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Medical College**
at Thomas Jefferson University

Management of Chronic PJI

Definition of Chronic PJI



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Definition of Chronic PJI

The Journal of Arthroplasty 33 (2018) 1309–1314



Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org



The 2018 Definition of Periprosthetic Hip and Knee Infection: An Evidence-Based and Validated Criteria

Javad Parvizi, MD ^{a,*}, Timothy L. Tan, MD ^a, Karan Goswami, MD ^a, Carlos Higuera, MD ^b,
Craig Della Valle, MD ^c, Antonia F. Chen, MD, MBA ^a, Noam Shohat, MD ^{a, d}

^a Rothman Institute, Thomas Jefferson University, Philadelphia, PA

^b Cleveland Clinic, Cleveland, OH

^c Rush University Medical Center, Chicago, IL

^d Sackler Faculty of Medicine, Tel Aviv University, Ramat Aviv, Israel

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

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

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



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Definition of Chronic PJI

Major criteria (at least one of the following)		Decision	
Two positive growth of the same organism using standard culture methods		Infected	
Sinus tract with evidence of communication to the joint or visualization of the prosthesis			
Minor Criteria	Threshold	Score	Decision
	Acute ^e	Chronic	
Serum CRP (mg/L)	100	10	
<i>or</i>			
D-Dimer (ug/L)	Unknown	860	
Elevated Serum ESR (mm/hr)	No role	30	1
Elevated Synovial WBC (cells/ μ L)	10,000	3,000	
<i>or</i>			
Leukocyte Esterase	++	++	3
<i>or</i>			
Positive Alpha-defensin (signal/cutoff)	1.0	1.0	
Elevated Synovial PMN (%)	90	70	2
Single Positive Culture			2
Positive Histology			3
Positive Intraoperative Purulence ^y			3

- ESR > 30 mm/hr
 - CRP > 10 mg/L (hip and knee)
 - Synovial WCC > 3,000 cells/ μ L
 - Synovial PMN > 80%
- Combined preoperative and postoperative score:
 ≥6 Infected
 3-5 Inconclusive*
 <3 Not Infected



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Definition of Chronic

- > 4 weeks
- Presence of a sinus tract
- Possible established biofilm



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How to Optimize Patients



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What Can We Optimize?

- Diabetes
- Anemia
- Malnutrition
- Smoking
- etc



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Diabetes Control?



■ THE KNEE SOCIETY

2019 John Insall Award: Fructosamine is a better glycaemic marker compared with glycated haemoglobin (HbA1C) in predicting adverse outcomes following total knee arthroplasty

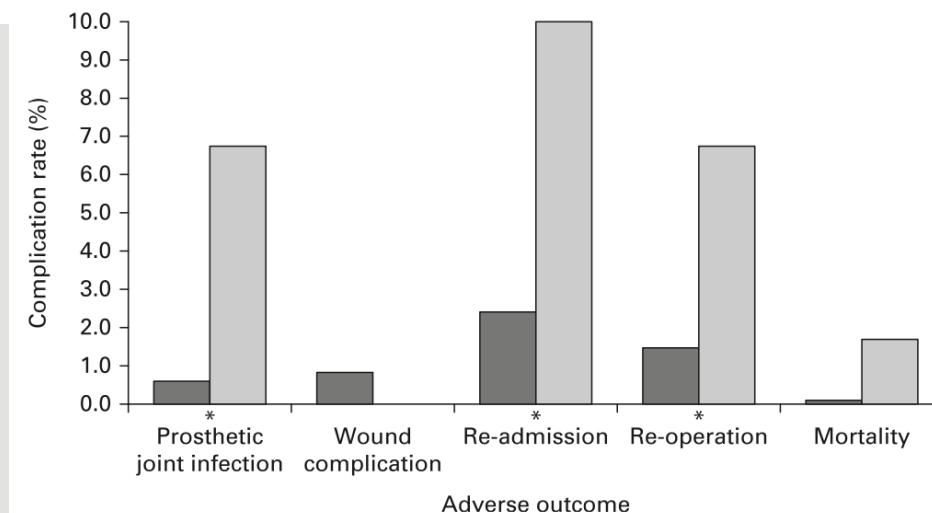
A PROSPECTIVE MULTICENTRE STUDY

N. Shohat,
M. Tarabichi,
T. L. Tan,
K. Goswami,
M. Kheir,
A. L. Malkani,
R. P. Shah,
R. Schwarzkopf,
J. Parvizi

From Rothman Orthopaedic Institute at Thomas Jefferson University, Philadelphia, Pennsylvania, United States

fructosamine
< 293 $\mu\text{mol/l}$

Low High



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Diabetes Control?



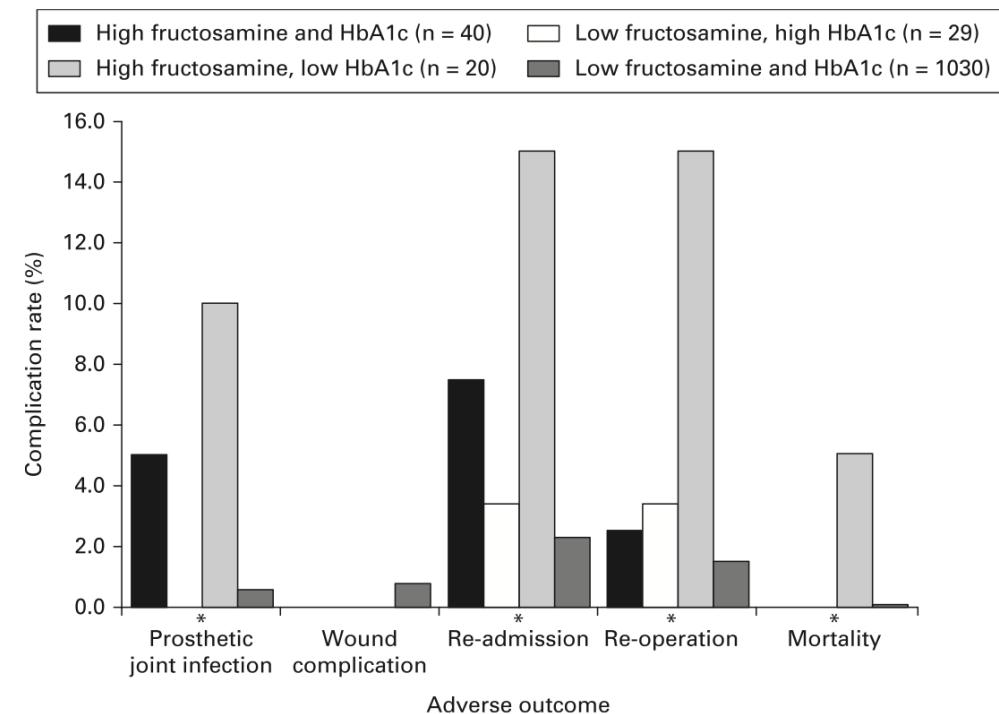
■ THE KNEE SOCIETY

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A PROSPECTIVE MULTICENTRE STUDY

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Glucose Variability

Complications - Infection

Increased Postoperative Glucose Variability Is Associated With Adverse Outcome Following Two-Stage Exchange Arthroplasty for Periprosthetic Joint Infection

Sheng-Hao Wang, MD ^{a, b, c}, Chi Xu, MD ^{a, d}, Timothy L. Tan, MD ^a,
Karan Goswami, MD, MRCS ^a, Alexus M. Cooper ^a, Javad Parvizi, MD, FRCS ^{a, *}

^a Rothman Institute, Thomas Jefferson University, Philadelphia, PA

^b Department of Orthopaedics, Tri-Service General Hospital, National Defense Medical Center, Taipei, Taiwan, ROC

^c Graduate Institute of Medical Science, National Defense Medical Center, Taipei, Taiwan, ROC

^d Department of Orthopaedic Surgery, General Hospital of People's Liberation Army, Beijing, People's Republic of China

Conclusion: Higher glucose variability is associated with increased risks of treatment failure, reinfection, and reoperation after 2-stage exchange arthroplasty in PJI patients. Compared to diabetic patients, nondiabetic patients have a higher association between glucose variability and poor outcomes. Reducing adverse outcomes may be achieved with close monitoring and strict postoperative glucose control.



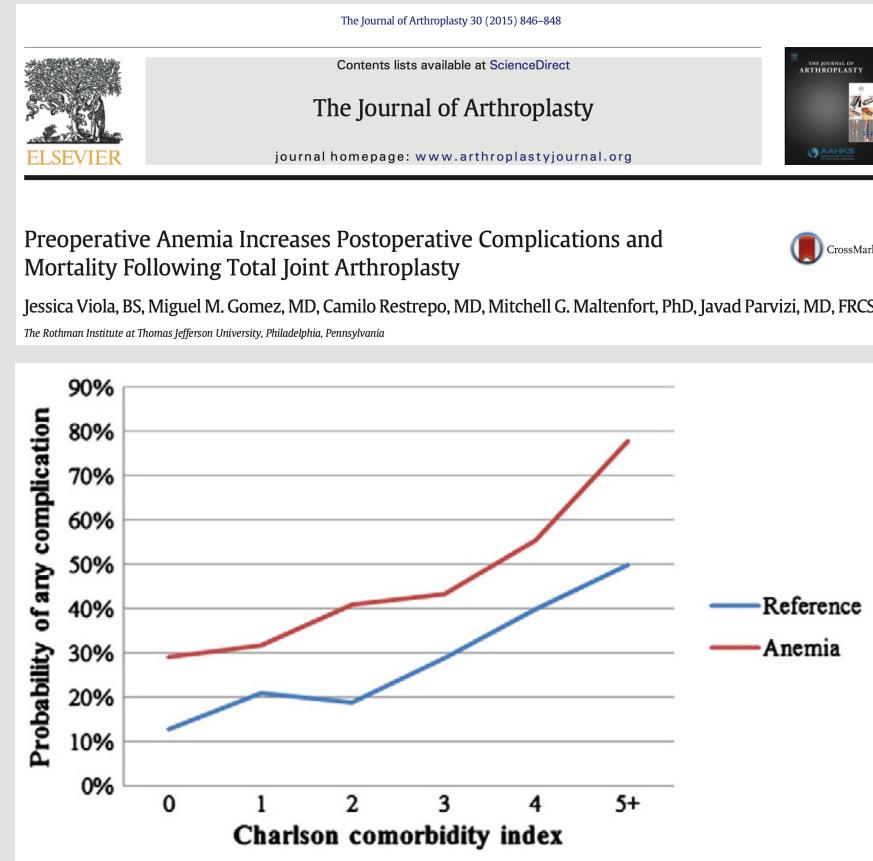
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Anemia

- 13,593 TJA
- 2,580 anemic patients
- Multivariate analysis (OR = 2.11)
 - Cardiovascular complication
26.5% vs 11.8%
 - Infection 4.5% vs 1.12%
 - Mortality 0.2% vs 0.08%



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Malnutrition

The Journal of Arthroplasty 33 (2018) 2971–2975



Contents lists available at [ScienceDirect](#)

The Journal of Arthroplasty
Multivariate Analysis:
journal homepage: www.arthroplastyjournal.org

• Low albumin
Complications - Infection
Malnutrition and the Development of Periprosthetic Joint Infection
in Patients Undergoing Primary Elective Total Joint Arthroplasty

Kier Blevins, BA ^a, Arash Aalirezaie, MD ^a, Noam Shohat, MD ^{a,b},
Javad Parvizi, MD, FRCS ^{a,*}

^a The Rothman Institute at Thomas Jefferson University, Philadelphia, Pennsylvania

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Malnutrition

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The Journal of Arthroplasty

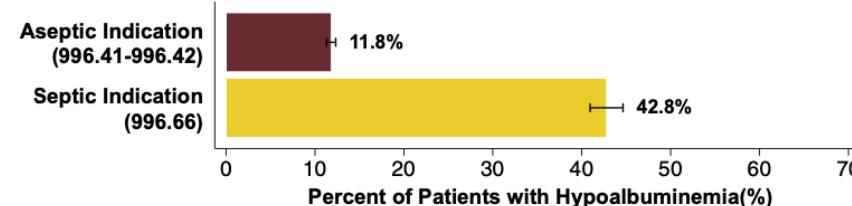
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Health Policy & Economics

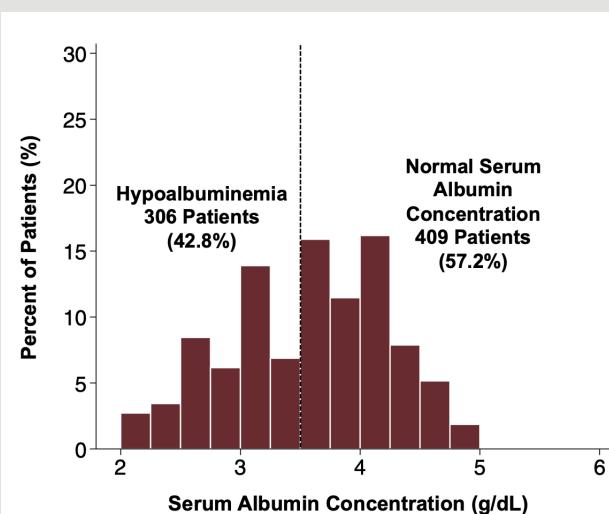
Is Hypoalbuminemia Associated With Septic Failure and Acute Infection After Revision Total Joint Arthroplasty? A Study of 4517 Patients From the National Surgical Quality Improvement Program

Daniel D. Bohl, MD, MPH, Mary R. Shen, MS, Erdan Kayupov, MSE,
Gregory L. Cvetanovich, MD, Craig J. Della Valle, MD *

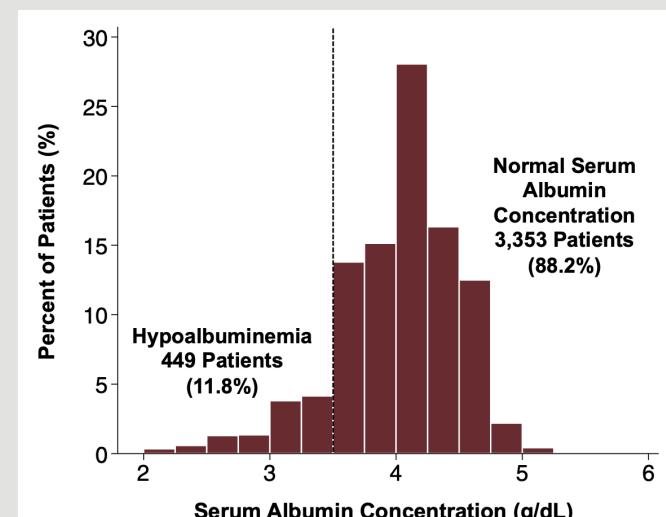
Department of Orthopaedic Surgery, Rush University Medical Center, Chicago, Illinois



Septic revision



Aseptic revision



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Malnutrition

Albumin/Fibrinogen Ratio



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Complications - Infection

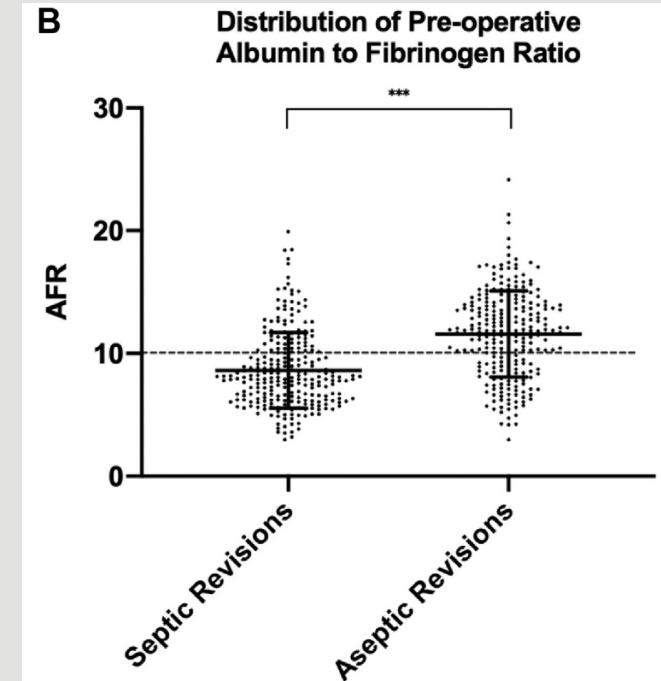
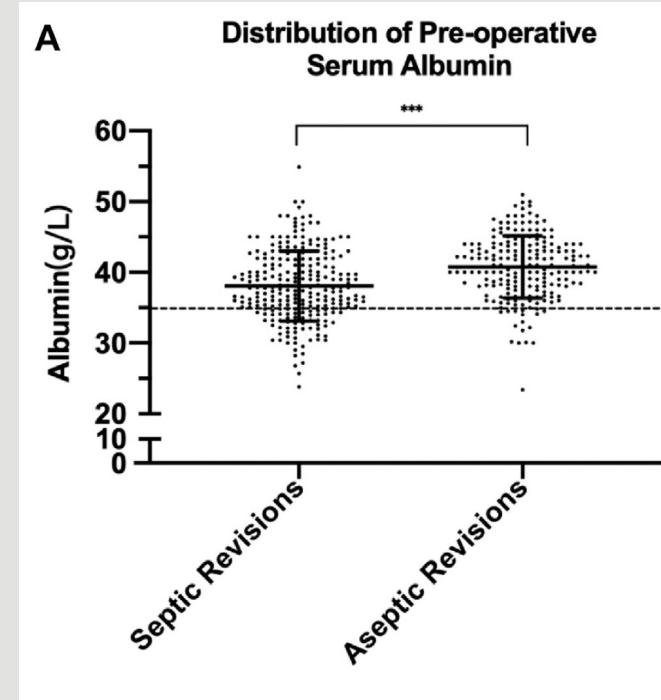
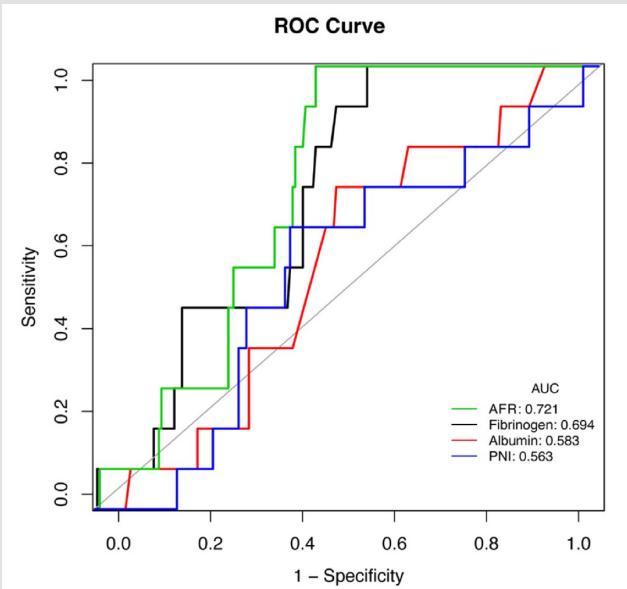
A Novel Biomarker to Screen for Malnutrition: Albumin/Fibrinogen Ratio Predicts Septic Failure and Acute Infection in Patients Who Underwent Revision Total Joint Arthroplasty

Zulipikaer Maimaiti, MD, PhD ^{a,b}, Chi Xu, MD ^b, Jun Fu, MD ^b, William Tianyu Li, MD ^c, Wei Chai, MD ^b, Yonggang Zhou, MD ^b, Jiying Chen, MD ^{b,*}

^a Medical School of Chinese PLA, Beijing, China

^b Department of Orthopaedics, The First Medical Centre, Chinese PLA General Hospital, Beijing, China

^c Department of Orthopaedic Surgery, University of Pittsburgh Medical Center, Pittsburgh, PA



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Treatment of Malnutrition

■ THE KNEE SOCIETY

2019 Chitranjan S. Ranawat Award: Elective joint arthroplasty outcomes improve in malnourished patients with nutritional intervention

A PROSPECTIVE POPULATION ANALYSIS DEMONSTRATES A MODIFIABLE RISK FACTOR

JAMA
Network | Open™

Original Investigation | Nutrition, Obesity, and Exercise

Association of Nutritional Support With Clinical Outcomes Among Medical Inpatients Who Are Malnourished or at Nutritional Risk

An Updated Systematic Review and Meta-analysis

Filomena Gomes, PhD; Annic Baumgartner, MD; Lisa Bouyoure, PhD; Martina Bally, MD; Nicolaas E. Deutz, MD; Jeffrey L. Greenwald, MD; Zeno Stanga, MD; Beat Mueller, MD; Philipp Schuetz, MD, MPH

CONCLUSIONS AND RELEVANCE This study's findings suggest that despite heterogeneity and varying methodological quality among trials, nutritional support was associated with improved survival and nonelective hospital readmission rates among medical inpatients who were malnourished and should therefore be considered when treating this population.



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Treatment of Malnutrition in PJI

Article

Moderate-to-Severe Malnutrition Identified by the Controlling Nutritional Status (CONUT) Score Is Significantly Associated with Treatment Failure of Periprosthetic Joint Infection

Zhuo Li ^{1,2} , Zulipikaer Maimaiti ² , Zhi-Yuan Li ², Jun Fu ^{2,3}, Li-Bo Hao ^{2,3}, Chi Xu ^{2,3,*}  and Ji-Ying Chen ^{2,3,*} 

Risk of failure of PJI treatment

Malnutrition at 1st stage - odds ratio = 5.86

Malnutrition at 2nd stage – odds ratio = 12.15



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Treatment of PJI

Options Available

- Antibiotic suppression alone
- Debridement and antibiotics
- Prosthesis Removal
 - One stage reimplantation
 - Two stage reimplantation
- Arthrodesis
- Resection Arthroplasty
- Amputation



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Who is a Candidate for One-Stage?

Hip and Knee Section, Treatment, One Stage Exchange: Proceedings of International Consensus on Orthopedic Infections

Indications for 1-Stage

Host/Local

- Non-immunocompromised host.
- Absence of systemic sepsis.
- Minimal bone loss/soft tissue defect allowing primary wound closure.

Microbiology

- Isolation of pathogenic organism preoperatively.
- Known sensitivities to bactericidal treatment.



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Who is a Candidate for One-Stage?

Hip and Knee Section, Treatment, One Stage Exchange: Proceedings of International Consensus on Orthopedic Infections

Criteria for Single-Stage Exchange Arthroplasty.

International Consensus Meeting [35]	Infectious Diseases Society of America [36]	University College of London Hospital [37]	ENDO-Klinik [38]
Organism identified preoperatively <i>Indications for 1-Stage</i>	Organism identified preoperatively Organism susceptible to antibiotics with oral bioavailability Good soft tissue Good bone stock Bone grafting not required Antibiotic-loaded bone cement used for fixation	Organism identified preoperatively Organism susceptible to antibiotics Good soft tissue	Organism identified preoperatively Organism susceptible to antibiotics
<i>Host/Local</i>			
<ul style="list-style-type: none">• Non-immunocompromised host.• Absence of systemic sepsis.• Minimal bone loss/soft tissue defect allowing primary wound closure. <i>Microbiology</i> <ul style="list-style-type: none">• Isolation of pathogenic organism preoperatively.• Known sensitivities to bactericidal treatment.			

Bialecki, J., Bucsi, L., Fernando, N., Foguet, P., Guo, S., Haddad, F., Hansen, E., Janvari, K., Jones, S., Keogh, P. and McHale, S., 2019. Hip and knee section, treatment, one stage exchange: proceedings of International Consensus on Orthopedic Infections. *The Journal of Arthroplasty*, 34(2), pp.S421-S426.

Osmon DR, Berbari EF, Berendt AR, Lew D, Zimmerli W, Steckelberg JM, et al. Executive summary: diagnosis and management of prosthetic joint infection: clinical practice guidelines by the Infectious Diseases Society of America. *Clin Infect Dis* 2013;56:1e10.

George DA, Haddad FS. One-stage exchange arthroplasty: a surgical technique update. *J Arthroplasty* 2017;32:S59e62.

Gehrke T, Zahar A, Kendoff D. One-stage exchange: it all began here. *Bone Joint J* 2013;95-B(11 Suppl A):77e83.



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Who is NOT a Candidate for One-Stage?

Hip and Knee Section, Treatment, One Stage Exchange:
Proceedings of International Consensus on Orthopedic Infections

- Severe soft tissue damage/deficiency
- Severe loss of bone stock
- Systemic sepsis
- Culture-negative PJI



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Outcomes of One stage vs Two Stage

Single-Stage Exchange

First Author/Year	Location	Subjects	Mean Follow-Up (y)	Eradication Rate (%)
Ji, 2019 [33]	Hip-cementless	111	58 mo	89.2
Siddiqi, 2019 [54]	TKA	57	52.9 mo	86
Zahar, 2018 [52]	Hip-cemented	85	10-11	94
Bori, 2018 [31]	Hip-cementless	19		94.7
Lange, 2017 [48]	Hip-cementless	56	4	91.1
Whiteside, 2017 [55]	Hip-cementless	21	5.2	95
Born, 2016 [56]	Hip-cementless	28	7	100
Choi, 2013 [51]	Hip	17	5.1	82
Rudelli, 2008 [57]	Hip	32	5	94
Callaghan, 1999 [58]	Hip	24	10	92
Ebied, 2017 [59]	Hip	33	6	97
Ilchmann, 2016 [60]	Hip	39	6.6	100
Kunutsor, 2015 [49]	Knee	423	—	90.1
Haddad, 2015 [32]	Knee	28	6.5	100
Tibrewal, 2014 [61]	Knee	50	10.5	98
Buechel, 2004 [62]	Knee	22	10	91
Silva, 2002 [63]	Knee	37	5	89

Recent one stage results
82 – 100%



Two-Stage Exchange

First Author/Year	Location	Subjects	Mean Follow-Up (y)	Eradication Rate (%)
Matar, 2019 [95]	Hip-cemented	29	5	96.5
Siddiqi, 2019 [54]	Knee	137	54.7 mo	75.9
Di Benedetto, 2017 [96]	Knee	45	3.4	89.9
Kunutsor, 2016 [49]	Knee	5129	—	87.8
Haddad, 2015 [32]	Knee	74	6.5	93
Sabry, 2014 [97]	Knee	314	—	66.6
Kubista, 2012 [98]	Knee	368	3.5	86
Mahmud 2012 [99]	Knee	253	4	95.7
Mortazavi, 2010 [100]	Knee	475	5.5	90.7
Ghanem, 2009 [101]	Knee	109	—	88.9

Recent two stage results
66.6 – 96.5%



Outcomes of One stage vs Two Stage

The Journal of Arthroplasty 35 (2020) S24–S30



ELSEVIER

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Single vs 2-Stage Revision for the Treatment of Periprosthetic Joint Infection

Beau J. Kildow, MD ^a, Craig J. Della-Valle, MD ^b, Bryan D. Springer, MD ^{a,*}

^a OrthoCarolina Hip and Knee Center, Charlotte, North Carolina

^b Department of Orthopaedic Surgery, Rush University, Chicago, Illinois

Conclusions

Periprosthetic joint infection remains a devastating complication. The shortcomings of the current literature fail to provide superiority of either the single-stage exchange or 2-stage exchange. There is a rising popularity of the single-stage exchange in North America based on recent literature demonstrating comparable success, potential functional benefits to the patients, and a decreased burden to the healthcare system. Large, randomized, controlled, comparative trials are needed to assist us in determining the best treatment option for these patients. A shared-decision model should be discussed with the patient regarding treatment options for chronic PJI.



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One stage vs Two Stage

Clinical and cost effectiveness of single stage compared with two stage revision for hip prosthetic joint infection (INFORM): pragmatic, parallel group, open label, randomised controlled trial

Ashley W Blom,^{1,2} Erik Lenguerrand,¹ Simon Strange,¹ Sian M Noble,³ Andrew D Beswick,¹ Amanda Burston,¹ Kirsty Garfield,^{3,4} Rachael Goberman-Hill,^{1,2} Shaun R S Harris,^{3,4} Setor K Kunutsor,^{1,2} J Athene Lane,^{3,4} Alasdair MacGowan,⁵ Sanchit Mehendale,⁶ Andrew J Moore,¹ Ola Rolfson,⁷ Jason C J Webb,¹ Matthew Wilson,⁸ Michael R Whitehouse,^{1,2} on behalf of the INFORM trial group



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The primary outcome :

- pain, stiffness, and functional limitations
(WOMAC)**

Secondary outcomes

- Complications**
- Recurrent infection**
- Cost effectiveness**



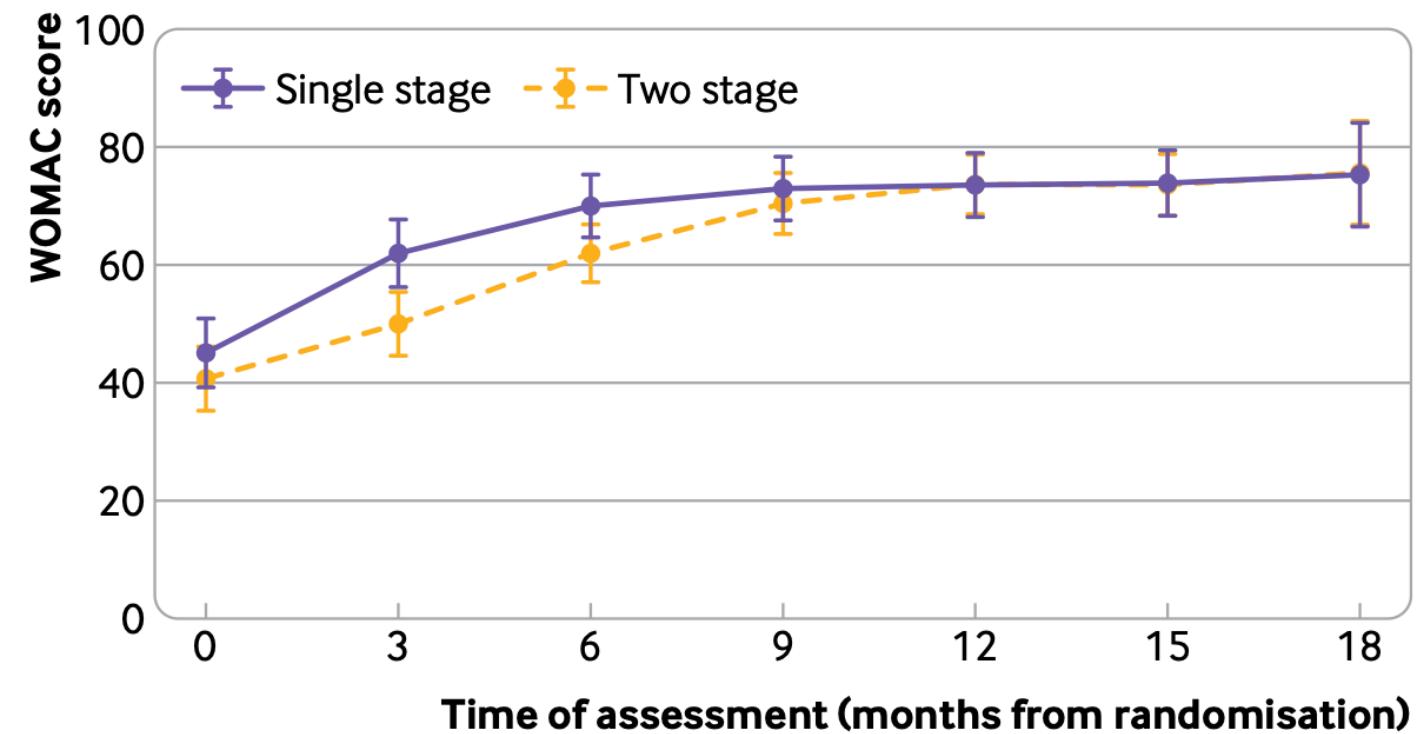
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Complication	Single stage revision surgery (n=65)	Two stage revision surgery (n=75)	P value
Death	2 (3)	5 (7)	0.45
Serious adverse event	11 (17)	16 (21)	0.51
Complication of surgery	27 (42)	43 (57)	0.04
Intraoperative event	5 (9)	20 (27)	0.01
Readmission to hospital	22 (34)	31 (41)	0.47
Reoperation	10 (15)	20 (27)	0.08
Readmission to hospital owing to prosthetic joint infection	10 (15)	17 (23)	0.33
Reoperation owing to prosthetic joint infection	6 (9)	9 (12)	0.55
Possible prosthetic joint infection at 15-18 months	9 (14)	8 (11)	0.62
Prescribed antibiotics at 15-18 months	4 (6)	4 (5)	—



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**£36 256 versus £46 312
a cost difference of – £10 055**



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Further Research is in Progress

ClinicalTrials.gov

One Stage Versus Two Stage For Periprosthetic Hip And Knee Infection

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Carilion Clinic
University of Southern California
Ochsner Health System
Cleveland Clinic Florida
University of Utah
University of California, San Francisco

Information provided by (Responsible Party):

OrthoCarolina Research Institute, Inc.

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<https://doi.org/10.1186/s12891-021-04044-8>

BMC Musculoskeletal Disorders

STUDY PROTOCOL

Open Access

One-stage versus two-stage revision of the infected knee arthroplasty - a randomized multicenter clinical trial study protocol

Martin Lindberg-Larsen^{1,2*} , Anders Odgaard³, Charlotte Fredborg⁴, Henrik Morville Schrøder⁵ on behalf of the One-stage vs Two-stage Collaboration Group



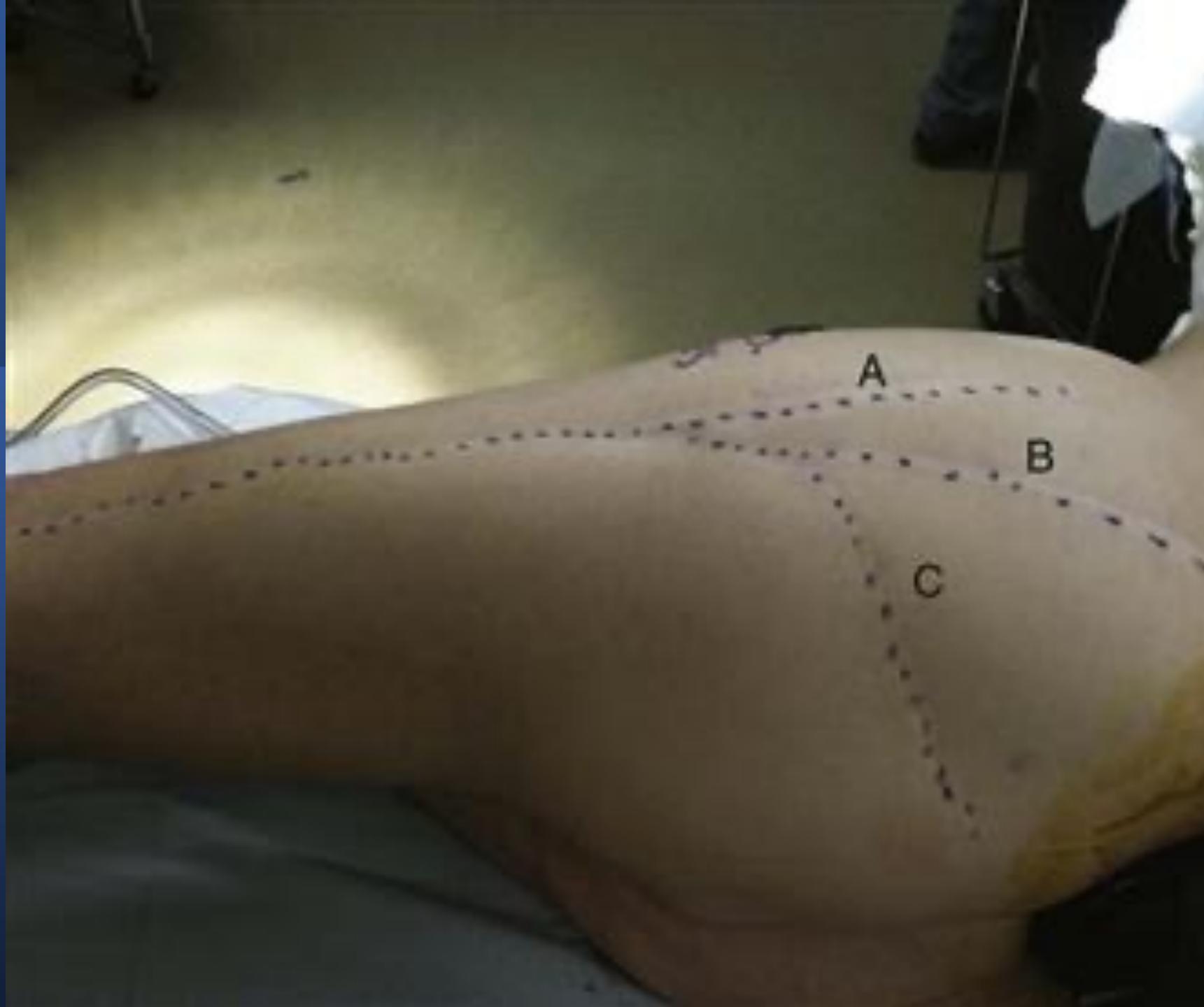
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How is a one stage done

Incision



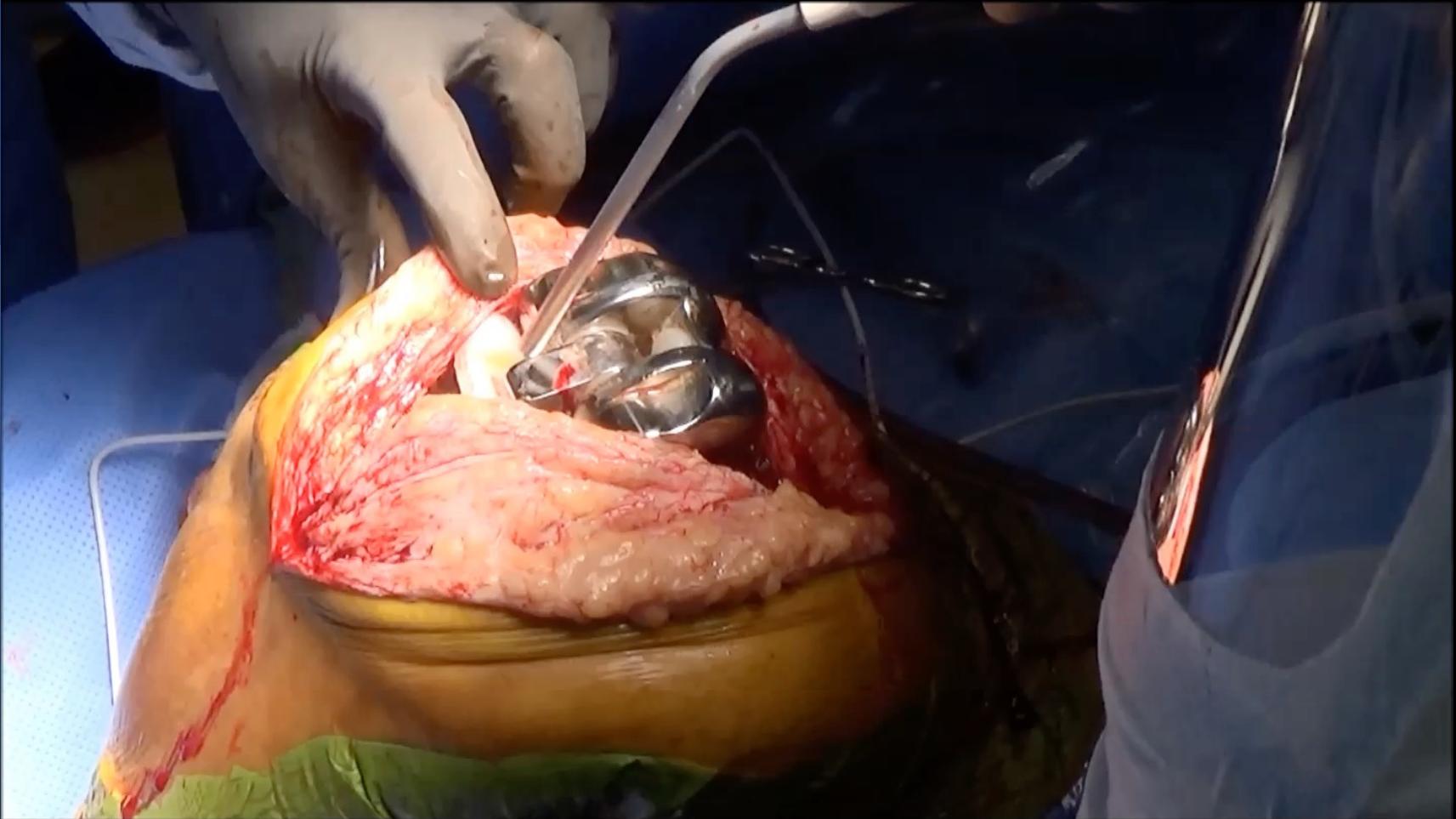
How is a one stage done

Debridement



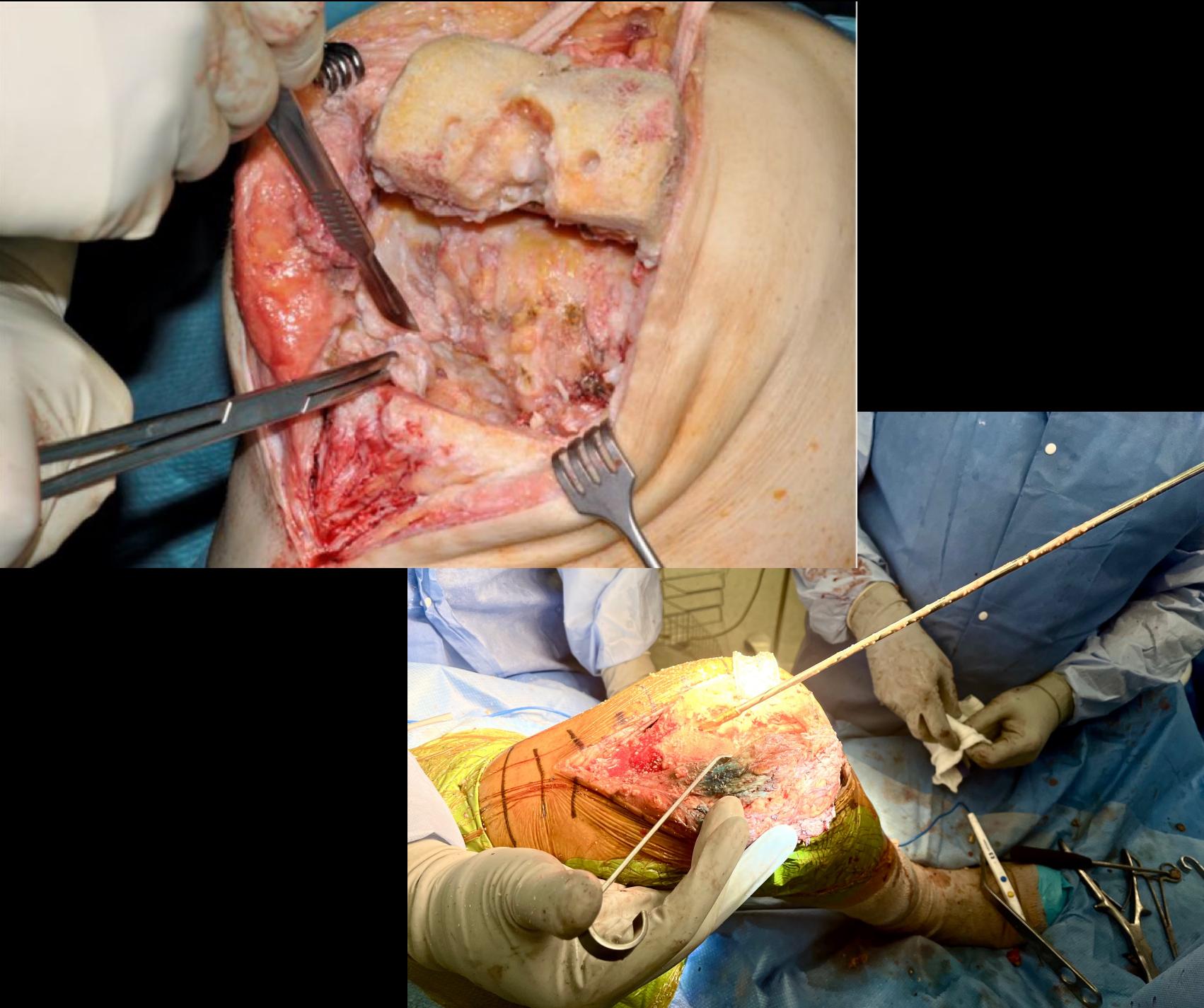
How is a one stage done

Explant



How is a one stage done

Further
debridement
+ canal
reaming



Irrigation

How is a one stage done



- 4% CHG scrub
- Dakin's solution (0.125% hypochlorite)
- 0.5% H₂O₂
- 0.5% PVP-I

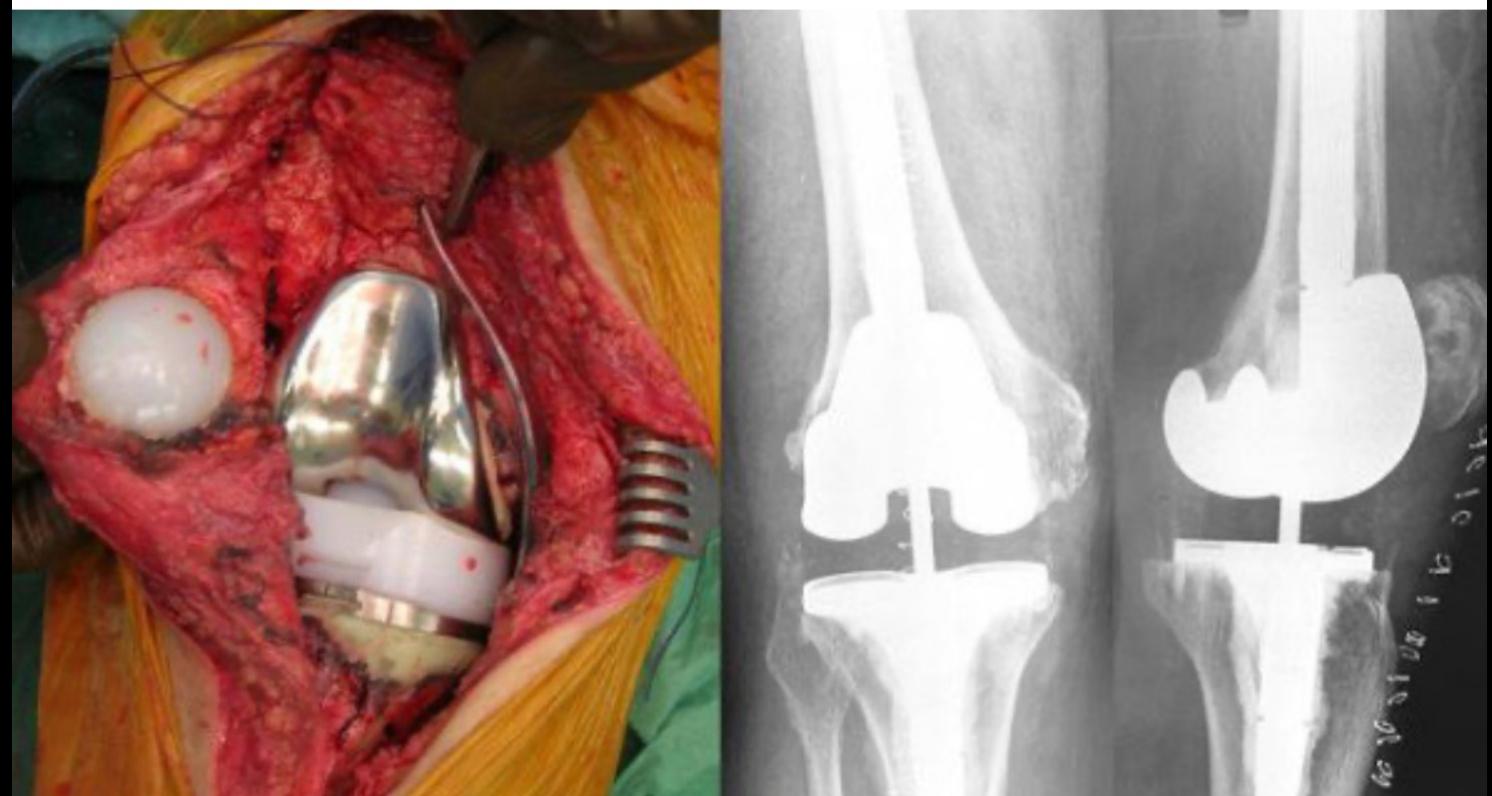
How is a one stage done

Change to
new set up



Reimplantation

How is a one stage done



Length of Anti-Microbial Treatment

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Antibiotic Therapy for 6 or 12 Weeks for Prosthetic Joint Infection

L. Bernard, C. Arvieux, B. Brunschweiler, S. Touchais, S. Ansart, J.-P. Bru, E. Oziol, C. Boeri, G. Gras, J. Druon, P. Rosset, E. Senneville, H. Bentayeb, D. Bouhour, G. Le Moal, J. Michon, H. Aumaître, E. Forestier, J.-M. Laffosse, T. Begué, C. Chirouze, F.-A. Dauchy, E. Devaud, B. Martha, D. Burgot, D. Bouteille, E. Stindel, A. Dinh, P. Bemer, B. Giraudeau, B. Issartel, and A. Caille

ABSTRACT

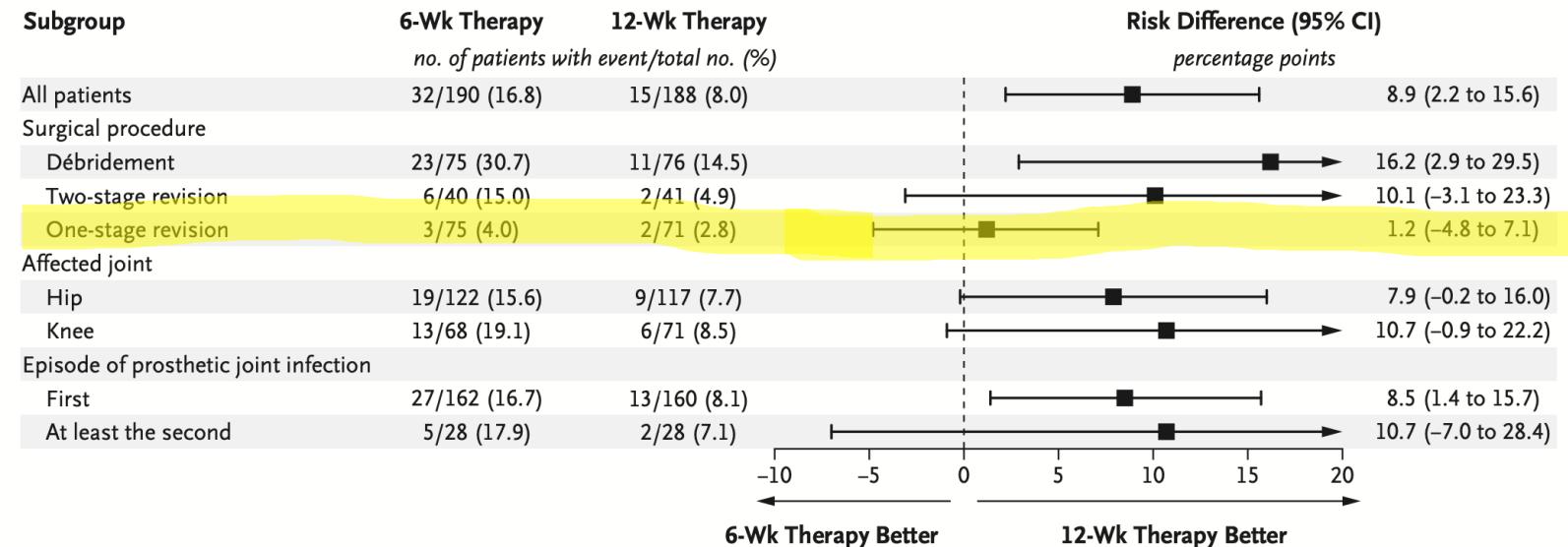


Figure 2. Exploratory Subgroup Analyses of Persistent Infection within 2 Years after the Completion of Antibiotic Therapy (Primary Outcome).



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How is a two
stage done

- Incision
- Initial debridement
- Explant
- Further debridement
- Irrigation

How is a two
stage done

Cement spacer

Dynamic Spacer

What Type of Spacer?

778

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A Randomized Trial of Static and Articulating Spacers for the Treatment of Infection Following Total Knee Arthroplasty

Cindy R. Nahhas, BS, Peter N. Chalmers, MD, Javad Parvizi, MD, Scott M. Sporer, MD, Keith R. Berend, MD, Mario Moric, MA, Antonia F. Chen, MD, MBA, Matthew S. Austin, MD, Gregory K. Deirmengian, MD, Michael J. Morris, MD, and Craig J. Della Valle, MD

Conclusions: Articulating spacers provided significantly greater range of motion and higher Knee Society scores at a mean of 3.5 years. Static spacers were associated with a longer hospital stay following removal of the infected implant. When the soft-tissue envelope allows and if there is adequate osseous support, an articulating spacer is associated with improved outcomes.



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What Type of Spacer?

Static Spacer for :

- Precarious soft tissue coverage
- Loss of bone stock
- Ligamentous instability

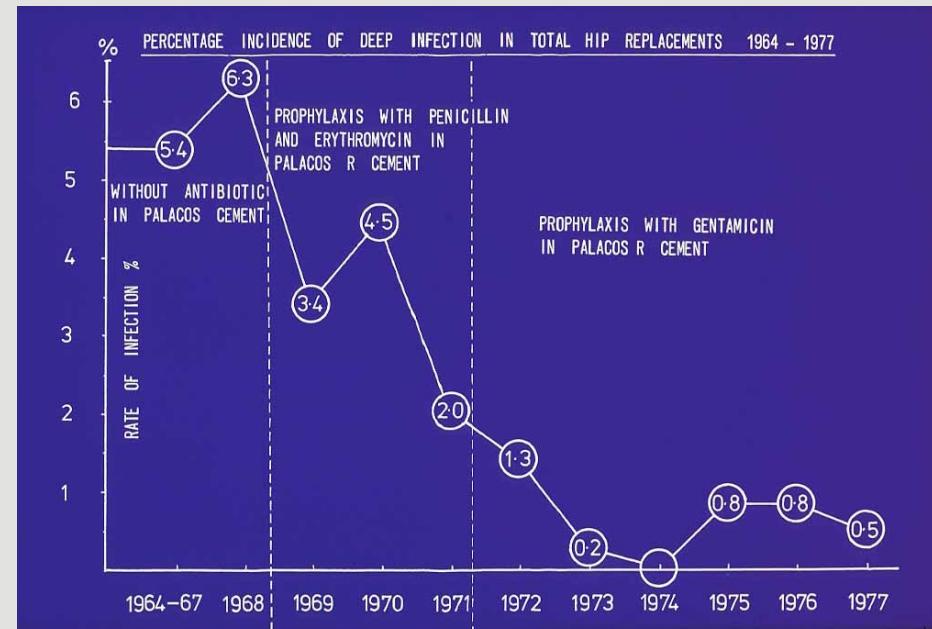
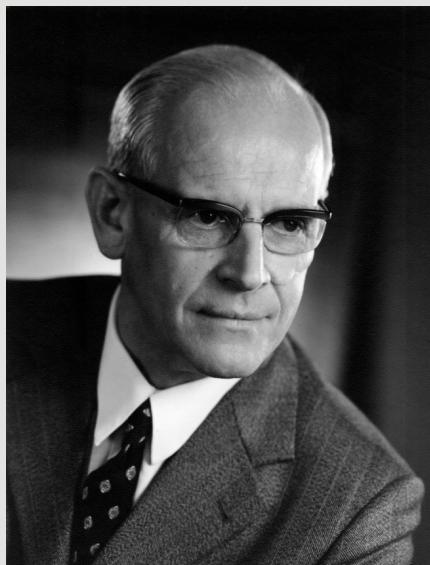


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Antibiotic Loaded Bone Cement



H.W. Buchholz

(Der Chirurg, Nov. 1970, S.511-515)

The concept of local antimicrobial delivery by loading PMMA with different antibiotics

H.W.Buchholz (德国外科医生, 1970年11月)

提出“使用配有不同抗生素成分的骨水泥进行局部抗菌治疗”的概念。



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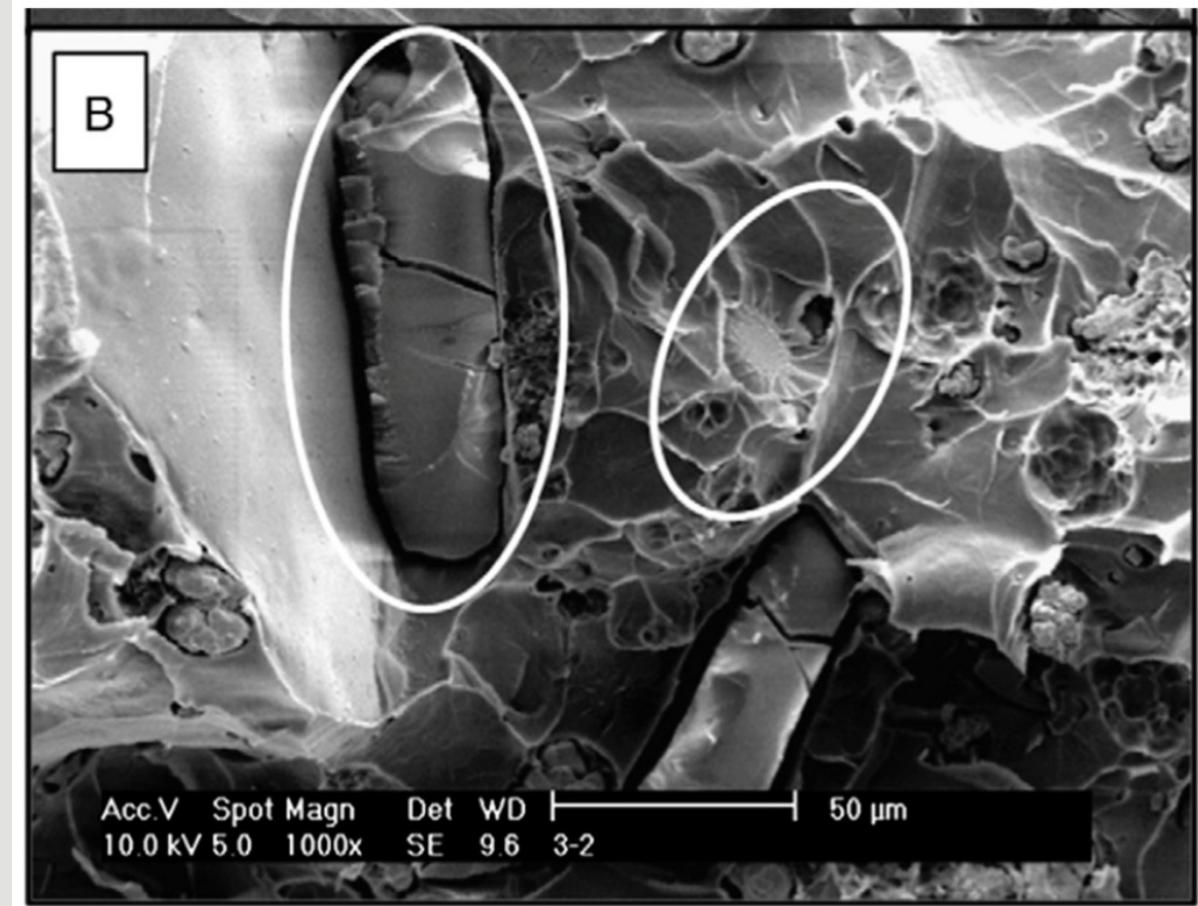


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Antimicrobials and PMMA Spacer

Ideal properties

- Available in powder form
- Wide antibacterial spectrum, bactericidal activity
- Elution from PMMA in high concentrations for
- Active for prolonged periods
- Thermal stability
- Low serum protein binding
- Low influence on the mechanical properties of cement



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Most common combinations of antibiotics in Bone Cement

Streptococci, Staphyloc.i, Propionibat.	Clindamycin + Gentamicin (COPAL®)
Multiresist. Staphylococci	Vancomycin + Ofloxacin + Gentamicin
Enterococci	Vancomycin + Ampicillin + Gentamicin
Enterobacter, E. coli	Cefotaxime + Ofloxacin + Gentamicin
Pseudomonas aeruginosa	Cefoperazone + Clindamycin + Gentamicin
Mycobacteria	Amikacin + Streptomycin



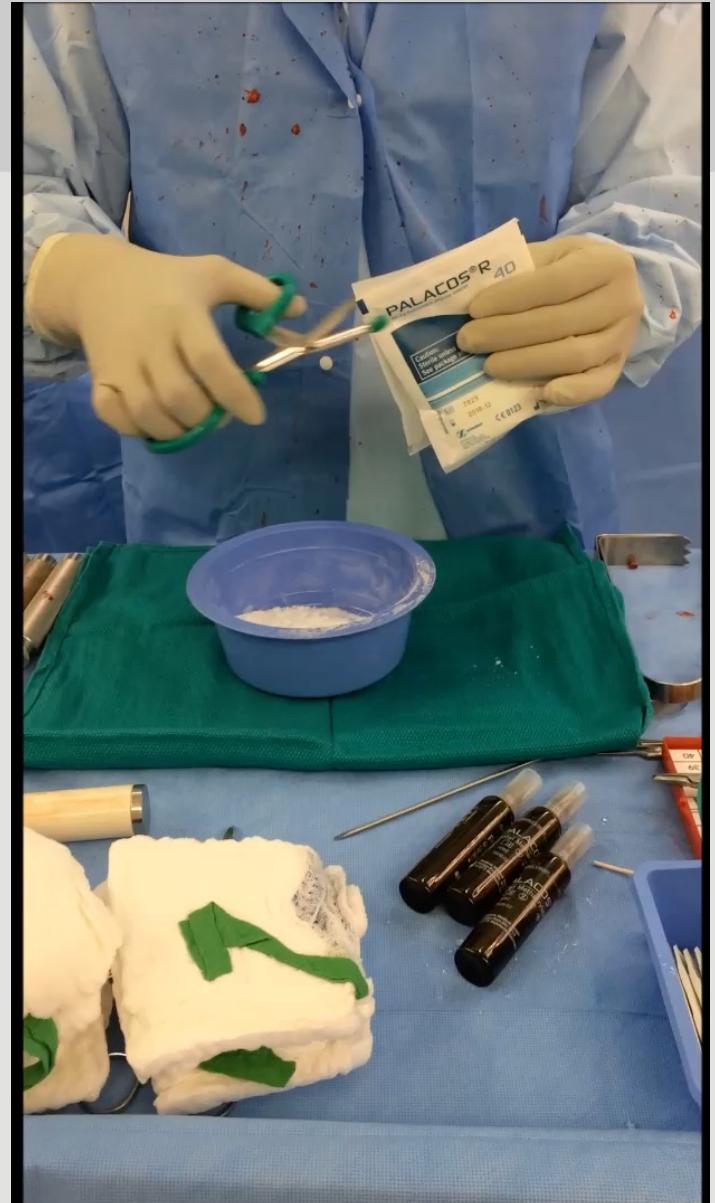
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How to Prepare a Spacer

- Hand mixing optimal
- Increases porosity of cement
- Increases antibiotic elution



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Type of Cement Makes a Difference

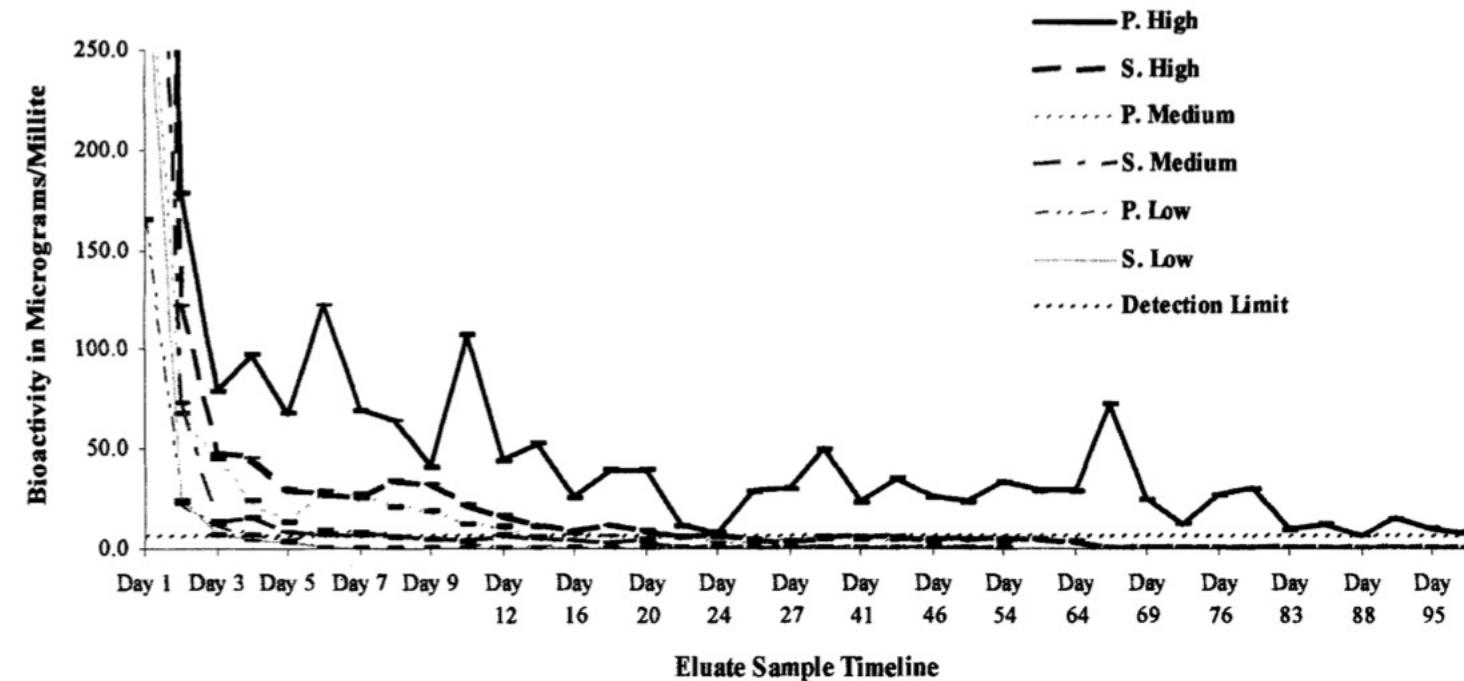
www.elsevier.com/locate/orthres

An articulated antibiotic spacer used for infected total knee arthroplasty: a comparative in vitro elution study of Simplex® and Palacos® bone cements

C. Melinda Stevens ^{a,b}, Kevin D. Tetsworth ^d, Jason H. Calhoun ^{a,*},
Jon T. Mader ^{a,b,c,*}

2004

BIOACTIVITY OF COMBINED ANTIBIOTICS
Tobramycin and Vancomycin Bioassay with *B. subtilis*



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Type of Cement Makes a Difference

The Journal of Arthroplasty 34 (2019) 1458–1461



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Contents lists available at ScienceDirect

The Journal of Arthroplasty

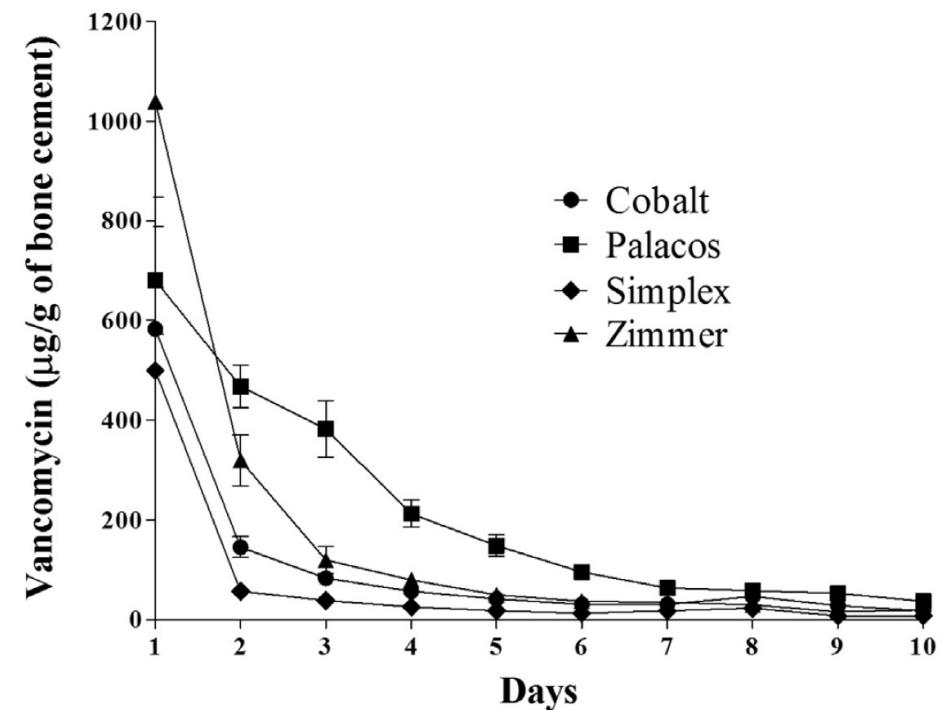
journal homepage: www.arthroplastyjournal.org

Complications - Infection

Comparative Study of Antibiotic Elution Profiles From Alternative Formulations of Polymethylmethacrylate Bone Cement

Daniel G. Meeker, PhD^a, Kasa B. Cooper, MD^b, Regis L. Renard, MD^b, Simon C. Mears, MD, PhD^b, Mark S. Smeltzer, PhD^a, C. Lowry Barnes, MD^{b,*}

2019



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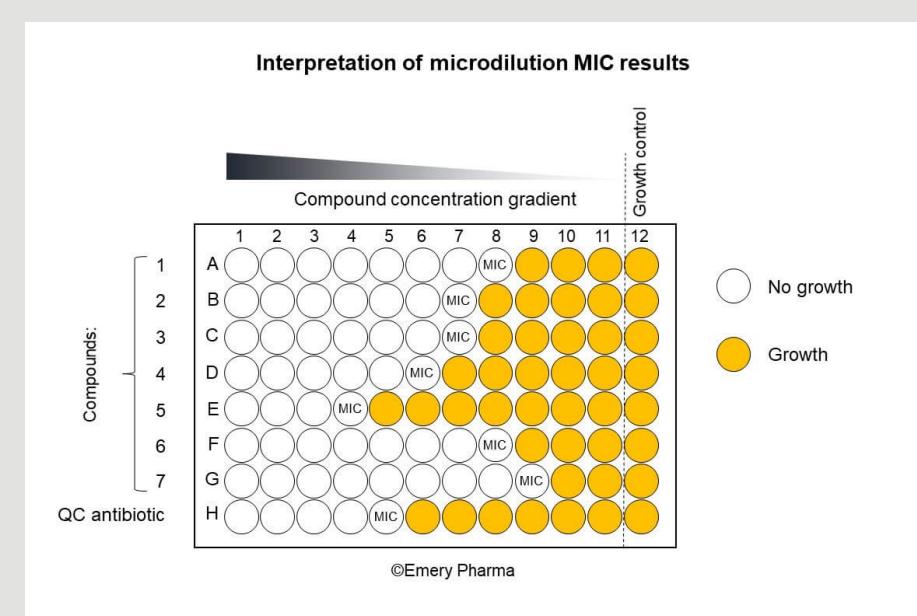
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Ideal Antibiotic Levels in PMMA

“minimum biofilm eradication concentration” (MBEC)

May be more important than

Minimal inhibitory concentrations (MIC)



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Ideal Antibiotic Levels in PMMA

Micro-organisms	<i>Staphylococcus aureus</i>			<i>Escherichia coli</i>			<i>Pseudomonas aeruginosa</i>		
Strain number	ATCC 29213 ATCC 35556			ATCC 25922			ATCC 27853		
Antimicrobial agents	MIC	MBEC	Ratio	MIC	MBEC	Ratio	MIC	MBEC	Ratio
Vancomycin	1	>1024 ⁽⁸⁵⁾ >128 ⁽⁸⁶⁾ >256 ⁽⁸⁷⁾	>1000						
Linezolid	8	>128 ⁽⁸⁶⁾	>16						
Rifampin	<0.02	4 ⁽⁸⁶⁾	200						
Ciprofloxacin	0.25-0.5	512	>1000	0.004-0.008	8	>1000	0.25	4	16
Amikacin							2-4	16	4-8
Gentamicin	0.5	2	4	2-4	16	4-8	2-4	128	32-64
Tobramycin				1-4	2	2	0.5-1	2	2-4

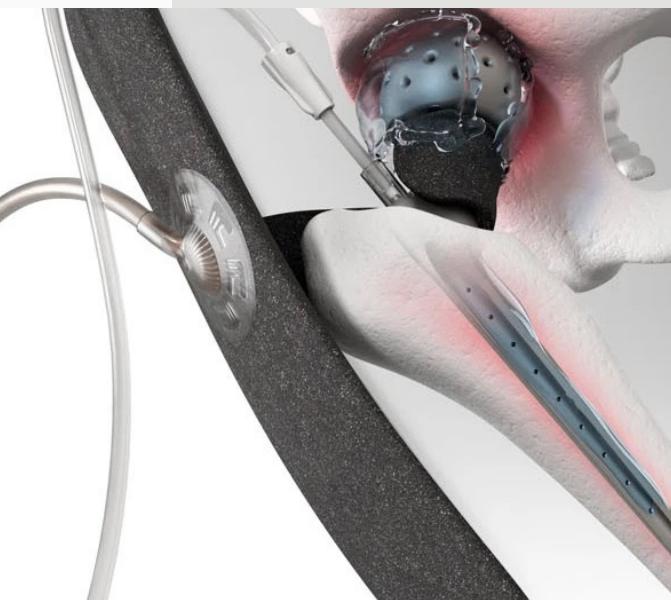


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Alternative Methods??



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How Much is Safe?

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A commentary by Per-Henrik Randsborg,
MD, PhD, is linked to the online version of
this article at [jbjs.org](#).

Acute Kidney Injury When Treating Periprosthetic Joint Infections After Total Knee Arthroplasties with Antibiotic-Loaded Spacers

Incidence, Risks, and Outcomes

Louis Dagneaux, MD, Afton K. Limberg, BS, Douglas R. Osmon, MD, Nelson Leung, MD, Daniel J. Berry, MD, and Matthew P. Abdel, MD

Investigation performed at the Mayo Clinic, Rochester, Minnesota

Incidence of AKI was 19%
2% with preoperative normal renal function
developed CKD
1% required dialysis

Two fold increased risk of AKI when antibiotics per batch were:
>3.6 g of vancomycin (OR, 1.9)
>3.6 g of an aminoglycoside (OR, 1.8)



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Antibiotic Cement

Summary

- 1) Know the antibiogram
- 2) Choose your cement
- 3) Check renal function
- 4) Consider cumulative dose of antibiotic



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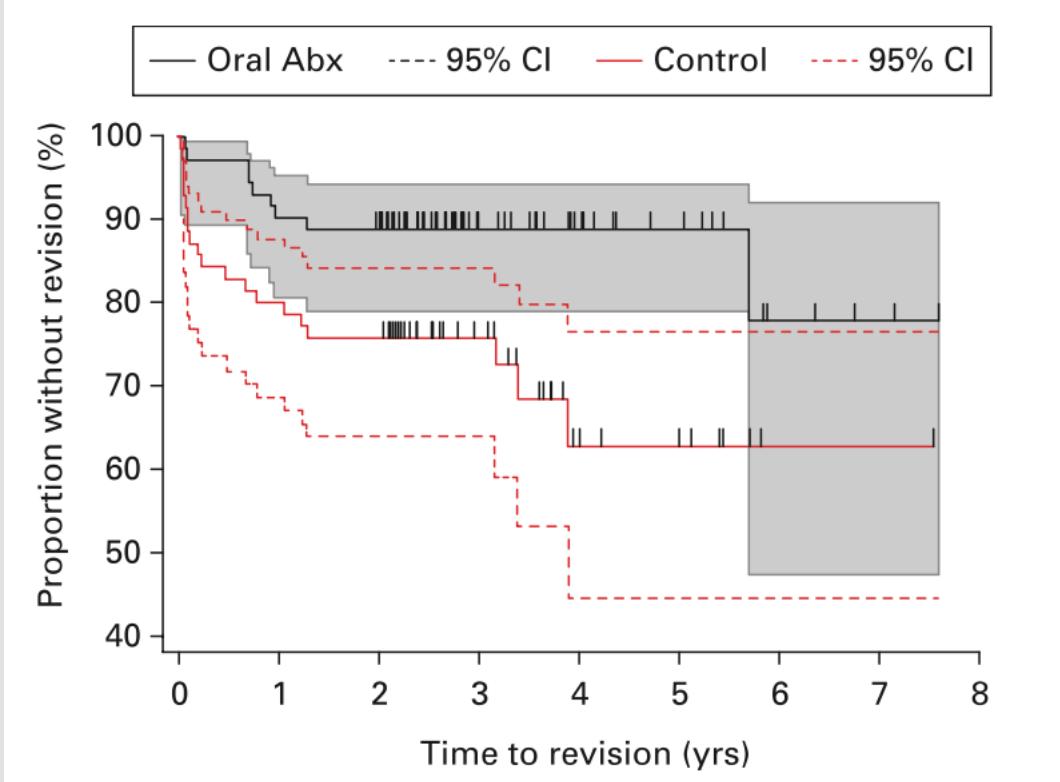
What is the Optimal Duration, Dose and Route of Antimicrobial Treatment After Reimplantation



J. Yang,
J. Parvizi,
E. N. Hansen,
C. N. Culvern,
J. C. Segreti,
T. Tan,
C. W. Hartman,
S. M. Sporer,
C. J. Della Valle,
The Knee Society
Research Group

■ THE KNEE SOCIETY

2020 Mark Coventry Award: Microorganism-directed oral antibiotics reduce the rate of failure due to further infection after two-stage revision hip or knee arthroplasty for chronic infection: a multicentre randomized controlled trial at a minimum of two years



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How Do We Decide on the Optimal Timing of Reimplantation



ELSEVIER

Contents lists available at [ScienceDirect](#)

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Hip and Knee Section, Diagnosis, Reimplantation: Proceedings of International Consensus on Orthopedic Infections

Recommendation: There are no definitive metrics to allow for determination of optimal timing of reimplantation. Thus, timing of reimplantation should consider resolution of clinical signs of infection, downtrend in the serological markers, and results of synovial analysis, if aspiration is performed.



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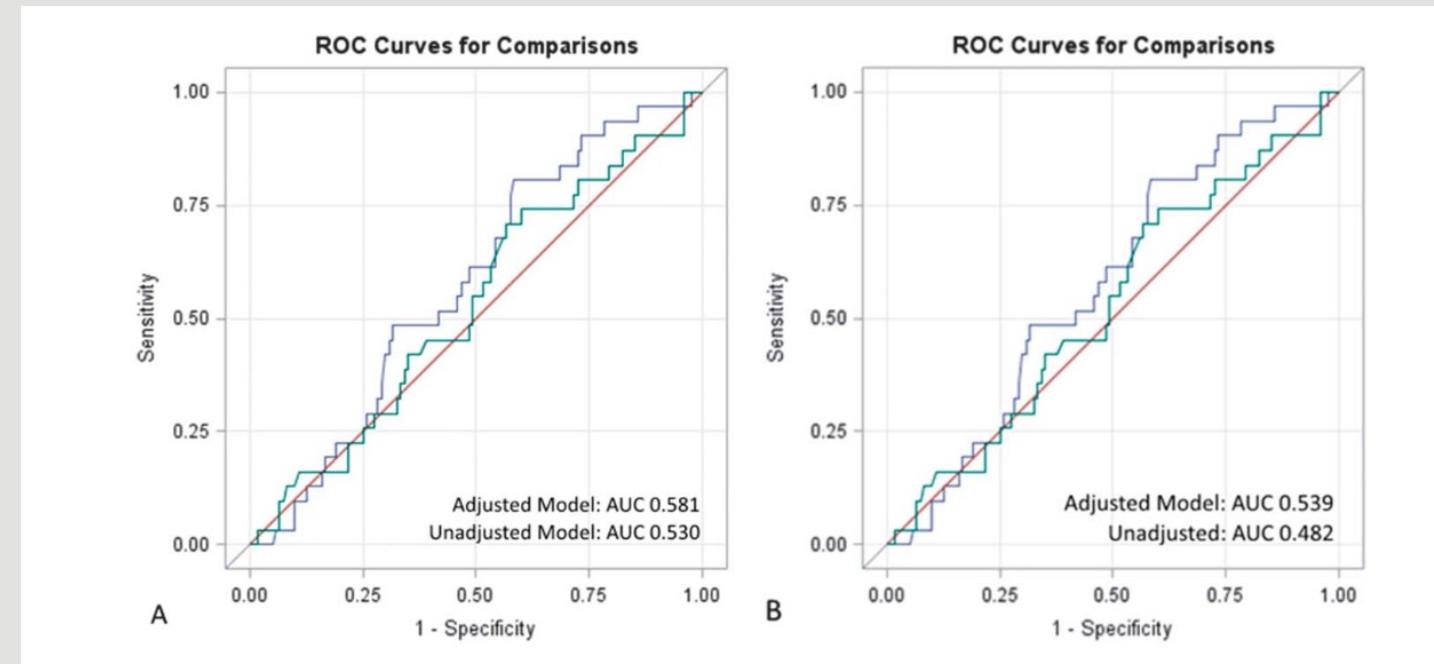


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How Do We Decide on the Optimal Timing of Reimplantation

Serological markers

- CRP / ESR



Both cut off levels and indication of trends have not shown diagnostic value



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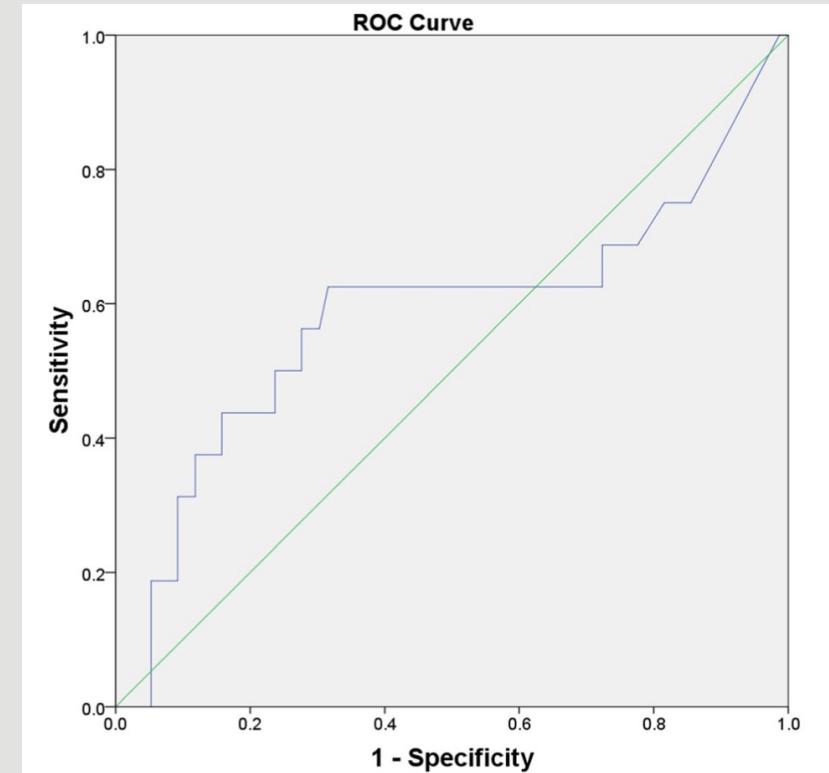


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How Do We Decide on the Optimal Timing of Reimplantation

Serological markers

- CRP / ESR
- Interleukin 6



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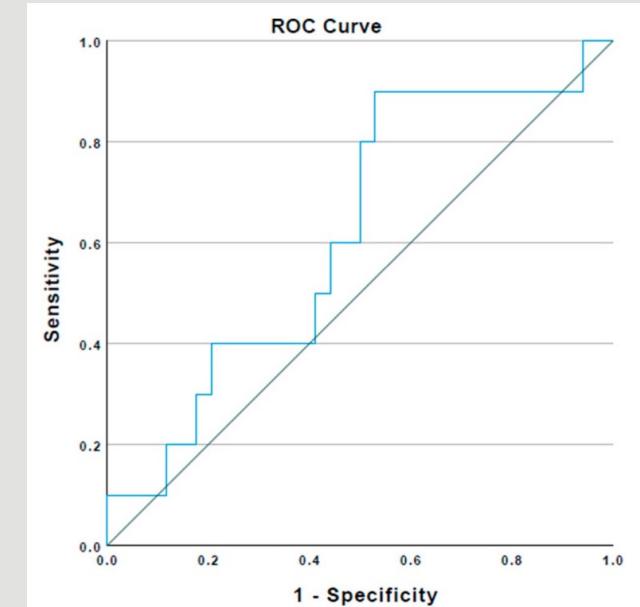


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How Do We Decide on the Optimal Timing of Reimplantation

Serological markers

- CRP / ESR
- Interleukin 6
- D-dimer



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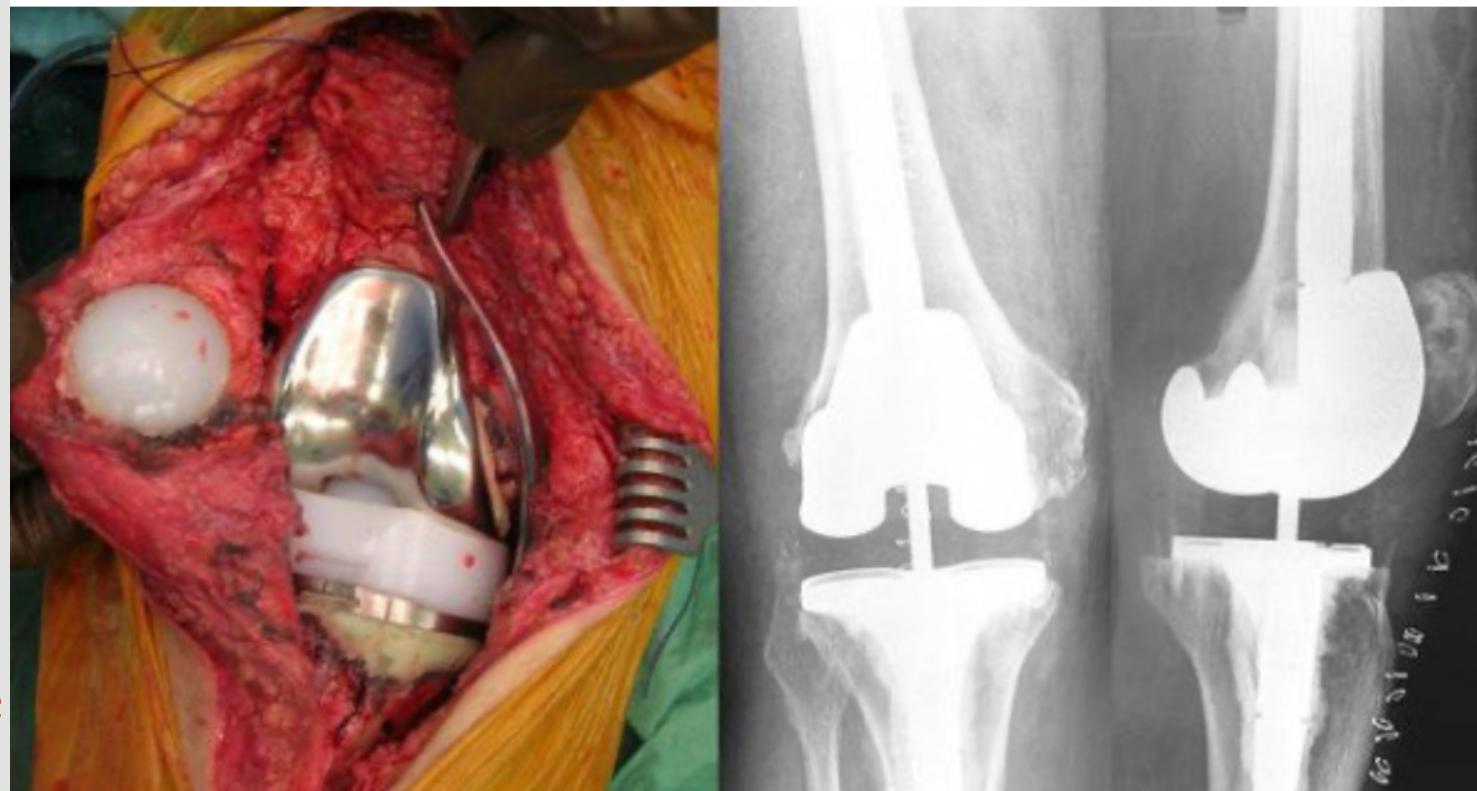


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How Do We Decide on the Optimal Timing of Reimplantation

Aspirate

- WCC
- % polymorphs
- Synovial CRP
- Leukocyte esterase
- Alpha defensin- No value



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How Do We Decide on the Optimal Timing of Reimplantation

- 1) Antimicrobial treatment completed
- 2) Serology down trending
- 3) Patient clinically optimised:
anemia, diabetes, malnutrition
- 4) The wound is clinically ready for reimplantation



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How is Reimplantation Done

- Aspirate in all cases
- Consider frozen sections if concerns for recurrence
- Send cultures
- Meticulous debridement
- Irrigation
- Reimplantation



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What is the Definition of Failure?

Success After Treatment of Periprosthetic Joint Infection: A Delphi-based International Multidisciplinary Consensus

**Claudio Diaz-Ledezma MD, Carlos A. Higuera MD,
Javad Parvizi MD, FRCS**

- (1) infection eradication, characterized by a healed wound without fistula, drainage, or pain, and no infection recurrence caused by the same organism strain
- (2) no subsequent surgical intervention for infection after reimplantation surgery
- (3) no occurrence of PJI- related mortality (by causes such as sepsis, necrotizing fasciitis).



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What is the Definition of Failure?

THE ORTHOPAEDIC FORUM

Definition of Successful Infection Management and
Guidelines for Reporting of Outcomes After Surgical
Treatment of Periprosthetic Joint Infection

From the Workgroup of the Musculoskeletal Infection Society (MSIS)

Tier 1. Infection control with no continued antibiotic therapy

Tier 2. Infection control with the patient on suppressive anti-biotic therapy

Tier 3. Need for reoperation and/or revision and/or spacer retention

Tier 4. Death



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Options After Failure?

- Antibiotic suppression alone
- Repeat two stage reimplantation
- Arthrodesis
- Resection Arthroplasty
- Amputation



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Who is a Candidate for Repeat Two-Stage Exchange

■ THE HIP SOCIETY

Outcomes of repeat two-stage exchange hip arthroplasty for prosthetic joint infection

N. Khan,
D. Parmar,
M. S. Ibrahim,
B. Kayani,
F. S. Haddad

From University
College London
Hospitals NHS
Foundation Trust,
London, United
Kingdom

57% successful control of infection
1/3 mortality rate at 2 yrs

Outcome	Repeat two-stage (n = 42)	Standard two-stage (n = 42)	p-value
Mean postoperative HHS (sd)	80 (9)	85 (8)	0.34*
Failure to control infection, n	16	2	0.0002†
Further procedures during interval, n	19	2	0.0002†
Dislocation, n	9	3	0.06*
Fracture, n	4	1	0.17*
Mean hospitalization, days (range)	19 (6 to 122)	9 (3 to 42)	0.04*



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Who is a Candidate for Repeat Two-Stage Exchange

Repeat Two-Stage Exchange Arthroplasty for Periprosthetic Knee Infection Is Dependent on Host Grade

Keith A. Fehring, MD, Matthew P. Abdel, MD, Matthieu Ollivier, MD, Tad M. Mabry, MD, and Arlen D. Hanssen, MD

Investigation performed at the Mayo Clinic, Rochester, M

Grade	Description†
Infection type	
I	Early postop. infection (<4 wk postop.)
II	Hematogenous infection (<4-wk duration)
III	Late chronic infection (>4-wk duration)
Host (medical and immune) status	
A	Uncompromised (no compromising factors)
B	Compromised (1-2 compromising factors)
C	Substantial compromise (>2 compromising factors) or 1 of following: <ul style="list-style-type: none">• Absolute neutrophil count <1000• CD4 T-cell count <100• Intravenous drug abuse• Chronic active infection at other site• Dysplasia or neoplasm of immune system
Extremity status	
1	Uncompromised (no compromising factors)
2	Compromised (1-2 compromising factors)
3	Substantial compromise (>2 compromising factors)



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Investigation performed at the Mayo Clinic, Rochester, Minnesota

Uncompromised host (MSIS type A)
Acceptable wound (MSIS type 1 or 2)

70% rate of success

TABLE V Recurrence of Infection Categorized by MSIS Classification

MSIS Classification*	No. (%) with Recurrence
A1	2 (40)
A2	1 (20)
B1	1 (25)
B2	10 (50)
B3	2 (66)
C2	4 (67)
C3	2 (100)

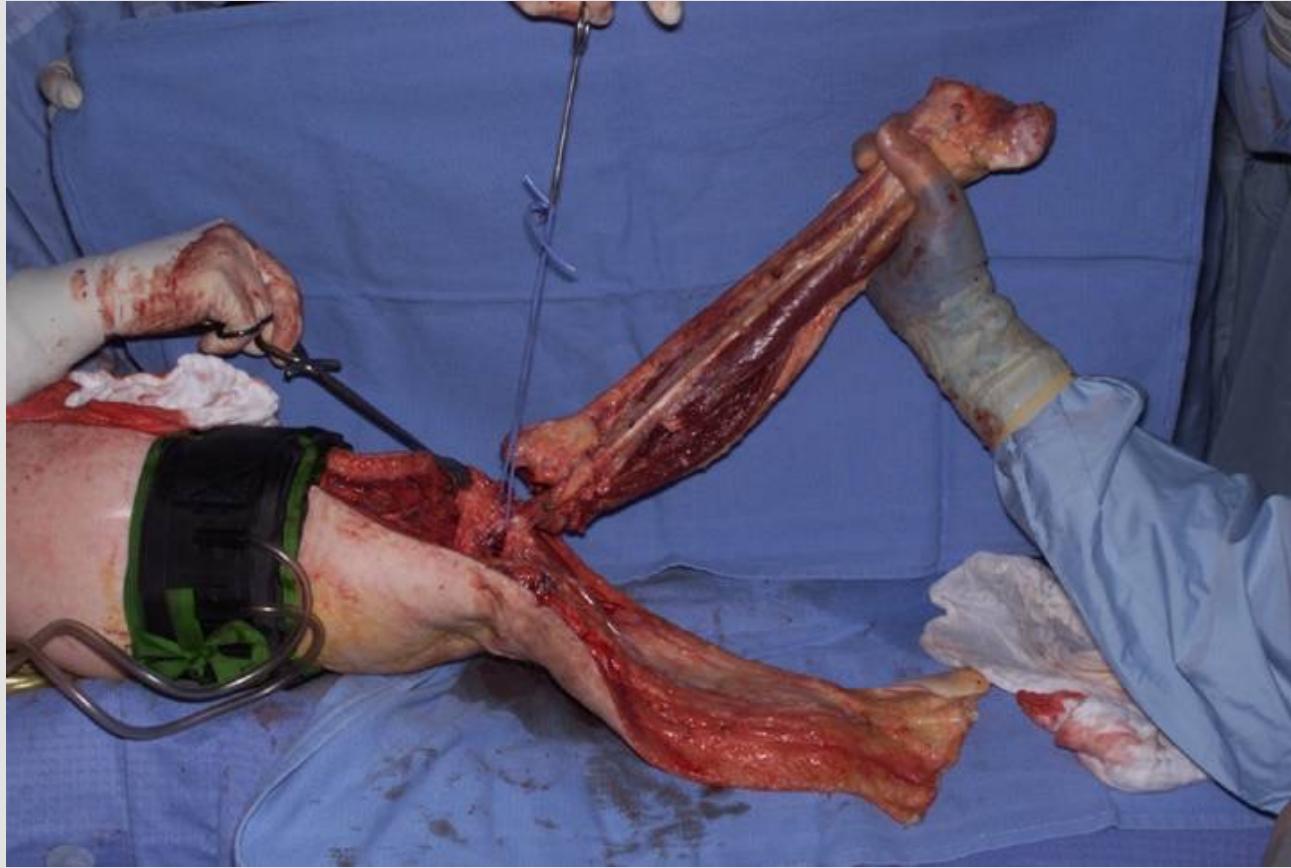


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Enough is Enough Amputation



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Enough is Enough Resection



Amputation



Resection arthroplasty



Arthrodesis



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THANK YOU.



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