

Antibiotic Prophylaxis and Prevention of Surgical Site Infection in Shoulder and Elbow Surgery

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KEYWORDS

- Antibiotic prophylaxis • Surgical site infection • Infection prevention • Shoulder surgery
- Elbow surgery • Shoulder arthroplasty

KEY POINTS

- The Centers for Disease Control and Prevention and the Musculoskeletal Infection Society current recommendations for prevention of surgical site infection incorporate the following: risk mitigation by host optimization, appropriate selection of perioperative antibiotics, preoperative skin preparation, operative environment, and wound management.
- Antibiotic prophylaxis in the shoulder and elbow should be carefully considered when assessing the unique susceptibility patterns of the common bacteria within this microbiome, especially *Propionibacterium acnes*.
- Standard surgical site sterilization protocols have been unable to eliminate bacterial contamination. Residual bacterial contamination, specifically *P acnes*, has been identified in superficial and deep tissues during clean procedures. Further research is needed to determine the significance of this contamination and the role of additional techniques for surgical site preparation.
- The potential mechanical advantage of irrigation before closure for reduction of bacterial burden is recognized, but the abundance of conflicting evidence precludes consensus on recommending any agent versus another.
- A summary of the author's current practice is included, although additional research is needed to help guide treatment protocols that allow for the highest level of prevention while avoiding unnecessary or potentially detrimental interventions.

INTRODUCTION

Infection after orthopedic procedures is a devastating and serious complication associated with significant clinical and financial challenges to the health care system and the unfortunate suffering patient. Surgical site infections (SSIs) are associated with extensive therapeutic regimens, technically difficult revision surgeries, poor patient outcomes, and substantially increased costs to the health care

system. There has been an increase in the number of orthopedic procedures performed in the United States, especially upper extremity arthroplasty procedures.^{1,2} The growth rates of upper extremity arthroplasty procedures are noted to be between 7% to 13% annually and have been shown to be comparable to growth rates for total hip and knee procedures. Between 1993 and 2007, primary total shoulder and total elbow arthroplasty

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procedures increased by 369% and 248%, respectively.³ Total shoulder arthroplasty rates are projected to increase by more than 150% by the year 2020.¹ A similar trend has been noted in recent years, in which a significant increase has been witnessed in the incidence of arthroscopic and open procedures treating shoulder and elbow injuries.^{4–11} This includes a notable 600% increase in the number of arthroscopic rotator cuff repairs witnessed between 1996 and 2006.⁵

Periprosthetic joint infection (PJI) accounts for a substantial percentage of shoulder arthroplasty procedure complications, with failure rates reported as high as 15.4%.^{12–15} The prevalence of SSI for all orthopedic procedures is reported to be between 0.6% and 2.55%.^{16,17} There is growing concern surrounding the current and predicted economic burden of PJI and SSI due to the rapid increase in the number of arthroplasty and other orthopedic procedures being performed, and the increasing rate of infection.¹⁸ Most cost analysis data and fiscal implications for treating infection stems from total knee arthroplasty (TKA) and total hip arthroplasty (THA) procedures and can be used as a framework for assessing the financial impact associated with revisions for infection of shoulder and elbow procedures. The direct medical cost for treating a case of infected THA is 2.8 times higher than for other causes of revision and 4.8 times higher than primary THA.¹⁹ Early literature reported costs per case averaging \$100,000, resulting in financial losses for hospitals between \$15,000 and \$30,000 per patient, with inpatient costs expected to double by 2020.^{18–22} This cost disparity is largely driven by the characteristics associated with revision procedures for infection: longer operative times with a higher number of total surgical procedures, longer length of stay, subsequent hospitalizations with higher inpatient charges, higher complication rates, administration of long-term antibiotics, and more outpatient visits.²³ The time and resource-intensive nature of treating infection after orthopedic procedures has turned attention toward enhancing preventative efforts and establishing quality improvement measures. Infection prevention strategies include risk mitigation, host optimization, reducing bacterial burden, and wound management throughout all phases of the perioperative period.

PREVENTION OF SURGICAL SITE INFECTION AND PERIPROSTHETIC JOINT INFECTION

In 2002, the Centers for Disease Control and Prevention (CDC) and Centers for Medicare

and Medicaid Services (CMS) instituted the Surgical Infection Prevention project, which later became the Surgical Care Improvement Program (SCIP). The expansion to SCIP included enhanced antimicrobial prophylaxis recommendations, patient hair removal at the surgical site, glycemic control, and normothermia process measures.^{24,25} In 2009, the US Department of Health and Human Services set a 5-year target goal of a 25% reduction in SSI detected on admission and readmission through the implementation of the *National Action Plan to Prevent Health Care-Associated Infections: Road Map to Elimination*. The CMS Hospital Inpatient Quality Reporting Program has required hospitals to report SSI outcome data since 2012; through the Deficit Reduction Act of 2005, payments are adjusted downward for health care-associated infections.²⁶ In May of 2017, the CDC released guidelines for prevention of SSI that are generalizable across surgical procedures and recommended integration of these guidelines to improve patient safety.²⁵ The first two aspects of prevention discussed are parenteral and nonparenteral antimicrobial prophylaxis. A summary of the relevant recommendations is found in [Table 1](#).

Despite technological advances, scientific discoveries, and improved care pathways, infection continues to provide a very complex and difficult problem for the treating surgeon. The Musculoskeletal Infection Society (MSIS) and the European Bone and Joint Infection Society, along with numerous other societies, developed an interdisciplinary team of more than 400 experts from orthopedic surgery, infectious disease, musculoskeletal disease, microbiology, dermatology, rheumatology, musculoskeletal radiology, pharmaceuticals, and scientists to critically evaluate the current evidence and reach a consensus on recommendations. The consensus statements on current practices for preventing SSI and PJI were presented at the most recent International Consensus Meeting on Surgical Site and Periprosthetic Joint Infection in 2013.²³ The recommendations included risk mitigation, perioperative antibiotics, preoperative skin preparation, operative environment, and wound management.

RISK MITIGATION AND HOST OPTIMIZATION

Host optimization incorporates various defined categories termed modifiable risk factors that have the potential to be changed or optimized in the perioperative period to help reduce the

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