

Antibiotic-Eluting Calcium Sulfate Beads as a Prophylactic Strategy in High-Risk Primary Total Hip Arthroplasty

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INTRODUCTION: Prosthetic joint infection (PJI) remains a serious complication after primary total hip arthroplasty (THA), especially in high-risk patients with multiple health conditions. While local delivery of antibiotics using absorbable calcium sulfate beads has been suggested for Periprosthetic joint infection treatment and revision procedures, data on its prophylactic use in high-risk primary THA are limited [1]. We aimed to analyze infection rates, wound complications, and reoperation risk related to prophylactic antibiotic bead placement in high-risk patients undergoing primary THA.

METHODS: Following approval from the institutional review board (IRB #25-1814), we retrospectively reviewed consecutive primary THAs performed by a single surgeon from October 1, 2018, to August 31, 2023. All included patients received prophylactic intra-articular placement of calcium sulfate beads loaded with vancomycin and tobramycin. Patients who had conversion arthroplasty, combined fixation procedures, or complex trauma cases were excluded. Risk factors for PJI were identified using established literature, and these were used to calculate the expected PJI risk in our cohort based on the 2018 International Consensus Meeting PJI risk calculator [2]. The primary outcome measured was PJI occurrences. Secondary outcomes included wound complications, reoperation, instability, and revision surgery.

RESULTS SECTION: A total of 151 patients met inclusion criteria, with a mean age of 56.7 years (SD 20.7) and mean follow-up time of 20.03 months (range 0.1-72.2). Of the patients included in analysis, 89 (58.9%) were female. All patients had at least one PJI risk factor, most commonly body mass index > 35 (22.7%), rheumatologic disease (21.2%), long-term steroid use (19.9%), renal disease (17.9%), and diabetes mellitus (15.9%) (Table 1). Based on the PJI risk calculator, the cohort showed a median predicted lifetime infection risk of 1.75% (range 0.58-18.89%). The 90th and 95th percentile risks were 11.91% and 15.07%, respectively. When added across the cohort, the expected number of lifetime PJIs was 5.7. The single highest-risk patient contributed 18.9% to this total, and the top five patients together accounted for 16.5% of the predicted burden. Zero PJIs occurred for patients included in the analysis. Six patients (4.0%) needed to return to the operating room, including three revisions (2.0%) for instability. Wound-related complications were seen in three patients (2.0%) (Table 2).

DISCUSSION: The discrepancy between predicted and observed PJI incidence indicates that local antibiotic bead prophylaxis significantly lowers infection risk in high-risk primary THA patients. While the cohort’s median predicted lifetime risk was 1.75%, with an expected burden of 5.7 infections, zero cases occurred. The biologic plausibility lies in achieving supratherapeutic local antibiotic levels that interfere with early bacterial adhesion and biofilm formation, especially during the vulnerable postoperative period when systemic prophylaxis alone may be inadequate [3]. This data suggests that bead placement lowers PJI risk for those with physiological and comorbid vulnerabilities. Study limitations include the retrospective design, modest follow-up relative to lifetime risk estimates, and lack of a non-bead control group. Nonetheless, the data from this study strongly supports a role for targeted local antibiotic prophylaxis in altering infection risk trajectories for high-risk arthroplasty patients.

SIGNIFICANCE/CLINICAL RELEVANCE: This study shows that antibiotic-eluting beads can lower the risk of prosthetic joint infections below predicted levels in high-risk THA patients. These results support using targeted local prophylaxis as an important addition to standard systemic antibiotics for patients with multiple comorbidities.

REFERENCES: [1] Su L, Park J, Mao YV, Wong MT, Dipane MV, Sassoon A. Use of Antibiotic Eluting Calcium Sulfate Beads in High-Risk Primary Total Knee Arthroplasty. *J Knee Surg.* 2025 Jul 3. [2] Tan, Timothy L. MD; Maltenfort, Mitchell G. PhD; Chen, Antonia F. MD, MBA; Shahi, AliSina MD; Higuera, Carlos A. MD; Siqueira, Marcelo MD; Parvizi, Javad MD, FRCS. Development and Evaluation of a Preoperative Risk Calculator for Periprosthetic Joint Infection Following Total Joint Arthroplasty. *The Journal of Bone and Joint Surgery* 100(9):p 777-785, May 2, 2018. [3] Howlin RP, Brayford MJ, Webb JS, Cooper JJ, Aiken SS, Stoodley P. Antibiotic-loaded synthetic calcium sulfate beads for prevention of bacterial colonization and biofilm formation in periprosthetic infections. *Antimicrob Agents Chemother.* 2015 Jan;59(1):111-20.

Risk factors	n	%
BMI > 35	34	22.7
Rheumatologic diagnosis	32	21.2
Long-term steroid use	30	19.9
Renal disease	27	17.9
Diabetes mellitus	24	15.9
Liver disease	20	13.3
Drug use	19	12.6
Previous surgery same joint	9	6.0
CHF	10	6.6
Deficiency anemia	8	5.3
Coagulopathy	8	5.3
HIV/AIDS	8	5.3
Metastatic disease	5	3.3
Alcohol use disorder	5	3.3
Current smoker	4	2.7
Psychosis	1	0.7

Table 1. Patient risk factors

Outcomes	n	%
Return to the operating room	6	4.0
Instability	3	2.0
Wound dehiscence or drainage	3	2.0
Superficial incision and drainage	3	2.0
Revision	3	2.0
Prosthetic joint infection	0	0
Deep incision and drainage	0	0

Table 2. Surgical and medical outcomes