Assessing potential measurement error in intra-operative acetabular cup placement accuracy due to early migration

Shahnaz Taleb,[1] Jennifer Polus,[1] Brent Lanting,[2] Matthew Teeter[1]
[1]Western University, London, ON, CA [2]London Health Sciences Center, London, ON, CA
staleb3@uwo.ca

Disclosures: Shahnaz Taleb (N), Jennifer Polus (N), Brent A. Lanting (3B-DePuy, IntelliJoint, Smith & Nephew, Stryker; 5-DePuy, Smith & Nephew, Stryker; 6-DePuy, Smith & Nephew, Stryker, Zimmer), Matthew G. Teeter (9-International Society for Technology in Arthroplasty, Canadian RSA Network, Canadian Orthopaedic Research Society).

INTRODUCTION: Proper alignment of the acetabular cup is essential for long-term total hip arthroplasty (THA) success. Conventional freehand and mechanically guided techniques can result in suboptimal cup alignment, even in the hands of experienced surgeons. Computer navigation and robotic techniques have been of interest to improve cup alignment, with their accuracy often reported by comparing the intraoperative to six-weeks postoperative alignment. However, early component migration is known to occur within the first six-weeks. This study aimed to assess the potential error in cup position measurements caused by early acetabular cup migration within the first six-weeks following THA.

METHODS: Patients were enrolled, and written consent was obtained pre-operatively as part of a larger prospective randomized clinical trial approved by our institutional research ethics board. A single fellowship trained arthroplasty surgeon performed all surgeries using the direct anterior approach with adjuvant fluoroscopy. Patients received a Pinnacle cup with AltrX highly crosslinked acetabular liner (DePuy Synthes, Warsaw, IN) with either no (n = 7), one (n = 16), or two (n = 10) screws, a Corail cementless femoral stem (standard or high-offset, as required), and a 28 mm, 32 mm, or 36 mm cobalt-chromium femoral head. No significant differences were found in placement change between groups; therefore, all patients were combined for the analysis. Acetabular cup inclination and anteversion angles were measured by two raters from radiographs taken intra-operatively and at six-week post-operation (Fig 1.). An RSA examination was performed on the day of surgery, within the first 24 hours post-operatively, as well as 6-weeks post-operation to assess anterior tilt about the x-axis, internal rotation about the y-axis, and valgus rotation about the z-axis.

RESULTS: Thirty-three patients were included in our analysis. Mean inclination angles were 31.2° intra-operatively and 32.8° at six-weeks post-operation (maximum difference = 11.1°). Mean anteversion angles were 23.5° and 29.3° intra-operatively and at six-weeks post-operation (maximum difference = 15.3°). Mean anterior tilt, internal rotation, and valgus rotation between day of surgery and six-weeks post-operation were 1.33° (0.01° – 3.84°), 0.98° (0.12 – 2.79°), and 0.80° (0.02° – 2.20°) respectively.

DISCUSSION: The advent of computer navigation systems to aid cup alignment have offered a more a more reproducible and accurate alternative; however, widespread acceptance of such systems requires validation based on post-operative studies, often at six-week follow-ups and beyond. Our results therefore that substantial cup migration may occur within the first few weeks of THA, which may partially confound attempts to measure cup placement accuracy.

SIGNIFICANCE: This study demonstrated that early migration of acetabular cups may introduce an error in studies reporting computer navigation accuracy in acetabular cup placement based on post-operative imaging follow-ups.

REFERENCES: [1] Lewinnek GE, Lewis JL, Tarr R, Compere CL, Zimmerman JR. Dislocations after total hip-replacement arthroplasties. vol. 60. 1978.

FIGURES:

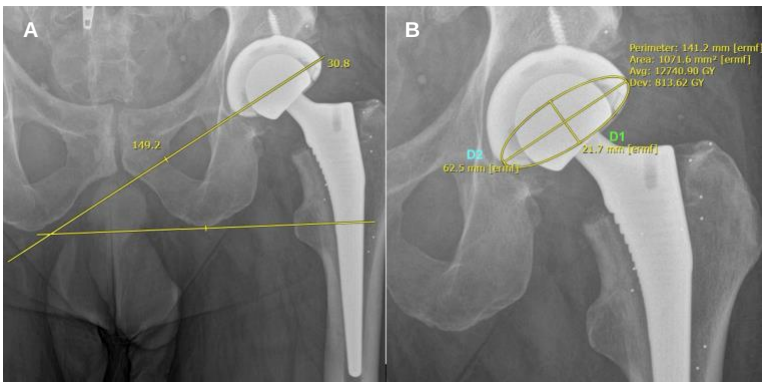

Figure 1: (A) Inclination and (B) anteversion measurements on standard AP radiographs. Inclination was measured as the angle between the bi-ischial line and a line tangent to the opening of the acetabular cup. Anteversion was measured as described by Lewinnek et al [1]