Navigating Infection Risks: The Safety and Efficiency of Robotic Techniques in THA

Josef Jolissaint, Andrew Thomson, Alexandra Prorock Grizas, Andy Miller, Geoffrey H Westrich

INTRODUCTION:

Total hip arthroplasty (THA) is a highly effective and commonly performed procedure for relieving pain and restoring function in patients with end-stage hip arthritis. Despite its overall success, periprosthetic joint infection (PJI) remains a rare but serious complication, and is associated with substantial morbidity, mortality, and healthcare costs. In recent years, computer navigation and robotic-assisted THA (RA-THA) have been increasingly used to improve the accuracy of implant positioning and reduce alignment-related complications. While these technologies offer enhanced surgical precision, they also introduce theoretical risks for infection, including increased operative time, additional instrumentation, and the potential for microbial entry through tracking pins or reference arrays. Whether these factors translate to higher infection rates remains unclear. This study evaluates superficial surgical site infection (SSSI) and PJI rates, as well as operative times, in primary robotic and navigated THA at a high-volume academic medical center, comparing them to traditional manual techniques.

METHODS:

Prospectively collected SSSI and PJI surveillance data was reviewed for all primary THA procedures performed from January 2018 to December 2024 at a high-volume academic orthopedic medical center. Patient demographics, case duration, and use of robotics or navigation was evaluated. Infection outcomes, including SSSI and PJI, were monitored for 90 days postoperatively using a dedicated surveillance program in accordance with National Healthcare Safety Network (NHSN) criteria. Statistical analyses were performed using chi-square or Fisher's exact tests for categorical variables and ANOVA for continuous variables, with significance defined as p < 0.05. Logistic regression was performed to control for known confounders such as age, gender, body mass index (BMI), surgical duration, surgical approach (anterior vs. posterior), diabetes, and smoking history.

RESULTS:

A total of 31,795 primary THAs were performed, 15,848 using manual techniques and 15,947 using robotic or navigated techniques. The robotic cases included 9,775 Mako, 3,332 Intellijoint, 904 Naviswiss, 927 Radlink, 741 OrthAlign, and 268 Velys. There were no significant differences in SSSI or PJI rates between manual and individual robotic or navigated techniques (p=0.50, p=0.19, p=0.11, p=0.12, p=0.15, p=0.57). When combined as a cohort, robotic and navigated techniques showed no significant difference in PJI (0.18% vs. 0.30%, p=0.06) or SSSI rates (0.18% vs. 0.26%, p=0.14) compared to manual techniques. Robotic and navigated techniques were associated with a modest 4.4-minute increase in operative time (91.5 vs. 87.1 minutes) compared to manual techniques. Logistic regression identified increased body mass index (BMI) and increased procedure duration as independent risk factors for PJI (p=0.002, p<0.001). Regression analysis additionally identified BMI, procedure duration, and anterior approach as independent risk factors for SSSI (p=0.001, p<0.001, p<0.001).

DISCUSSION AND CONCLUSION:

In this large cohort of patients from a single academic center robotic and navigated THA demonstrated no difference in PJI or SSSI rates compared to traditional methods despite a small increase in operative time. These findings reinforce that robotic-assisted and navigated approaches can be safely integrated into routine clinical practice, including in academic and high-volume centers with trainees. Compared to prior national database analyses, this study provides granular, prospectively collected clinical data from a real-world setting, strengthening the evidence base. Given the ongoing rise in THA volume globally and the demand for reproducible, high-quality outcomes, these technologies offer a safe pathway for enhancing surgical precision without compromising infection safety.

Logistic Regression Predicting PJI

Variable	Odds Ratio	CI Lower 95%	CI Upper 95%	p-value
Age	0.984	0.965	1.005	0.130
BMI	1.055	1.019	1.091	0.002
Diabetes	1.571	0.791	3.121	0.197
Anterior Approach	0.769	0.422	1.401	0.390
Robotic/Navigation Use	0.628	0.389	1.014	0.057
Duration	1.008	1.004	1.013	0.000
Male Gender	0.783	0.491	1.251	0.306
Non Smoker	1.111	0.677	1.823	0.677
Smoker	1.334	0.504	3.536	0.562
Low Volume	0.98	0.303	3.175	0.9740
Ultra High Volume	0.817	0.45	1.481	0.505

Logistic Regression Predicting SSI

Variable	Odds Ratio	CI Lower 95%	CI Upper 95%	p-value
Age	1.013	0.99	1.038	0.275
BMI	1.086	1.046	1.128	0.000
Diabetes	0.807	0.319	2.042	0.651
Anterior Approach	3.858	2.312	6.439	0.000
Robotic/Navigation Use	0.675	0.414	1.098	0.113
Duration	1.01	1.004	1.015	0.001
Male Gender	0.643	0.387	1.069	0.089
Non Smoker	0.856	0.525	1.396	0.533
Smoker	0.609	0.143	2.586	0.501
Low Volume	0.637	0.086	4.702	0.658
Ultra High Volume	1.536	0.901	2.616	0.115

Variable	Category	PJI (%)	SSSI (%)	Procedure Duration		
				Mean	SD	
Robotic	No	46 (0.3)	41 (0.3)	87.06	29.2	PJI p-value: 0.061
	Yes	29 (0.2)	28 (0.2)	91.48	26.35	SSSI p-value: 0.141