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Fluoroscopy-based Robotics in Total Hip Arthroplasty Mitigates Laterality-based Differences in Acetabular Cup Placement when Compared to Manual, Fluoroscopic-assisted Technique

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Surgeon hand-dominance may impact cup placement in Total Hip Arthroplasty

Fluoroscopy-based robotics mitigates the influence of hand-dominance on cup placement

Fluoroscopy-based robotics may reduce the rates of post-operative complication

Introduction

- Favorable outcomes following total hip arthroplasty (THA) are dependent on accurate positioning of the acetabular cup
- Surgeon hand-dominance can impact acetabular cup placement accuracy in manual, unassisted THA (mTHA)
- Cup impaction ergonomics may be hindered if case laterality does not align with the surgeon's dominant hand
- **Purpose of the study:** To determine if the use of a fluoroscopy-based robotic-assisted THA system (RA-THA) reduces laterality-based discrepancies in acetabular cup placement between left (L) and right (R) THA

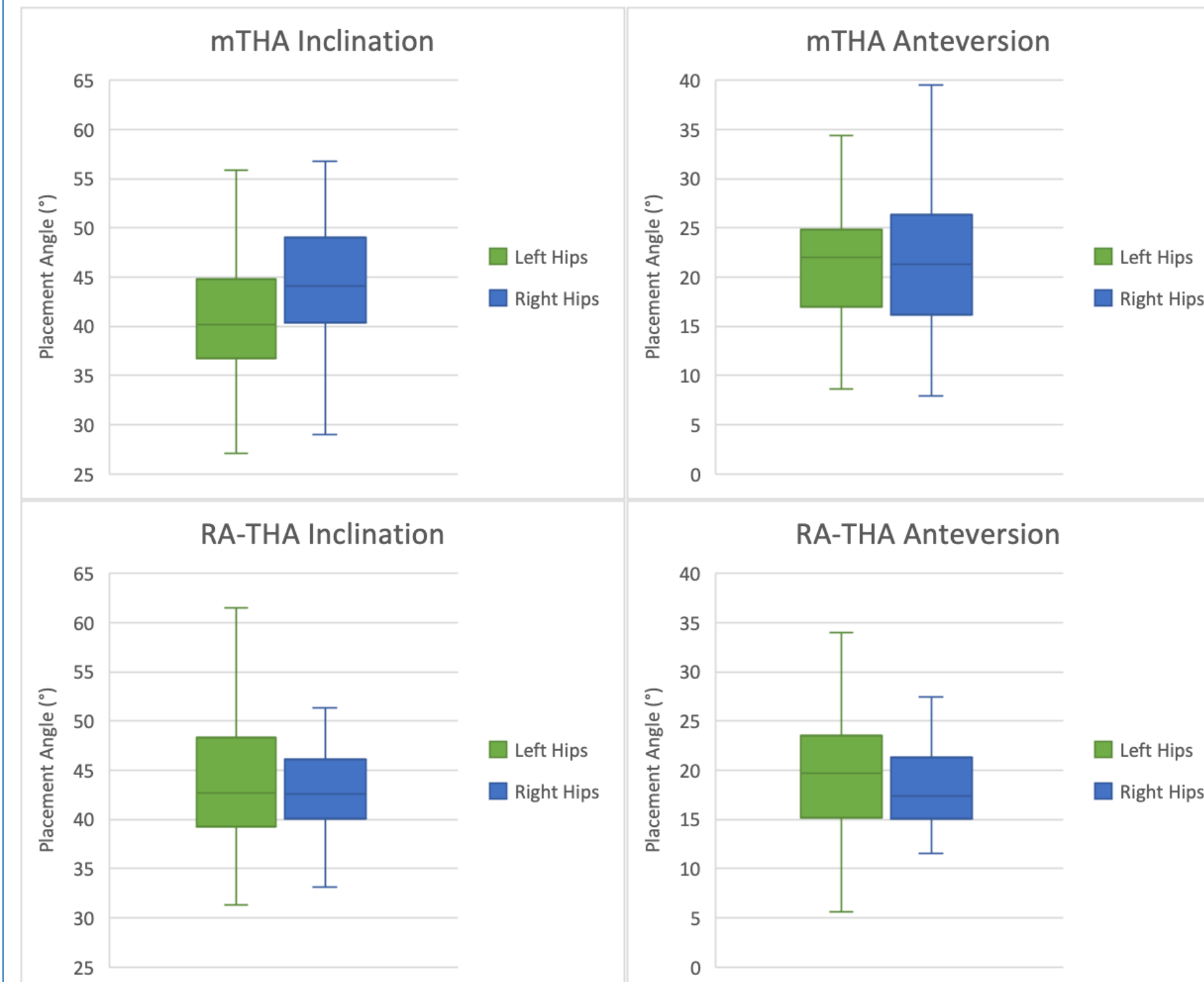
Methods

- All procedures were performed by a single right-hand-dominant surgeon at the same institution, via a direct anterior approach
- Control group: 106 consecutive mTHA (40 L/66 R)
- Study group: 102 consecutive RA-THA (48 L/54 R)
- Cohorts were similar in their distributions of age, sex, race, body mass index (BMI), pre-operative diagnosis, procedure laterality, and pre-operative American Society of Anesthesiologists (ASA) risk classification
- Inclusion criteria: 1) Age ≥ 18 ; 2) Primary THA; 3) Primary dx osteoarthritis, rheumatoid arthritis or avascular necrosis
- Exclusion criteria: 1) Age < 18 ; 2) Revision THA
- Outcome variables: 1) Average cup inclination and anteversion angles ($^{\circ}$); 2) Proportion of cups placed within the Lewinnek "safe" zone ($40^{\circ} \pm 10$ inclination, $15^{\circ} \pm 10$ anteversion)

Results

- The average inclination of mTHA L cases was smaller than that of mTHA R cases ($41.10^{\circ} \pm 7.38$ vs. $43.97^{\circ} \pm 6.27$; $p=0.04$)
- For RA-THA, L and R cup angles were similar
- There were fewer overall mTHA cups than RA-THA cups placed within safe zone (0.59 vs. 0.78; $p=0.003$)

Figure 1: mTHA and RA-THA cup inclination and anteversion angles by procedure laterality



Note: * = $p < 0.05$

Discussion

- **The use of a novel, fluoroscopy-based robotic-assistance system for primary DAA THA mitigated laterality-based differences in acetabular cup placement**
- It is estimated that 85% of orthopaedic surgeons are right-hand-dominant, which may present ergonomic challenges for left hip arthroplasties
- Improper acetabular cup positioning has been associated with post-operative complication: 1) Dislocation; 2) Accelerated component wear; 3) Revision surgery
- The use of fluoroscopy-based robotics may reduce complication rates following DAA THA

Conclusions

- Use of a novel, fluoroscopy-based robotic system mitigated laterality-based differences in acetabular cup placement that were observed in a manual non-robotic cohort
- Adoption of the robotic-assisted DAA THA may be associated with reduced rates of complication and improved functional outcomes relative to mTHA
- Additional prospective research amongst an expanded cohort that is still needed to validate these findings



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