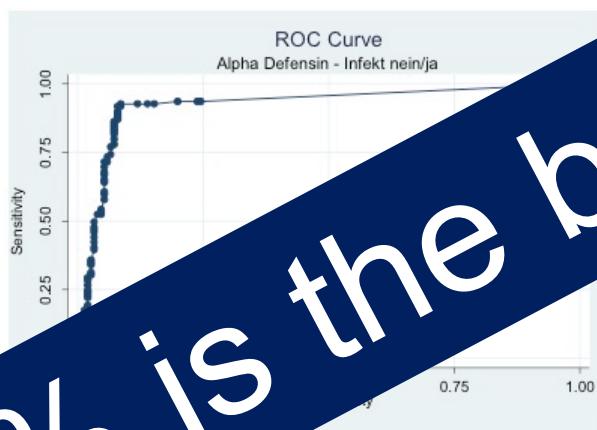


Evaluating the Diagnostic Performance of the 2018 International Consensus Meeting Preoperative Minor Criteria for **Chronic** Periprosthetic Joint Infection

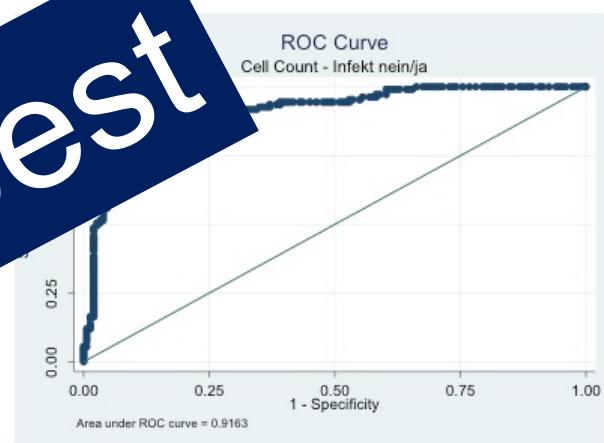
PMN %



Alpha-Defensin



Cell Count



Diagnostic performance of the minor criteria

Minor Criteria ranked in descending order:

N = 345

PMN% is the best

1. PMN% (0.926)
2. Alpha-Defensin (0.922)
3. Cell count (0.916)
4. LE-test (0.861)
5. Serum CRP (0.860)



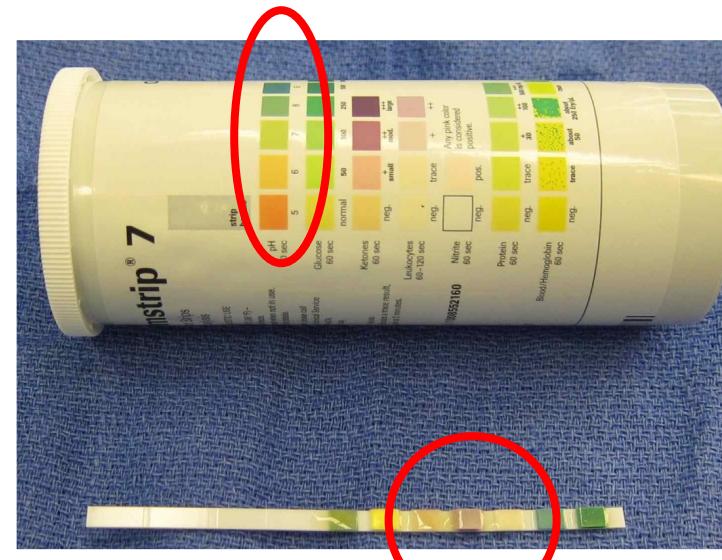
Leukocyte-esterase (LE) – Urinary Strips

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Diagnosis of Periprosthetic Joint Infection: The Utility of a Simple Yet Unappreciated Enzyme

Javad Parvizi, MD, FRCS, Christina Jacovides, BS, Valentin Antoci, MD, PhD, and Elie Ghanem, MD

Investigation performed at the Rothman Institute of Orthopedics at Thomas Jefferson University Hospital, Philadelphia, Pennsylvania



- **Parvizi J, Jacovides C, Antoci V, Ghanem E:** Diagnosis of periprosthetic joint infection: the utility of a simple yet unappreciated enzyme, JBJS-Am 2011, 93(24): 2242-8
- **Aggarwal VK, Tischler E, Ghanem E, Parvizi J:** Leukocyte esterase from synovial fluid aspirate: a technical note, J arthroplasty 2013, 28(1): 193-5

- cheap
- quick
- easy to carry out

Sensitivity: 85.7 %
Specificity: 88.3 %



Leukocyte Esterase Versus ICM 2018 Criteria in the Diagnosis of Periprosthetic Joint Infection

Emanuele Chisari ¹, Steven Yacovelli ¹, Karan Goswami ¹, Noam S

Javad Parvizi ¹

Affiliations + expand

PMID: 33812714 DOI: [10.1016/j.arth.2021.03.006](https://doi.org/10.1016/j.arth.2021.03.006)

- **Methods:** This is a retrospective study of patients undergoing primary total knee arthroplasty at a single institution between March 2009 and December 2019. All patients were evaluated for periprosthetic joint infection (PJI). PJI was defined using the 2018 ICM criteria.
- **Results:** As per the 2018 ICM criteria, 111 patients had chronic PJI and 181 were not infected. An LE test with a cutoff of $\geq 1+$ had a sensitivity of 0.744, a specificity of 0.773, an accuracy of 0.773 (95% confidence interval 0.772-0.788), and a likelihood ratio positive (LR+) was 7.917. Using an LE cutoff of 2+ had a sensitivity of 0.513, a specificity of 1.000, and an LR+ of 0.812.
- **Conclusion:** Leukocyte esterase testing is a point of care test which can be performed at the bedside. Its performance is valuable as per ICM criteria. Based on the findings of this study, we suggest using the cutoff of LE1+ (result = negative or trace) as a point of care test to exclude infection, whereas LE at 2+ has near absolute specificity for the diagnosis.



Can the Leukocyte Esterase Strip Test Predict Persistence of Periprosthetic Joint Infection at Second-Stage Reimplantation?

Nicola Logoluso ¹, Antonio Pellegrini ¹, Virginia Suardi ¹, Ilaria Morelli ²,
Antonino Giulio Battaglia ³, Roberto D'Anchise ⁴, Elena De Vecchi ⁵, Luigi Zagra ³

Affiliations + expand

PMID: 34822929 DOI: 10.1016/j.arth.2021.11.022

LE: 82% Sensitivität

CRP: 82% Sensitivität

Eosinophilic Granuloma: 82% Sensitivität

- **Conclusion:** The LE strip test proved a reliable tool to diagnose persistence of infection and outperformed the serum CRP and ESR assays. The LE test provides a valuable intraoperative diagnostic during second-stage revision for PJI.

LE is a good predictor for PJI Persistence



Follow-Up after 4 months (10/19)

Still pain



New Aspiration

**WBC: 3478
PMN: 80%
No Growth**

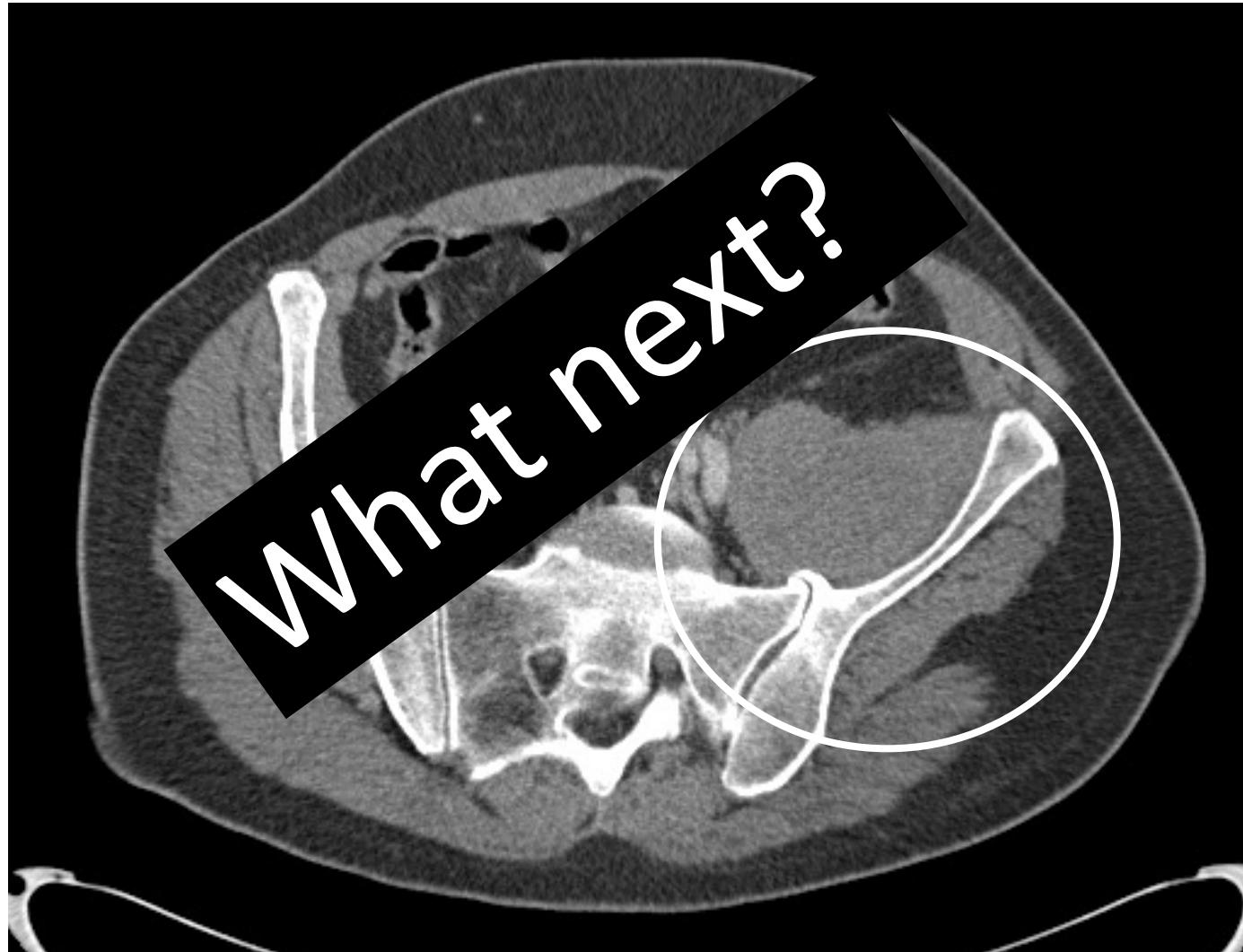


Some other examinations?

PET-CT (12/19)

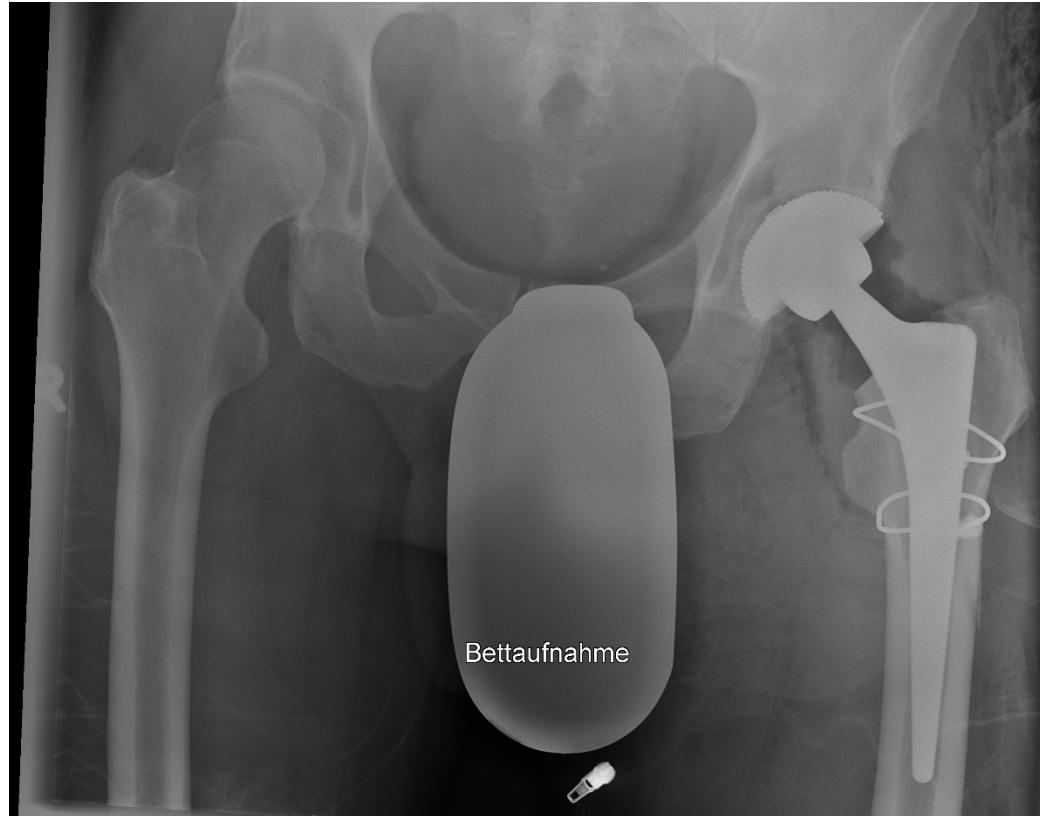


CT with psoas abscess (12/19)



PCR: DNS of coagulase negative Staphylococcus

Open biopsy of the left Hip: No germ found



What next?

One Stage Exchange ?
Two Stage Exchange ?
Girdlestone ?
Fistula Persistence ?
Nothing ?



Spacer ?

1. Hand-made



2. Molds



4. Modular



3. Preformed



Spacer

How long?

Length of the Intervall?

Length of Antibiotic Therapy?

Antibiotic Holiday?

Reaspiration before Reimplantation?



Two Stage Exchange

Explantation and Sonication of the implants

12/2019

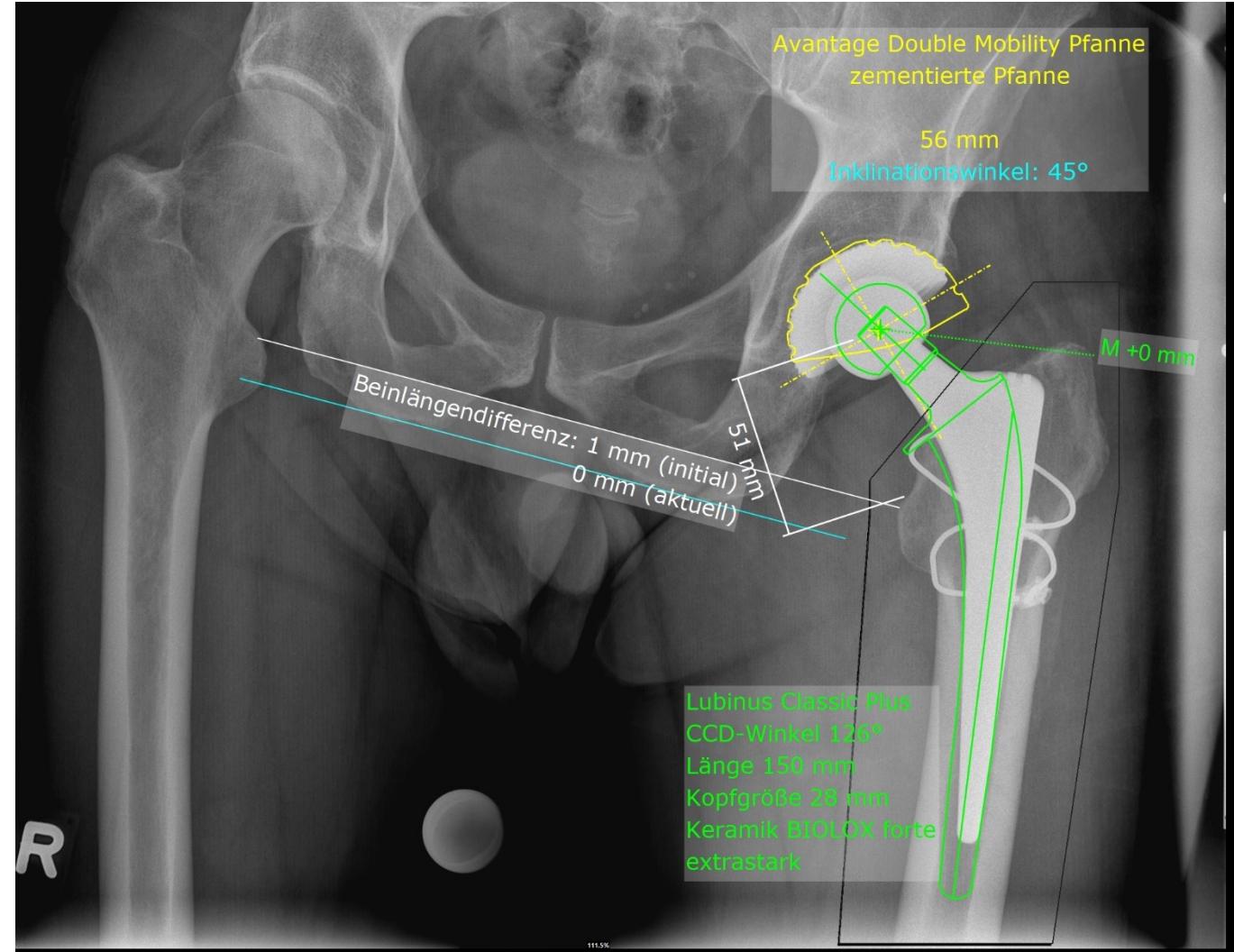
Sonication: *Cutibacterium acnes*

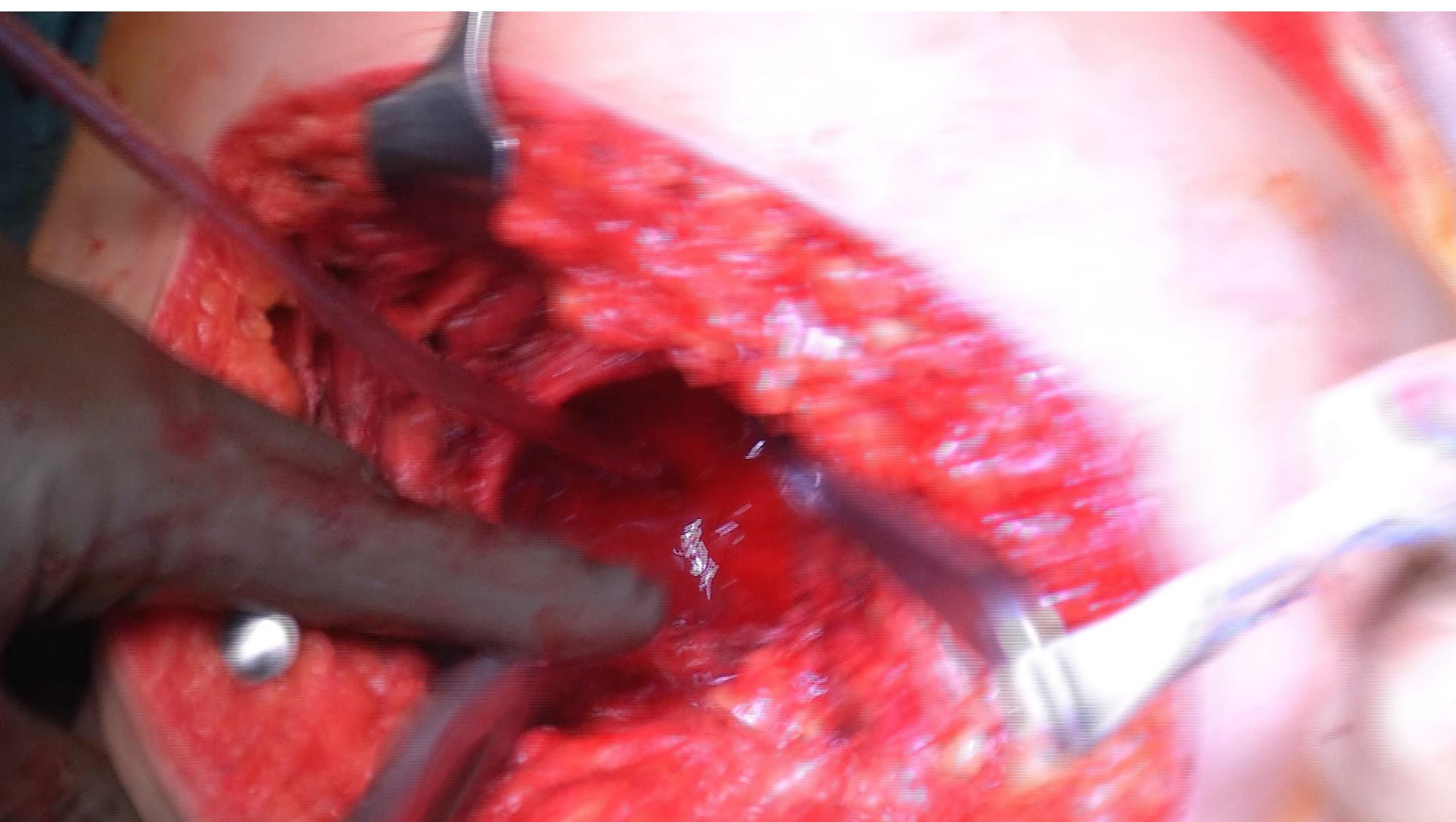
- **Topic therapy (Spacer):**
Vancomycin,Clindamycin,Gentamicin;
- **Systemic therapy:** Daptomycin, Ciprofloxacin;
- **Sequential therapy until re-implantation:** Clindamycin



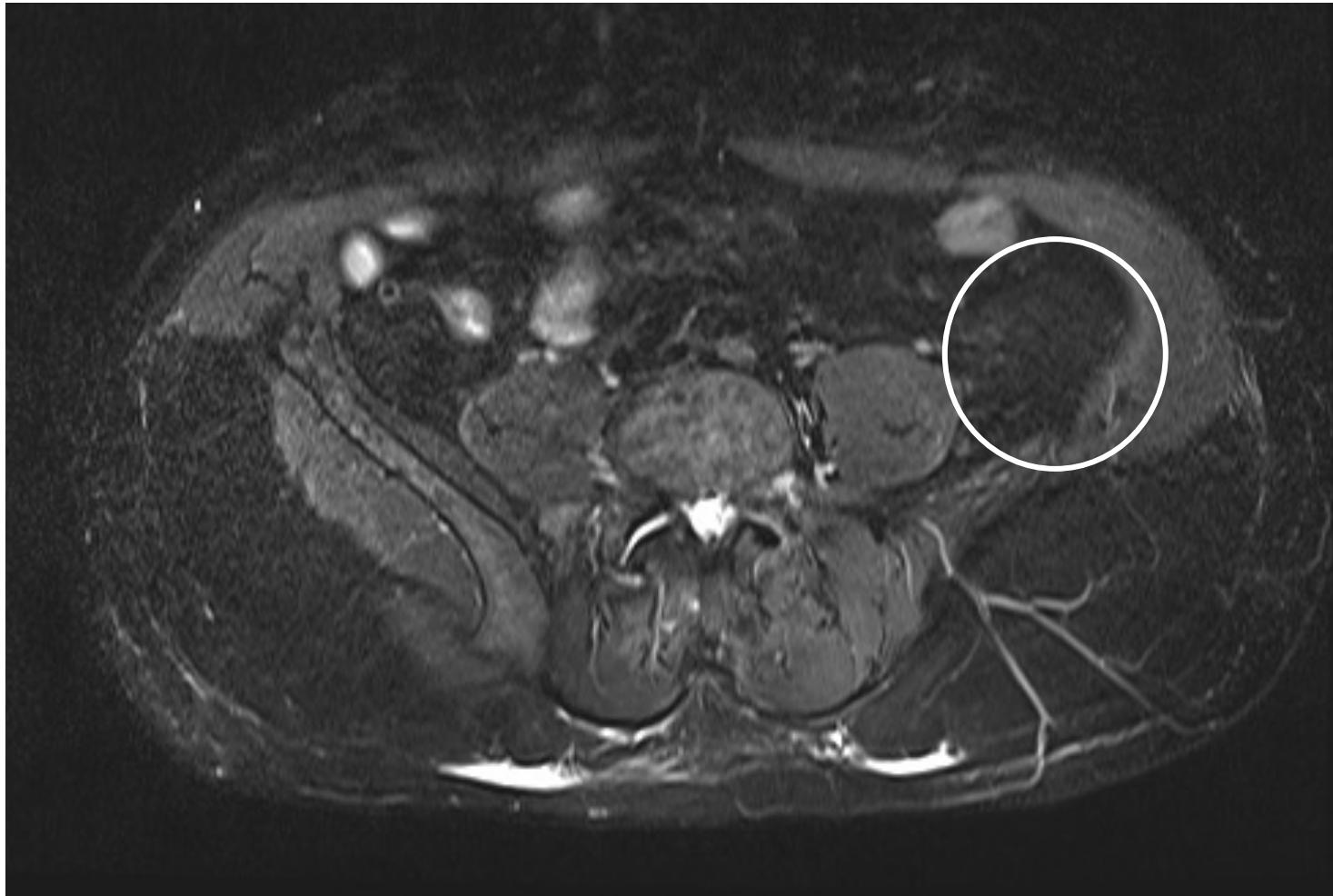
Planning ENDO-Spacer

Topic therapy:
Vancomycin, Clindamycin, Gentamicin
Systemic therapy:
Vancomycin, Rifampicin

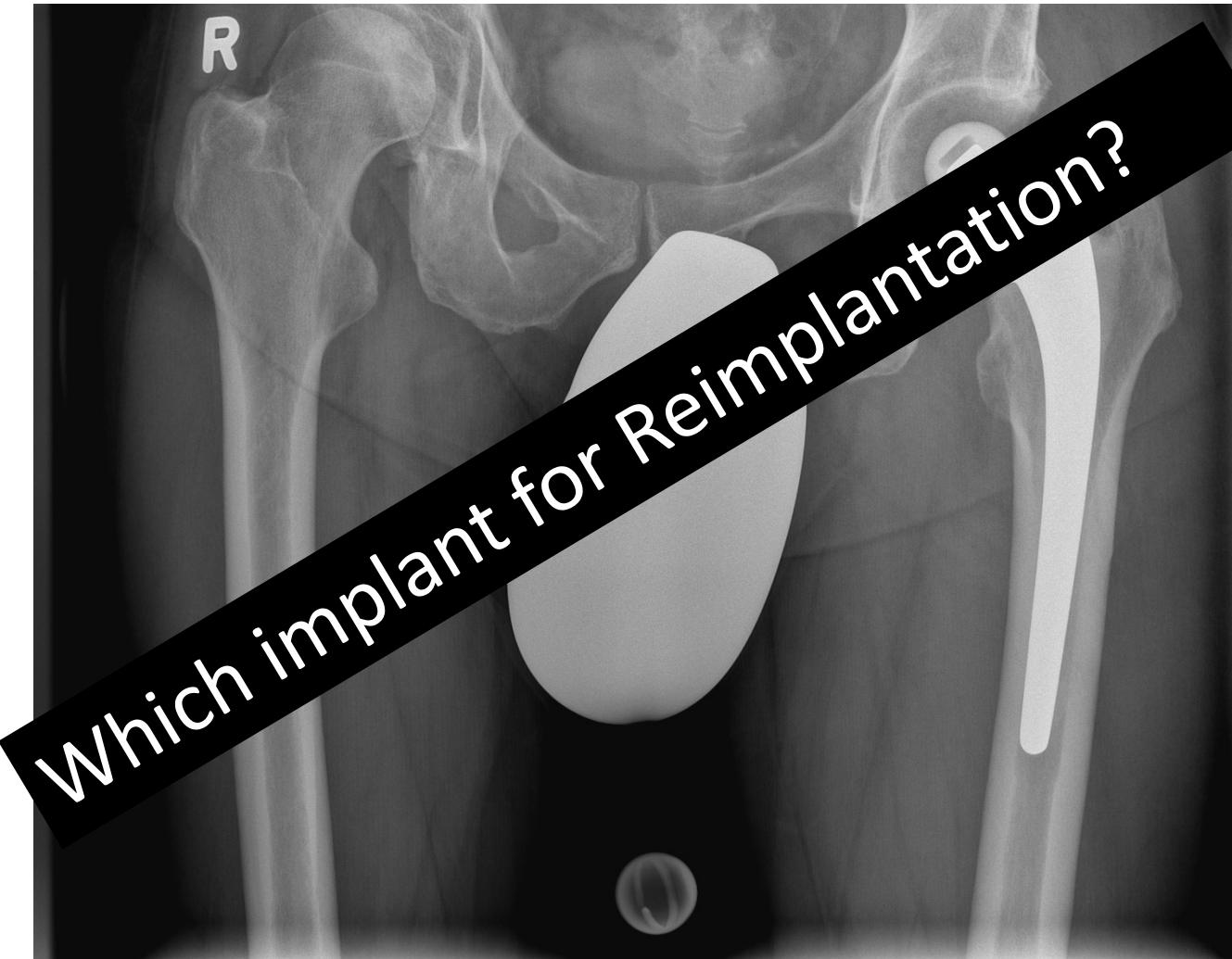




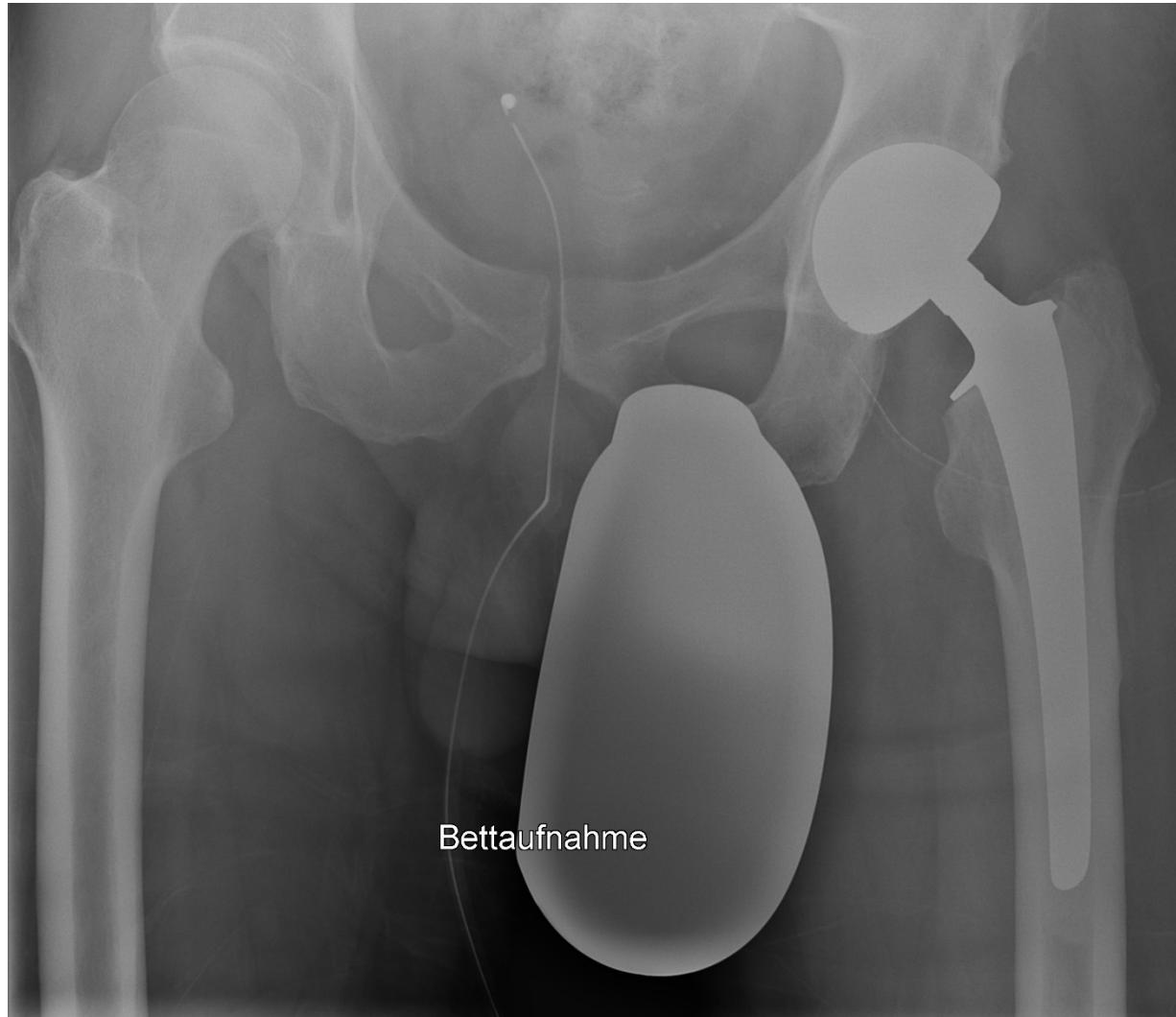
MRI of psoas after 6 weeks of ENDO-Spacer



ENDO-Spacer after mobilization



After re-implantation

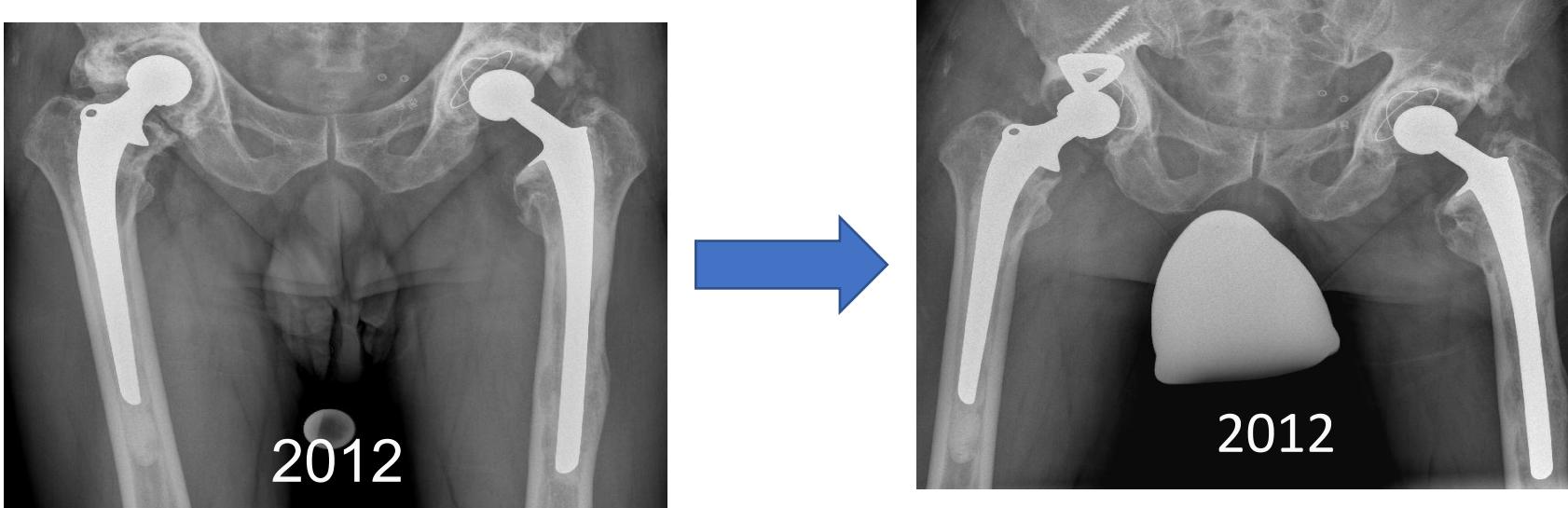


Length of
antibiotic
Treatment?

Paul, 75 Years

- Primary THR both sides 1995
- Cup Exchange right + Total Exchange left 2012

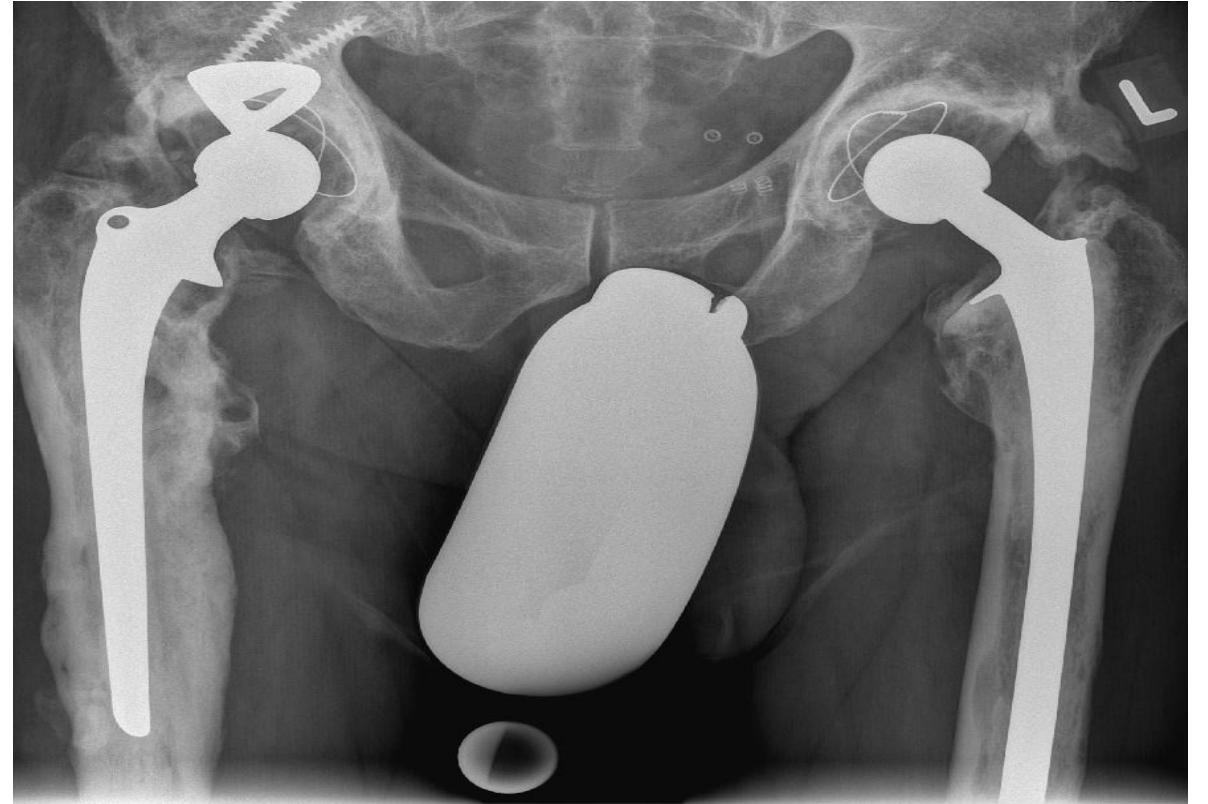
Hip pain since one year right hip



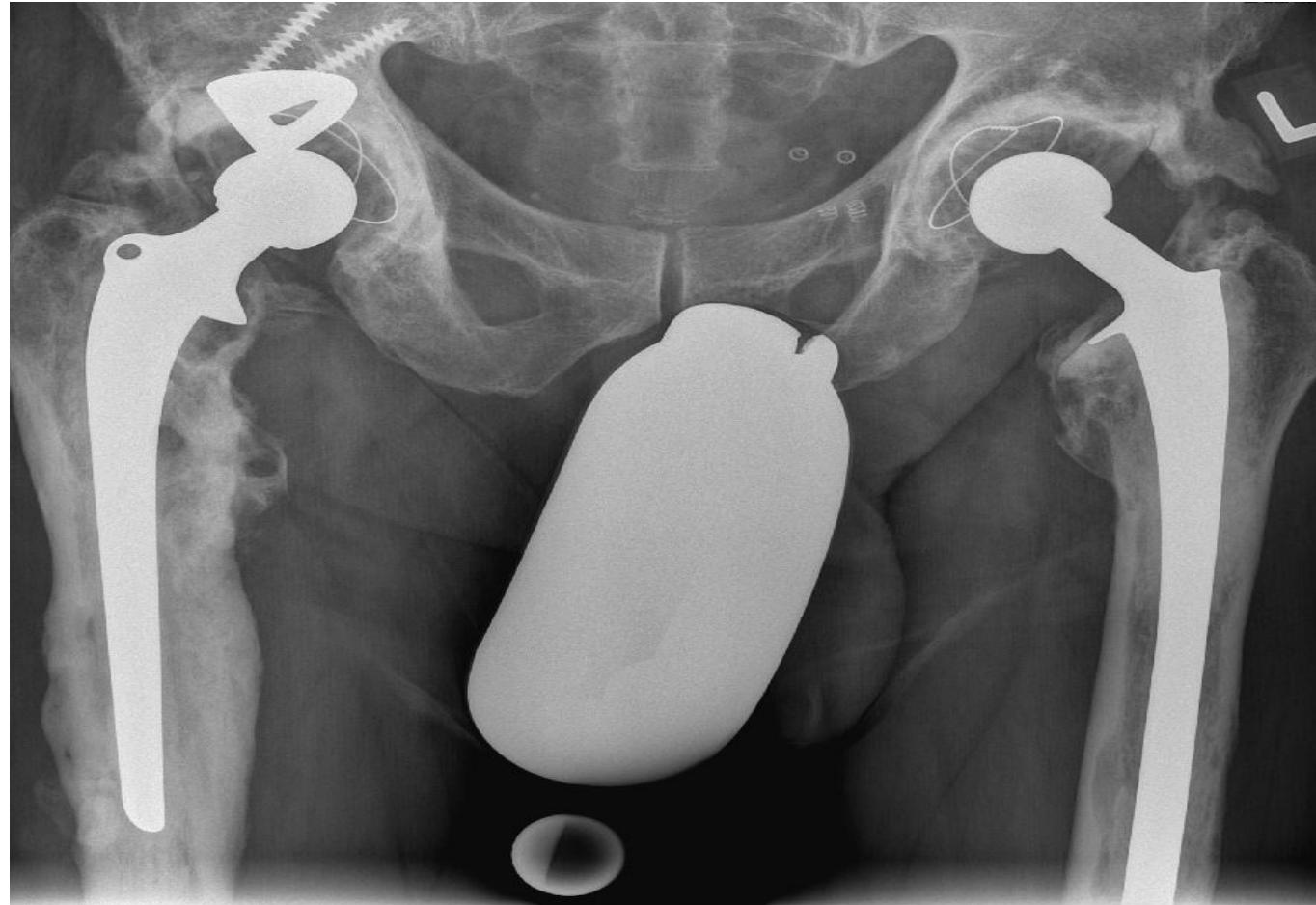


Imaging?

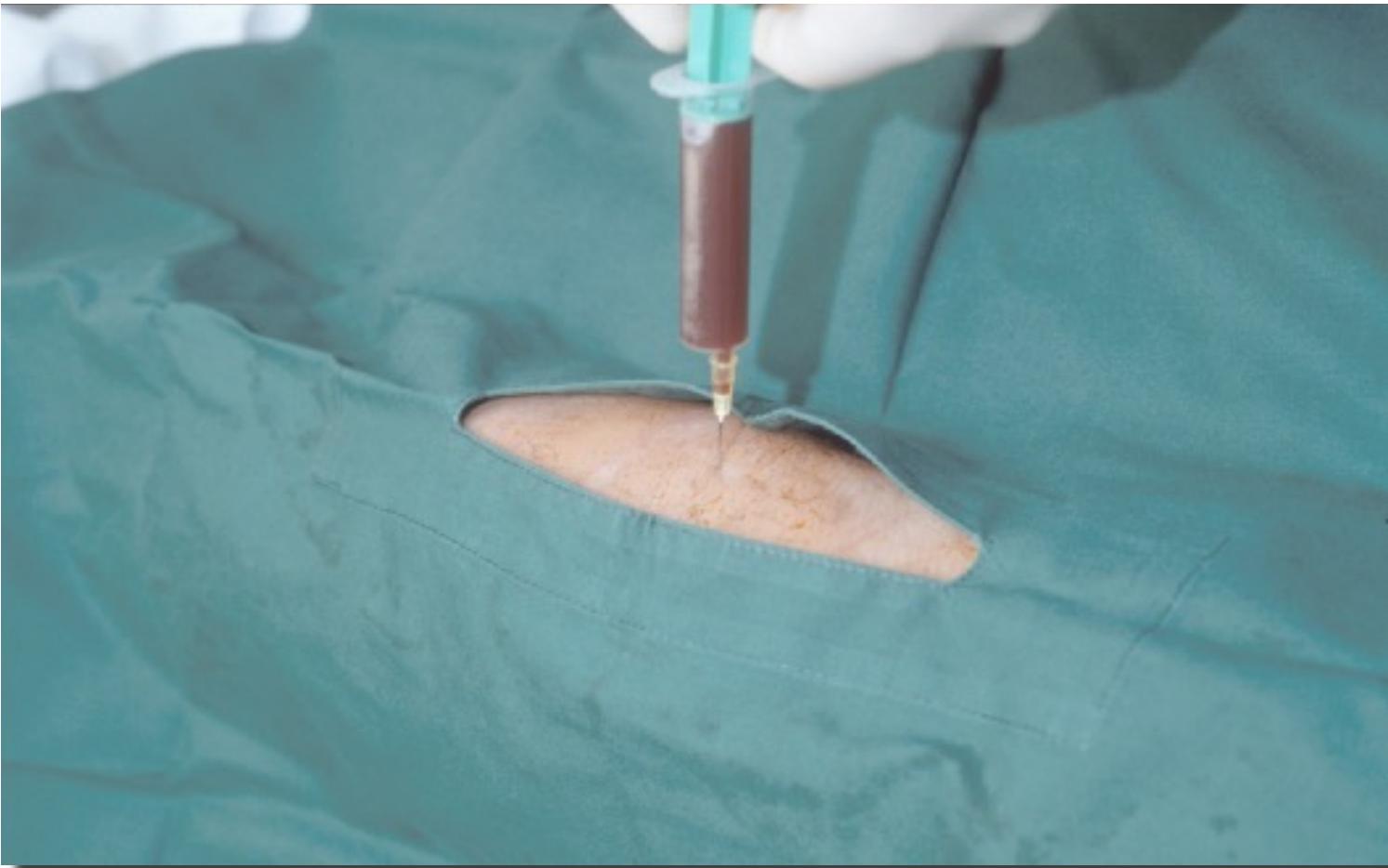
- CT
- MRI
- PET-CT



Serum parameters?



Aspiration



Aspiration

- How?
- Every revision?
- If not - why?



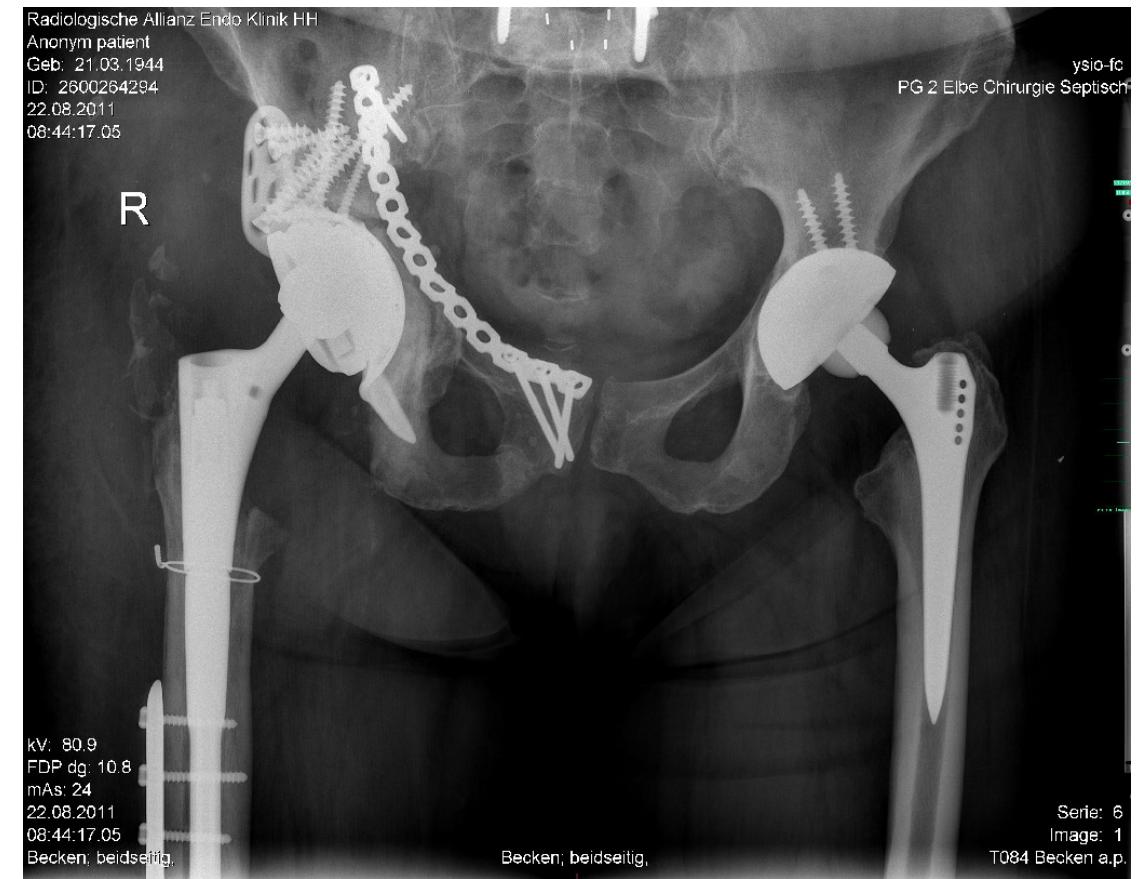
Aspiration

- Synovasure® (Lateral Flow)
- Alpha Defensin (Quantitativ)
- Leukozytenesterase (neutrophile Elastase)
- CRP
- Cell Count
- PMN %
- Culture (Microbiology)



**Would you aspirate
the other hip as well?**

PJI right hip



Aspiration right hip 04/2019

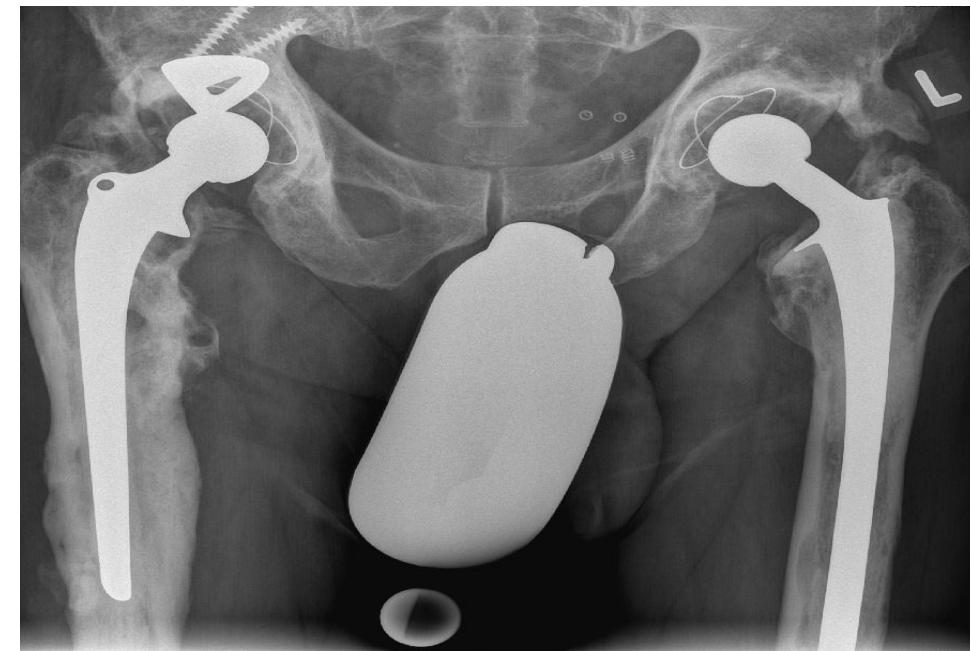
Alpha Defensin 3,5

LE-Test +++

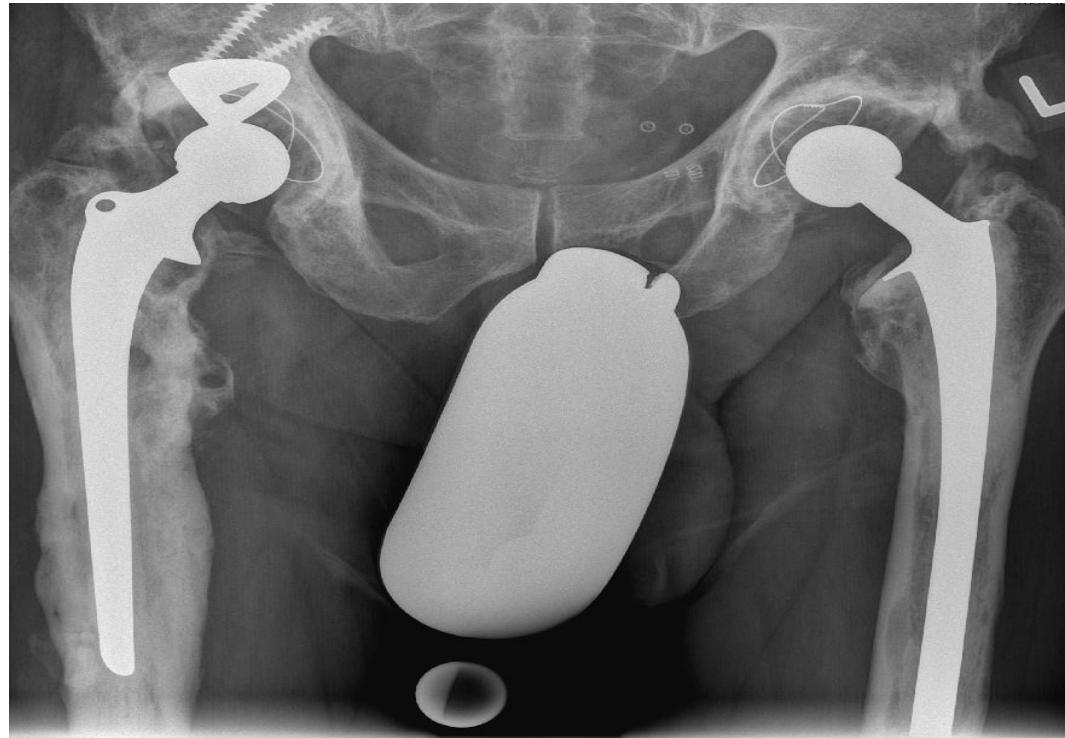
Zellzahl 59830

PMN 96%

Culture: **Staph. capitis**



Therapy



Therapy

- Dair
- One Stage Exchange
- Two Stage Exchange
- Girdlestone
- Amputation



Dair

Cut off ?
What do you change?
Postop. Antibiotics?



One Stage Exchange

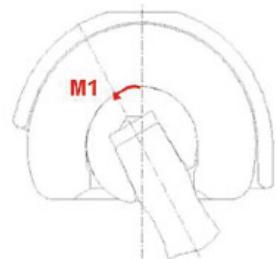
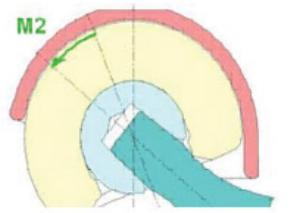
- Prerequisites?
- Always cemented implants?
- What kind of antibiotics do you add to the bone cement?
- How long postop. Antibiotics?



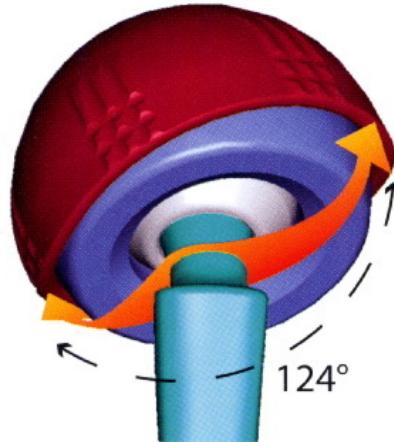
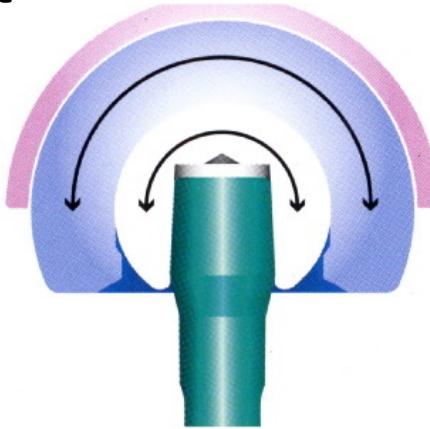
Two Stage exchange

- Spacer Type?
- Intervall?
- Antibiotic Holiday?
- When do you do the Reimplantation?

How often do you use a Dual Mobility Cup in Septic revisions

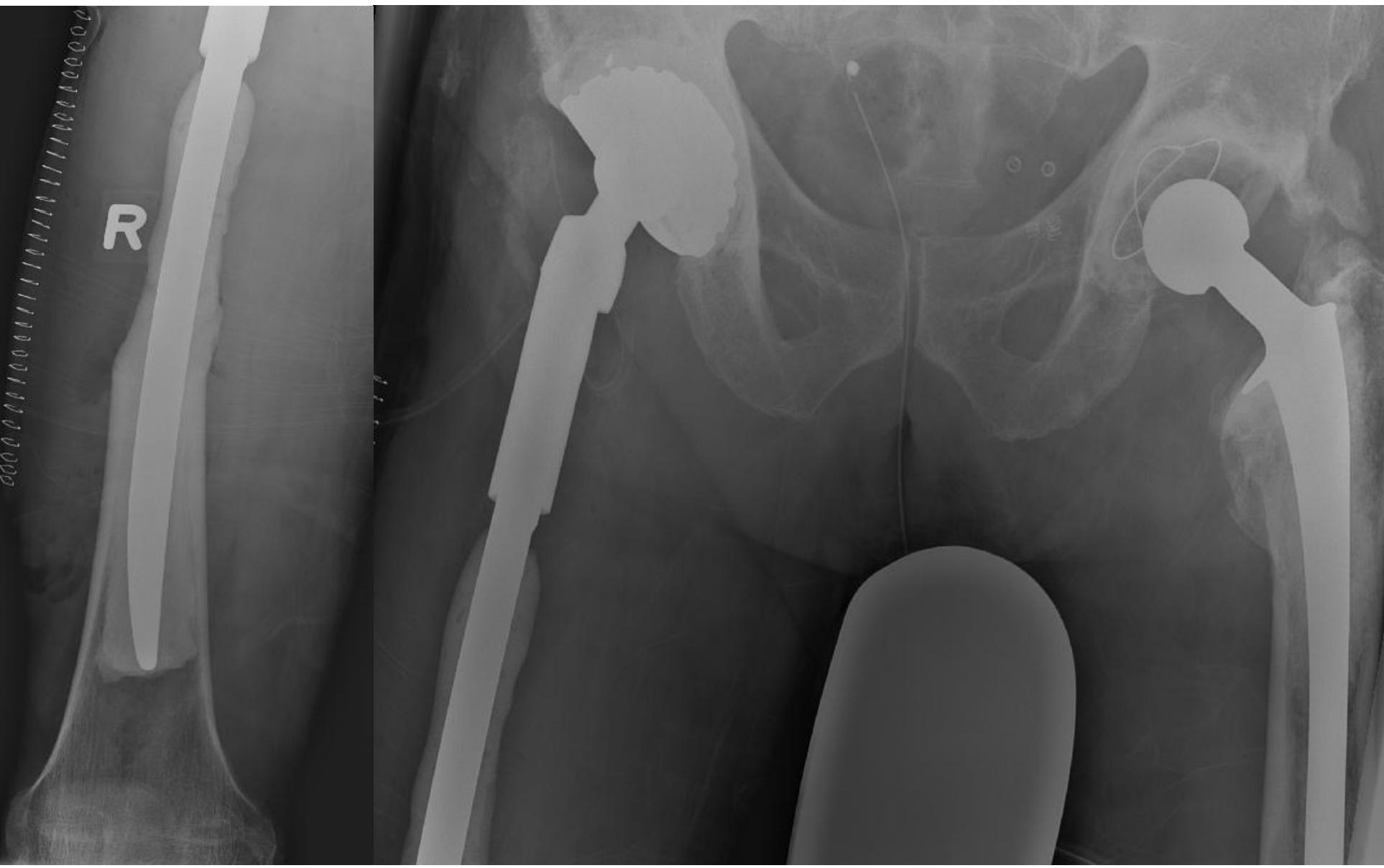


Irg



ENDO-KI





06/2019 One Stage Exchange with resection of the proximal femur,
Cemented modukar Revision Stem, Dual Mobility Cup

Thank You

