## Robotic and Computer-Navigated Total Hip Arthroplasty Associated with Lower Revision Rates and Complications Compared to Conventional Techniques: A Propensity-Matched Analysis

Eric Schweppe, Mohammed Shayan Abdullah<sup>1</sup>, Harmon Singh Khela, Tarun R Sontam, Weston Smith, Neil P Sheth <sup>1</sup>The University of Pennsylvania

INTRODUCTION: Robotic and computer-assisted technology may enable arthroplasty surgeons to achieve more precise implant positioning, but debate continues regarding the effect these techniques have on clinical outcomes, particularly when compared to conventional total hip arthroplasty (C-THA). The purpose of this study was to evaluate the associations of both robotic-assisted (RA-THA) and computer-navigated (CN-THA) with postoperative complications versus C-THA. METHODS: This retrospective cohort study screened more than 250 million patients between 2007 and 2022 using the TriNetX US-collaborative health records database. The International Classification of Diseases, Ninth and Tenth Revisions (ICD-9 and ICD-10) procedure codes were utilized to identify patients undergoing primary, elective THA. After excluding for trauma, infection, revision, and malignancy indications, patients were stratified by surgical technique. Propensity score matching (PSM) on a 1:1 basis was performed based on age, sex, race, ethnicity, smoking history, obesity, and Charleston Comorbidity Index components to pair patients who underwent C-THA (640,890 total; 97%) with patients who underwent (1) RA-THA (9,860 total; 1.5%) and (2) CN-THA (7,341 total; 1.1%). Multivariable logistic regression was used to compare risks of postoperative complications at intervals of 30 days, 90 days, 1 year, and 2 years. RESULTS: Following PSM, the C-THA versus RA-THA analysis included 19,720 patients (9,860 per group), while the C-THA versus CN-THA analysis included 14,682 patients (7,341 per group). Both RA-THA and CN-THA were associated with significantly lower rates of revision arthroplasty at every timepoint compared to C-THA (Figure 1). Patients who underwent CN-THA had the most pronounced rate decrease of revision arthroplasty compared to C-THA, specifically 59% at 30 days (Odds Ratio [OR]: 0.413; 95% Confidence Interval [CI]: 0.211, 0.810; p < 0.008) and 44% at 2 years (OR: 0.464: 95% CI: 0.310, 0.694: p < 0.0001). While remaining significant for both cohort comparisons, the magnitude of the odds of requiring revision surgery decreased over time with RA-THA returning closest to parity with 48% lower odds at 30 days (OR: 0.542; 95% CI: 0.350, 0.841; p < 0.005) and 30% lower odds at 2 years (OR: 0.699; 95% CI: 0.512, 0.954; p < 0.023). RA-THA also had lower odds of dislocations at all timepoints with decreasing magnitude: 50% lower odds at 30 days (OR: 0.503; 95% CI: 0.486, 1.684; p < 0.0001) and 35% at 2 years (OR: 0.648; 95% CI: 0.494, 0.852; p < 0.002). In contrast, CN-THA showed no difference in dislocation rates but a decreased odds of prosthetic joint infections at 1 year (OR: 0.454; 95% CI: 0.215, 0.959; p < 0.034) and 2 years (OR: 0.499; 95% CI: 0.249, 0.999; p < 0.045). No significant difference was noted in rates of pulmonary embolism, deep vein thrombosis, or opioid utilization.

DISCUSSION AND CONCLUSION: Conventional total hip arthroplasty (C-THA) was consistently associated with higher rates of revision arthroplasty compared to both robotic-assisted (RA-THA) and computer-navigated (CN-THA) techniques. Furthermore, RA-THA was associated with significantly lower odds of dislocations across all timepoints, while CN-THA demonstrated a reduction in prosthetic joint infections at later intervals. These findings suggest that both RA-THA and CN-THA may offer superior outcomes in terms of reducing revision rates and certain complications.



**Figure 1**: Odds Ratio of revision total hip arthroplasty over time: Computer-Navigated and Robot-Assisted versus Conventional Instrumentation.