

## GUEST EDITORIAL

## What's New in Hip Replacement

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*Investigation performed at the Department of Orthopedic Surgery, University of Minnesota, Minneapolis, Minnesota***Implant Design and Related Outcomes****Dual Mobility**

Dual-mobility cups do not reduce the revision risk for patients with acute femoral neck fracture, as concluded by Rogmark and Naclér in an observational cohort of 2,242 patients with dual-mobility cups compared with a matched cohort of 6,726 patients treated with a conventional total hip implant<sup>1</sup>. The authors reported that, with implant revision surgery as the outcome, they “could not detect any differences between a total hip arthroplasty with a dual mobility cup and one with conventional bearing.” Outcomes were similar and independent of whether the implants were inserted via a direct lateral or posterior approach as well as for subgroup analyses of revision for dislocation and infection. The authors concluded that improvements in the care of patients with hip fracture are most likely to come from elsewhere in the care pathway and “not in design variations of contemporary orthopedic implants.”

Cnudde et al. reported similar findings when they investigated patients with neurologic disease undergoing arthroplasty for femoral neck fracture<sup>2</sup>. Comparing hemiarthroplasty, conventional total hip arthroplasty (THA), and dual-mobility THA performed in 9,638 patients with conditions such as Alzheimer and Parkinson diseases, the authors found that there was an increased risk of dislocation when comparing hemiarthroplasty and THA with a <32-mm head but not with conventional THA with a 32-mm head (hazard ratio [HR], 1.54 [95% confidence interval (CI), 0.94 to 2.51];  $p = 0.083$ ) and THA with a dual-mobility implant (HR, 0.68 [95% CI, 0.26 to 1.84];  $p = 0.451$ ). Overall, the authors found no difference in the rate of reoperation or revision-free survival between any of the different prostheses or sizes of the femoral head.

**Cobalt-Chromium**

Using data from the National Joint Registry linked to U.K. National Health Service (NHS) English hospital inpatient episodes for 374,359 primary THAs, Deere et al. investigated 158,677 hips (42.4%) containing an implant with cobalt-chromium<sup>3</sup>. With a maximum 14.5-year follow-up (mean [and

standard deviation],  $5.1 \pm 3.5$  years [range, 1 day to 14.5 years]), the authors reported finding no association with any of the negative clinical outcomes studied, including all-cause mortality, heart outcomes, cancer, and neurodegenerative disorders. They stated that these data may provide reassurance to patients and clinicians that cobalt-chromium-containing primary THA implants are not associated with detectable adverse systemic effects.

In a recent single-surgeon cohort, Gani et al. suggested that metal-on-metal hip resurfacing provides a durable intervention at a mean follow-up of 14.9 years (range, 9.3 to 19.1 years) for men receiving resurfacing implants with a head size of  $>46$  mm<sup>4</sup>. The survivorship in this group was reported as 97.7%, with no metal ion level exceeding the accepted safe limits. However, the survivorship in female patients was 73.4%. The authors suggested that this high failure rate was closely related to head sizes of  $\leq 46$  mm.

**Patient Factors in Relation to Outcomes****Socioeconomics**

In a recent investigation of 103,901 patients who underwent THA between 1995 and 2017 and were included in the Danish health registries, Edwards et al. concluded that socioeconomic inequality adversely influences the risk of infection after THA<sup>5</sup>. The cumulative incidence of any infection at 90 days was highest in patients who had the lowest amount of savings (1.3% [95% CI, 1.2% to 1.4%]) compared with those who had the highest amount of savings (0.7% [95% CI, 0.6% to 0.8%]), in patients who had the least education (1.1% [95% CI, 1.0% to 1.2%]) compared with those who had the highest education (0.7% [95% CI, 0.5% to 0.8%]), in patients who lived alone (1.5% [95% CI, 1.3% to 1.6%]) compared with those who did not (0.7% [95% CI, 0.7% to 0.8%]), and in patients who had the lowest income (1.6% [95% CI, 1.5% to 1.70%]) compared with those who had the highest income (0.4% [95% CI, 0.3% to 0.5%]). Also, the risk ratios for any infection within 90 days were 1.5 (95% CI, 1.4 to 1.8) when comparing patients who had the lowest amount of savings with those who had the highest amount of savings, 1.2 (95% CI, 1.0 to 1.3) for patients

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who had less education compared with those who had higher education, 1.3 (95% CI, 1.2 to 1.4) for patients who lived alone compared with those who did not, and 1.7 (95% CI, 1.4 to 2.1) for patients with low income compared with those with high income. The authors advocated for the development of targeted intervention strategies to mitigate the impact of socioeconomic strategies on the risk of infection.

In a recent study examining the effects of socioeconomic status on Harris hip scores at 1 year after primary and revision THAs, Stisen et al. observed improvement in patient-reported outcome scores at the 1-year follow-up<sup>6</sup>. Using a database of 16,932 patients undergoing a surgical procedure between 1995 and 2018, the authors found that scores were 2.6 points (95% CI, 2.1 to 3 points) higher for primary THA for patients with high wealth compared with those with low wealth and 12 points (95% CI, 10 to 14 points) higher for patients with high education compared with those with low education. The authors questioned if the identification of these risk factors preoperatively and extra rehabilitation postoperatively might help to improve equality in this health outcome.

### *Patient Age and Risk of Revision*

Utilizing a large health system total joint registry, Prentice et al. conducted a cohort study including 11,671 patients who underwent primary elective THA and were <55 years of age and 53,106 patients who were ≥65 years of age<sup>7</sup>. When the authors examined cause-specific revision risks, they found that patients who were <55 years of age had higher risks of instability (HR, 1.35 [95% CI, 1.09 to 1.68]), aseptic loosening (HR, 2.60 [95% CI, 1.99 to 3.40]), and septic revision (HR, 1.30 [95% CI, 1.02 to 1.66]). When patients who were <55 years of age were compared with patients who were ≥65 years of age, the risk of revision for periprosthetic fracture was lower (HR, 0.36 [95% CI, 0.22 to 0.59]). Ceramic-on-ceramic design, anterior surgical approach, and hypertension were associated with aseptic loosening, whereas American Society of Anesthesiologists (ASA) classification ≥3, posterior surgical approach, ceramic-on-ceramic design, White race, paralysis, patient being a smoker, and smaller head diameter were associated with instability.

### *Improvement in Low Back Pain After THA*

The preoperative factors that may be predictive of improvement in low back pain after THA were investigated in 151 patients who underwent primary THA and reported a visual analog scale (VAS) for low back pain of ≥2<sup>8</sup>. Patients were followed for 1 year and were then classified as either having improved low back pain or having continuing low back pain, with improvement defined as a decrease of >2 in the VAS for low back pain. The preoperative mean VAS for back pain was similar ( $p = 0.96$ ) between the groups at  $5.1 \pm 2.0$  compared with  $5.1 \pm 2.1$ . The authors reported improvement in low back pain in 60% of patients at the 1-year follow-up. Low Cobb angle and high anterior pelvic plane angle were associated with

low back pain improvement, and sagittal spinal imbalance and high Cobb angle were associated with persistent low back pain as defined in this study. The authors concluded that a radiographic evaluation of spinal alignment may help in preoperative patient counseling.

### **Surgical Factors in Relation to Outcomes**

#### *Patients with Both Hip and Spine Symptoms*

In a retrospective review of consecutive patients with instability, Heckmann et al. investigated the effect of hip offset and spinopelvic abnormalities on the risk of dislocation after THA<sup>9</sup>. When compared with age and gender-matched controls without instability, patients with instability had a higher prevalence of spinopelvic pathology (odds ratio [OR], 7.80 [95% CI, 2.59 to 23.50];  $p < 0.001$ ). Although the authors found that a smaller femoral head was a risk factor for instability, as was the cup position outside of the Lewinnek safe zone, the patients with instability “were at greater risk of markedly under-restored hip offset ( $\Delta\text{offset} \leq 3$  mm; OR 6.34, 95% CI 2.20-18.30,  $P = .001$ ).” The authors concluded that under-restoration of hip offset, particularly in patients with spinopelvic pathology, “may be more important than historically described acetabular targets.”

#### *Outpatient Arthroplasty*

Seeking to assess early complications in a population who underwent outpatient THA, DeMik et al. utilized the National Surgical Quality Improvement Program (NSQIP) database to compare outpatients with patients managed with a longer postoperative hospitalization<sup>10</sup>. The authors identified 4,813 patients (4%) who underwent outpatient THA between 2015 and 2018, 84,627 patients (64%) who underwent THA and had a length of stay of 1 to 2 days, and 42,293 patients (32%) who underwent THA and had a length of stay of ≥3 days. Outpatients were younger and had lower body mass index and fewer medical comorbidities compared with patients who had postoperative hospitalization. Any complication was experienced in 3.2% of the outpatient group, 5.3% of the group with a 1 to 2-day length of stay, and 15.6% for the group with a length of stay of ≥3 days ( $p < 0.0001$ ). The readmission rates were 1.6% for the outpatient group, 2.6% for the 1 to 2-day hospitalization group, and 4.7% for the 3-day hospitalization group ( $p < 0.0001$ ).

However, revision THA may not be well suited to an outpatient pathway, according to Sutton et al., who reported on a consecutive series of 1,026 revision THAs and total knee arthroplasties (TKAs) over a 5-year period<sup>11</sup>. The authors reported that, when outpatient status was defined as a hospital stay of <2 midnights only, 16% of their patients met outpatient criteria. Although patients who underwent THA with head-and-liner exchange were the most likely of the subgroups to meet outpatient criteria (49%), the authors expressed concern that, if the U.S. Centers for Medicare & Medicaid Services (CMS) removes all revision arthroplasties from the inpatient-

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only list, decreased facility reimbursement and early discharge may result in restricting access to the complex care required by many of these patients.

### Perioperative Management

#### *Patient-Reported Outcome Scores*

Sabah et al. recently calculated the contemporary values for the minimal important changes (MICs) and minimal important differences (MIDs) for the Oxford Hip and Knee Scores for primary and revision joint replacement<sup>12</sup>. Using the 694,487 procedures in the NHS PROMs (Patient Reported Outcome Measures) data set between 2012 and 2020, the authors reported that, for the comparison of  $\geq 2$  groups (such as in a clinic trial), MID estimates were approximately 5 points out of a maximum score of 48 points. For cohort studies investigating changes over time in a single group of patients, estimates were 12.4 points for primary hip replacement and 8.6 points for revision hip replacement. For studies investigating changes over time at the individual patient level, estimates were approximately 8 points for primary hip replacement and approximately 6 points for revision hip replacement. The authors concluded that these data may assist surgeons in interpreting both the literature and scores that they collect themselves.

#### *Perioperative Opioids*

In a recent study examining the effect of opioid use prior to THA, Simonsson et al., using the Swedish Hip Arthroplasty Register, Statistics Sweden, Swedish National Patient Register, and Prescribed Drug Register, found that patient-reported outcome scores were worse and adverse event and reoperation rates were higher in patients whose symptoms were managed with opioids in the year leading up to the surgical procedure<sup>13</sup>. The authors reported that patients with  $\geq 4$  opioid prescriptions in the year before total hip replacement (14,720 patients [18%]), compared with patients who had not received opioids, had a higher risk of revision within 2 years (1.8% compared with 1.1%; OR, 1.4 [95% CI, 1.3 to 1.6]) and adverse events within 90 days (9.4% compared with 6.4%; OR, 1.2 [95% CI, 1.2 to 1.3]). At 1 year after the surgical procedure, patients with  $\geq 4$  opioid prescriptions rated themselves 5 points worse on a 0-to-100 scale of VAS for pain and 9 points worse on the general health EuroQol (EQ)-VAS at 1 year postoperatively.

#### *Informed Consent*

In a recent prospective randomized controlled trial of 70 adults undergoing elective THA, patients were randomized to receiving or not receiving a preadmission procedure-specific consent document in addition to a procedure-specific consent form on the morning of the surgical procedure<sup>14</sup>. The additional informed consent document given at preadmission did not improve recall of potential complications 4 weeks after the surgical procedure, at which time 30% of patients could not recall a single potential complication of the procedure.

#### *Return to Sport*

The return to playing golf after hip, knee, and shoulder arthroplasty was the topic of investigation of a recent meta-analysis of 23 studies, 4 of which reported on a total of 250 patients who underwent THA<sup>15</sup>. The mean rate of patients returning to golf after THA was 90% (95% CI, 82% to 98%), the highest of the 3 procedures. Of the patients who underwent THA and returned to golf, the mean time after the surgical procedure was 4.5 months (95% CI, 3.2 to 5.8 months). Three of the 4 studies showed an increase in golf handicap after THA (+2, +1.4, and +1.1).

#### *Hip Precautions*

Whether patients adhere to hip precautions in the first 6 weeks after a surgical procedure was investigated with a self-reporting questionnaire completed by 120 patients following elective primary THA<sup>16</sup>. Theaker et al. found that 76% of the respondents could be classified as "highly adherent" while they were inpatients. This number decreased to 68% once the patients went home, and 24% of patients were found to not adhere to the precautions >90% of the time. Supine sleeping was the most difficult precaution to adhere to in this study and the easiest precaution was avoiding crossing legs and using a raised chair.

This percentage appears to be even lower by 12 weeks, according to the findings reported in a separate study, also utilizing a patient questionnaire<sup>17</sup>. McNaught et al. reported that, of the 297 consecutive patients who attended their 12-week follow-up appointment, only 6.3% (19 patients) reported that they restricted their daily activities as prescribed for the full 12-week period. The authors stated that they found patients to instead return to their activities of daily living based on their pain and activity levels. They recorded no dislocations during the study period.

In a recent biomechanical study<sup>18</sup>, Sah stated: "Hip precautions are often enforced after total hip arthroplasty without knowing normal arcs of motion during real-life activities." The author studied 30 volunteers, using a validated wearable sensor above and below the waist, through typical activities of daily living. Sah found that walking, ascending stairs, and descending stairs were well under a typical 90° limitation. However, the mean transition from sitting to standing was 103.0°, the mean maximum transition for rising from the toilet was 112.6°, the mean transition from squatting was 120.0°, and the mean transition for tying shoes was 126.1°. The author stated that the information may be useful in educating patients undergoing THA.

#### *Postoperative Follow-up*

In a recent systematic review of the literature, Loppini et al. concluded that the field lacks evidence-based indications for the follow-up schedule after THA, finding no original papers, 4 expert consensus guidelines for routine follow-up, and 3 expert consensus guidelines for special cases<sup>19</sup>. The authors concluded

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that the current state of practice is “arbitrary,” based on consensus among experts and not evidence, and stated that there is a clear need to “develop data-based recommendations for clinical and radiographic follow-up after hip replacement.”

### Complications

In what Edelstein et al. described as the first representative study of periprosthetic femoral fracture in the United States (118,675 THA cases from the CMS), elderly women receiving ingrowth femoral stems were found to have a higher incidence of fracture when compared with the same population receiving cemented stems<sup>20</sup>. This advantage did not extend to male patients, who were also found to have a higher 30-day mortality with cemented stems compared with ingrowth stems. Overall, the 90-day periprosthetic femoral fracture rate was 2.0%, and the 30-day mortality rate was 0.18%.

In a recent meta-analysis, Lamb et al. reported that postoperative periprosthetic femoral fractures carry a 30-day mortality like that experienced by patients with femoral neck fracture<sup>21</sup>. Pooling a total of 4,841 patients from 35 cohort studies, the authors found that mortality was 2.4% (95% CI, 1.6% to 3.4%) for inpatient stays, 3.3% (95% CI, 2.0% to 5.0%) within 30 days, and 4.8% (95% CI, 3.6% to 6.1%) within 90 days. The pooled mortality was 13.4% (95% CI, 11.9% to 14.8%) within 1 year. The authors concluded that mortality after postoperative periprosthetic femoral fractures was like that of femoral neck fractures up to 30 days, but better at 1 year, and that further research into factors predictive of early mortality for these patients is needed.

Mortality was also the end point used by investigators who evaluated the outcomes of periprosthetic hip infection<sup>22</sup>. Reporting on a cohort of 442 patients at a minimum of 10 years after a periprosthetic hip infection, Wildeman et al. found that all-cause 10-year mortality was significantly higher for patients who underwent THA and developed periprosthetic joint infection (PJI) (45%) compared with patients who underwent THA and did not develop it (29%) (OR, 1.4 [95% CI, 1.2 to 1.6];  $p < 0.001$ ). In addition, patients who experienced PJI, compared with those who did not, reported a lower EQ-5 Dimensions-5 Levels (EQ-5D-5L) index score (0.83 compared with 0.94; difference,  $-0.13$  [95% CI,  $-0.18$  to  $-0.08$ ];  $p < 0.001$ ), a greater need for assisted living (21% compared with 12%; OR, 2.0 [95% CI, 1.2 to 3.3];  $p = 0.01$ ), a greater need for ambulatory aids (65% compared with 42%; OR, 3.1 [95% CI, 2.1 to 4.8];  $p < 0.001$ ), and a lower Oxford Hip Score (36 compared with 44; difference,  $-5.9$  [95% CI,  $-7.7$  to  $-4.0$ ];  $p < 0.001$ ). Factors associated with a lower Oxford Hip Score were  $\geq 3$  operations and a revision surgical procedure using a direct lateral approach.

### Technology-Assisted THA

There has been a substantial increase in patient interest in robotic-assisted THAs, according to a recent study utilizing the Google Trends online tool, although this increase is less than

that seen in the online search volume for robotic-assisted TKA<sup>23</sup>. Between 2011 and 2021, there was a linear increase in search volume for robotic-assisted THA compared with an exponential increase seen in search volume for robotic-assisted TKA. However, the increase in search volume for robotic-assisted THA was significantly higher than the increase seen for nonrobotic arthroplasty over the same time period. The authors called for high-quality studies that may be used to appropriately guide this public interest.

In a related study, using Amazon Mechanical Turk, Pagani et al. surveyed 588 members of the public with regard to their perceptions and beliefs regarding robotic-assisted orthopaedic surgery<sup>24</sup>. The authors found that most respondents believed that robotic-assisted surgery leads to better results (69%), fewer complications (69%), less pain (59%), and faster recovery (62%) than conventional manual methods. Roughly half (49%) would prefer a low-volume surgeon using robotic technology than a high-volume surgeon using conventional manual methods. The authors concluded that “the public’s unawareness of the dubious outcome superiority associated with robotic-assisted orthopedic surgery may contribute to misinformed decisions” while functioning as a “powerful marketing tool for surgeons and hospitals.”

Using the American College of Surgeons (ACS) NSQIP database, Simcox et al. recently investigated the real-world application of technology-assisted THA<sup>25</sup>. Among the 238,755 patients in the database who underwent THA, 3,149 cases (1.3%) were found to have been performed using either computer navigation or robotics. Patients who underwent technology-assisted THA, compared with patients who underwent unassisted THA, were discharged earlier ( $2.0 \pm 1.1$  days compared with  $2.5 \pm 2.0$  days;  $p < 0.001$ ) and subsequently experienced a higher readmission rate (3.8% compared with 2.4%;  $p < 0.001$ ). The authors called for clinical trials to assess the utility of assistive technologies in THA.

### Current Trends and Debates

#### *THA Compared with Hemiarthroplasty for Intracapsular Femoral Neck Fracture*

In a recent meta-analysis of 13 randomized controlled trials with a pooled sample size of 3,050 patients, Wek et al. questioned the practice of performing THA instead of hemiarthroplasty for the management of a femoral neck fracture<sup>26</sup>. The authors found higher rates of adverse events in the patients treated with THA. The authors suggested that the “limited functional improvement conferred by THA vs. HA [hemiarthroplasty]” may be outweighed by the increased risk of dislocation and, for patients  $>80$  years of age, of 1-year mortality.

#### *Cemented Compared with Cementless Femoral Stem*

Using inclusion criteria that excluded conventional polyethylene and metal-on-metal bearings, Babazadeh et al. recently reported lower revision rates for polished cemented stems



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when compared with commonly used cementless prostheses<sup>27</sup>. Reporting on 201,889 total hip replacements from the Australian Orthopaedic Association National Joint Replacement Registry, the authors found that cemented stems had a lower rate of revision at all time points, compared with cementless stems, overall as well as in subanalyses by head size, bearing type, and surgeon volume. The authors recommended cemented polished tapered stems in all age groups for both low-volume and high-volume surgeons.

Bloch et al. investigated implant fixation and reported on a single-center database of 10,112 THAs performed between 2003 and 2019<sup>28</sup>. The authors found no difference in survivorship of THAs with hybrid fixation when compared with all-cementless fixation for any age group.

#### Antibiotic Protocol for 2-Stage Periprosthetic Infection Management

In a recent systematic review<sup>29</sup>, Kurapatti et al. investigated 3 protocols for managing antibiotics between stages 1 and 2 of a 2-stage revision for PJI after THA. Nine studies met the inclusion criteria. There were 3 studies that used a prolonged intravenous antibiotic therapy and showed PJI eradication rates of 79% to 96%, 4 studies that used a shortened intravenous antibiotic therapy and showed PJI eradication rates of 88% to 100%, and 2 studies that used a shortened course of intravenous antibiotic therapy with oral antibiotics and showed PJI eradication rates of 95% and 97%. Despite the array of microorganisms that underwent culture tests across the stud-

ies, no significant difference in eradication rates across intravenous antibiotic duration strategies was observed. The authors determined that the 3 protocols had similar eradication rates, despite their differences and the variety of microorganisms treated.

#### Resident Education

Graduate candidates of North American orthopaedic residency programs were queried on their training in cementing a femoral stem in a recent study<sup>30</sup>. Ryan et al. reported that, in the 152 surveys returned, only 37% of resident respondents perceived their training in cementation technique to be comprehensive or very comprehensive, with 17% reporting that their training was inadequate or nonexistent. Although 82% reported feeling “adequately trained” to properly cement a femoral implant, 40% reported being less than satisfied with this training. The authors believed that this is an actionable insight into the current state of training in cementation technique in the United States.

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