
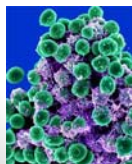


Propionibacterium acnes Infection in Shoulder Surgery

Hithem Rahmi, DO
John Itamura, MD
The Kerlan Jobe Orthopaedic Clinic
Professor of Orthopaedic Surgery
Keck School of Medicine
University of Southern California



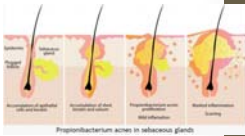
KERLAN - JOBE
ORTHOPAEDIC CLINIC
A CEDARS-SINAI AFFILIATE

Los Angeles Dodgers



Microbiology

- *P. acnes*
 - Anaerobic, Gram-positive Bacillus
 - Found in sebaceous follicles of the axilla
 - Greater concentration exist in the axilla compared with the hip or knee
 - Can also be found in deep layers of skin, conjunctiva, external auditory canal, respiratory tract, and intestinal tract
 - Colonization is more common in men than women
 - Common pathogen in infections after shoulder surgery along with *Staphylococcus* species



Propionibacterium acnes colonization of the human shoulder

Amar Patel, MD*, Ryan P. Calfee, MD*, Matthew Plante, MD*, Staci A. Fischer, MD*, Andrew Green, MD**

Propionibacterium acnes: an underestimated etiology in the pathogenesis of osteoarthritis?

Ofer Levy, MD, MCh (Orth), FRCS^a, Shabnam Iyer, MBBS, MD, DTM&H, FRCPath^b, Ehud Atoun, MD, MCh (Orth)^c, Noel Peter, MRCS^d, Nir Hous, MD^e, Dave Cash, BSc (Hons)^f, Fawaz Musa, MBChB, FRCPath^g, A. Ali Narvani, FRCS (Orth & Trauma)^h

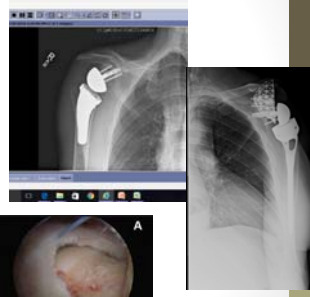
Low rate of Propionibacterium acnes in arthritic shoulders undergoing primary total shoulder replacement surgery using a strict specimen collection technique

Cristobal B. Maccioni, MD^{1,2}, Adam B. Woodbridge, MD, MBBS^{3,4}, Jean-Christian Y. Balestro, MD^{5,6}, Melanie C. Fittree, MD, FRACP, FRCPA⁷, Bernard J. Hudson, MD, FRACP, FRCPA⁸, Benjamin Cass, MD, FRACS⁹, Allan A. Young, MBBS, MSpMed, PhD, FRACS¹⁰

- May play a role in development of arthritis
- High incidence of *P.acnes* in shoulders prior to arthroplasty suggesting a correlation with arthropathy (Levy et. al., JSES 2013)
- However, a recent study saw a low rate of positive cultures (3.125%) of *P. acnes* using the Oxford protocol to collect tissue specimens (Macioni et. al., JSES 2015)
 - Different results reflect different rates of contamination rather than infection
- Emphasizes the need for strictly controlled specimen collection

Incidence of Infection

- Arthroplasty
 - Anatomic TSA – 0.4-2.9%
 - Reverse TSA – 1-10%
 - Revision shoulder arthroplasty – as high as 15.4%
- Arthroscopic RCR- 1.9%



Risk Factors

- Male patients
 - More hair in the upper body harbors more of the bacterium
- Increased duration of surgery
- Preoperative anemia
- Age less than 65
- Posttraumatic shoulder arthroplasty
 - 3 times higher risk of infection than elective surgery (Richards et. al., CORR 2014)
- Prior shoulder surgery
- Workman's compensation

The effect of axillary hair on surgical antisepsis around the shoulder

Geoffrey S. Marecek, MD^{1,2*}, Brian M. Weatherford, MD³, Eric B. Fuller, MD⁴, Matthew D. Saltzman, MD⁵


- Axillary hair removal
 - Maracek et. al. (JSES, 2015)
 - 85 healthy male volunteers
 - Cultured clipped vs. unclipped axillae
 - Clipped axillae had a higher total bacterial burden
 - After preparation with chloraprep however there was no difference in bacterial load
 - Based on this study, the authors no longer routinely remove axillary hair



Efficacy of preoperative home use of 2% chlorhexidine gluconate cloth before shoulder surgery

Michael R. Murray, MD^{*}, Matthew D. Saltzman, MD, Stephen M. Gryzlo, MD, Michael A. Terry, MD, Chase C. Woodward, BS, Gordon W. Nuber, MD

- JSES 2011
- Home use of 2% chlorhexidine wipes before shoulder surgery decreases overall bacterial culture rates, especially for coagulase-negative Staphylococcus



Efficacy of Surgical Preparation Solutions in Shoulder Surgery

By Matthew D. Saltzman, MD, Gordon W. Nuber, MD, Stephen M. Gryzlo, MD, Geoffrey S. Marecek, MD, and Jason L. Koh, MD

Investigation performed at Northwestern Memorial Hospital, Northwestern University, Chicago, Illinois

- JBJS 2009
- Surgical preparation
 - **ChloroPrep** (2% chlorhexidine gluconate and 70% isopropyl alcohol) vs. **DuraPrep** (0.7% iodophor and 74% isopropyl alcohol) vs. **povidone-iodine scrub** vs. **paint** (0.75% iodine scrub and 1.0% iodine paint)
 - No difference in eliminating *P. acnes*
 - However, **ChloroPrep** was most effective in eliminating coagulase negative *Staphylococcus* when used for preoperative preparation

Frequent isolation of *Propionibacterium acnes* from the shoulder dermis despite skin preparation and prophylactic antibiotics

Jaideep Phadnis, FRCS (Tr&Orth)^{a,b,*}, David Gordon, FRACP, FRCPA^c, Jeganath Krishnan, FRACS, PhD^{a,d}, Gregory Ian Bain, FRACS, PhD^b

^aDepartment of Trauma & Orthopaedics, Brighton and Sussex University Hospitals, UK
^bDepartment of Orthopaedics and Trauma, Flinders University, Adelaide, SA, Australia
^cDepartment of Microbiology and Infectious Diseases, Flinders University, Adelaide, SA, Australia
^dInternational Musculoskeletal Research Institute, Adelaide, SA, Australia

- 50 consecutive patients
- 70% chlorhexidine alcohol
- 42% pre preparation positive for p bacter
- 14 % post preparation positive
- 52% positive dermal swabs
- 40% positive dermal biopsies
- Higher rate in patients <50 years old and revision surgeries

Efficacy of topical benzoyl peroxide on the reduction of *Propionibacterium acnes* during shoulder surgery

James R. Sabetta, MD^a, Vishal P. Rana, BS^b, Katherine B. Vadasdi, MD^b, R. Timothy Greene, MD^b, James G. Cunningham, MD^b, Seth R. Miller, MD^b, Paul M. Sethi, MD^{b,*}

- Residual bacteria can still be found on the skin up to 29-40% of the time after skin preparation.
- Incising the skin/sebaceous glands can introduce *P. acnes* into the surgical wound.
- Sabetta et. al. (JSES, 2015)
 - Benzoyl peroxide (BPO) as a good adjunct preoperatively to chlorhexidine preparation
 - Use of 5% topical BPO cream for 2 days prior to surgery substantially reduced the rate of *P. acnes* identified in cultures to 6%
- This was only done in arthroscopic cases
- Future study to include open shoulder cases

- Nottage, et al, ASES 2016, unpublished
- He has been using BPO clindamycin compound preoperatively
- Showed almost no p bacter growth

THE JOURNAL OF BONE & JOINT SURGERY [AMERICAN VOLUME] | COMPLICATIONS IN TOTAL SHOULDER ARTHROPLASTY
VOLUME 95-A | NUMBER 6 | MARCH 20, 2013

AAOS
AMERICAN ACADEMY OF
ORTHOPAEDIC SURGEONS

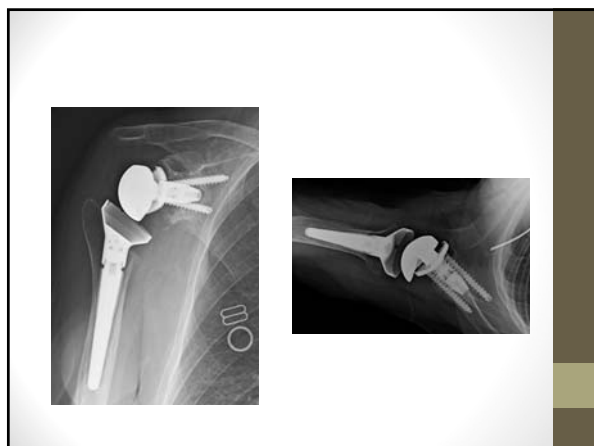
Complications in Total Shoulder Arthroplasty

John W. Sperling, MD, MBA, Richard I. Hawkins, MD, Gilles Walsh, MD, and Joseph D. Zuckerman, MD
An Instructional Course Lecture, American Academy of Orthopaedic Surgeons

- Type 1 = positive cultures at the time of revision surgery when preoperative workup is negative.
- Type 2 = are identified within 30 days after surgery and are considered acute.
- Type 3= infections are acute hematogenous infection identified more than 30 days after surgery.
- Type 4 = infections are chronic infections

Diagnosis

- *P. acnes* is a commensal organism considered to be low virulence
- Makes clinical diagnosis difficult
- Patients usually only present with shoulder pain and may have no fever or local inflammation and may have normal inflammatory markers
- Inflammatory markers also may be poor indicators. Sensitivities of CRP and ESR in shoulder infections were found to be 42% and 16%, respectively (contrast to lower limb 88% and 75%, respectively)



Revision shoulder arthroplasty with positive intraoperative cultures: The value of preoperative studies and intraoperative histology

Mark S. Topolski, MD, Patrick Y.K. Chin, MD, FRCS(C), John W. Sperling, MD, and Robert H. Colfield, MD, Rochester, MN

- Topolski et al. (JSES, 2006)
 - Evaluated 75 patients with positive cultures at the time of revision shoulder arthroplasty without overt signs of infection
 - The white blood-cell count was normal in 93%
 - Polymorphonuclear cell or neutrophil distribution was normal in 91%
 - Erythrocyte sedimentation rate was normal in 86%
 - C-reactive protein was normal in 75%
 - The intraoperative histological studies were negative for acute inflammation in 92%.

Diagnosis

- Gold standard is intraoperative cultures
- 7-21 days of incubation are often necessary for detection

Interleukin-6 as a predictor of infection

Villacis et. al. (JBJS, 2014)
prospectively evaluated serum IL-6 in shoulder arthroplasty patients

- sensitivity = 14%
- specificity = 95%

Frangiomore et. al. (JBJS, 2015)
prospectively evaluated synovial fluid IL-6 of patients undergoing revision surgery

- sensitivity = 87%
- specificity = 90%

Cost associated

Infections in Revision Shoulder and Elbow Surgery Holding Cultures 21 Days

Michael Beckett MD¹, Venkat Kavuri BS,
Ann Z Tan MD², Byron Williams MD²,
John Itamura MD^{2,3}

³Kerlan Jobe Orthopaedic Clinic

²White Memorial Medical Center

¹Kaiser Permanente West LA

March 22, 2013
AAOS Annual Meeting Chicago

Organism and Culture Times

Organism	Number of Infections (49 total)	Avg # of Days to Growth of all Culture Specimens (days)	Avg # of Days to Growth of 1 st Positive Culture (days)	Range (days)
P. acnes	26 (54%)	12.2	12.2	6-21
Coag Negative Staph	16 (33%)	5.9	5.8	2-21
Corynebacterium	4 (8%)	8.8	8.8	8-10
enterococcus	4 (8%)	4.3	5.3	2-12
MRSA	3 (6%)	3.2	2.3	1-6
Candida	3 (6%)	11.9	9.3	4-20
MSSA	2 (4%)	2	2	1-3
Acid Fast Bacilli	2 (4%)	11	11	11
Aspergillus	1 (2%)	5	5	5
E. coli	1 (2%)	2	2	2

Late Cultures

Organism	Number of Infections (49 total)	Number of Cultures that became positive after 10 days	Number of Cultures that became positive after 14 days
Propionibacterium Acnes	26	57%	28%
Coagulase Negative Staph	16	8%	2.7%
Corynebacterium	4	0	0
enterococcus	4	9.1%	0
MRSA	3	0	0

Frozen Section Correlation

Organism	>5 PMNs per HPE	P value	Φ correlation coefficient
P. acnes	3/20	.71	-.06
Coag Negative Staph	1/11	.65	-.14
Corynebacterium	0/3	1	-.16
MRSA	2/2	.056	.48
enterococcus	0/2	1	-.13
MSSA	1/1	.22	.37
Candida	2/2	.056	.48
Acid Fast Bacilli	0/2	1	-.13
E. coli	0/1	1	-.09

Discussion

- Organisms and rates similar to the literature
- Average incubation time 12.2 days
 - Slightly longer than only other study in literature holding cultures 21 days
- Frozen sections cannot reliably be used

Diagnosis

- Different Strains of *P. acnes*
- Nodzo et. al. (Am J Orthop, 2014)
 - Took samples from patients who have undergone arthroplasty or nonarthroplasty shoulder procedures
 - An orthopedic surgeon classified these infections as definite, likely, or unlikely.
 - Overall 22 *P. acnes* samples, 13 were hemolytic, 9 were nonhemolytic
 - 10/13 hemolytic strains were definite infections
 - 3/9 nonhemolytic strains were definite infections
 - Hemolytic strain is the pathologic strain

Early Versus Late Culture Growth of *Propionibacterium acnes* in Revision Shoulder Arthroplasty


Salvatore J. Frangiamore, MD, Anas Saleh, MD, Matthew J. Grosso, BS, Bashar Alolabi, MD, Thomas W. Bauer, MD, PhD, Joseph P. Iannotti, MD, PhD, and Eric T. Ricchetti, MD

Investigation performed at the Department of Orthopaedic Surgery, Cleveland Clinic Foundation, Cleveland, Ohio

- Contaminant vs. true positive????
- Frangiamore et. al. (JBJS, 2015)
 - Evaluated the timing of growth of *P. acnes* after intraoperative cultures taken
 - Probable true-positive cultures grew at a significantly shorter time (4-7 days) compared to probable contaminants (6-12 days)

Treatment

- Treatment can be further complicated with unexpected intraoperative positive cultures
 - Grosso et al. (JSES, 2012)
 - Treated patients with unexpected positive intraoperative cultures with a one-stage revision and no postoperative antibiotics and found low reinfection rates (5.9%)
 - Foruria et. al. (JSES, 2013)
 - Supported ignoring or monitoring unexpected intraoperative positive cultures of low virulence and negative preoperative workup in healthy patients
 - Pottinger et al.(JBJS, 2012)
 - Found preoperative and intraoperative risk factors that correlate with positive cultures during revision surgery.
 - They included male sex, osteolysis, membrane formation, and cloudy fluid. This information might help guide decision making in prosthesis removal or retention and the need for immediate antibiotic therapy

 **Antimicrobial Agents and Chemotherapy**
AAC Article | Journal Info | Authors | Reviewers | Permissions | Journals.ASM.org

Antimicrob Agents Chemother. 2013 Jul; 57(7): 3424-3425. PMID: PMC3697349
doi: 10.1128/AAC.02463-13

Antimicrobial Susceptibility of *Propionibacterium acnes* Isolates from Shoulder Surgery

John K. Crane,¹ Donald W. Hoffman,^{2,3} Scott R. Nodan,^{3,4} and Thomas R. Duzun^{3,5}

- Guidelines for treatment of *P. acnes* infections are few and are based mostly on anecdotal experience.
- Vancomycin and clindamycin typically are first-line for deep *P. acnes* infections of the shoulder
- Crane et. al., 2013
 - Antibiotics with the lowest minimum inhibitory concentration (MIC) values against *P.acnes* (MIC50 and MIC90) included penicillinG (0.006,0.125), cephalothin (0.047and0.094), and ceftriaxone (0.016, 0.045).
 - First-generation cephalosporins and penicillins may have a greater role in prevention. They did note strains resistant to clindamycin

Summary

- *P. acnes* is a commensal bacteria found in sebaceous glands of hair follicles around the shoulder
- Diagnosis is difficult due to its indolent course and normal clinical findings
- Gold standard for diagnosis is intraoperative cultures
- Can take up to 3 weeks for *P. acnes* to grow
- Surgical skin preparation can decrease the bacterial burden and plays a large role in prevention along with antibiotic prophylaxis

Thank you!



KERLAN - JOBE
ORTHOPAEDIC CLINIC
A CEDARS-SINAI AFFILIATE
