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Is a modular dual mobility acetabulum a viable option for the young, active total hip arthroplasty patient?

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Aims

Modular dual mobility (DM) prostheses in which a cobalt-chromium liner is inserted into a titanium acetabular shell (*vs* a monoblock acetabular component) have the advantage of allowing supplementary screw fixation, but the potential for corrosion between the liner and acetabulum has raised concerns. While DM prostheses have shown improved stability in patients deemed 'high-risk' for dislocation undergoing total hip arthroplasty (THA), their performance in young, active patients has not been reported. This study's purpose was to assess clinical outcomes, metal ion levels, and periprosthetic femoral bone mineral density (BMD) in young, active patients receiving a modular DM acetabulum and recently introduced titanium, proximally coated, tapered femoral stem design.

Patients and Methods

This was a prospective study of patients between 18 and 65 years of age, with a body mass index (BMI) < 35 kg/m^2 and University of California at Los Angeles (UCLA) activity score > 6, who received a modular cobalt-chromium acetabular liner, highly crosslinked polyethylene mobile bearing, and cementless titanium femoral stem for their primary THA. Patients with a history of renal disease and metal hardware elsewhere in the body were excluded. A total of 43 patients (30 male, 13 female; mean age 52.6 years (SD 6.5)) were enrolled. All patients had a minimum of two years' clinical follow-up. Patient-reported outcome measures, whole blood metal ion levels (ug/l), and periprosthetic femoral BMD were measured at baseline, as well as at one and two years postoperatively. Power analysis indicated 40 patients necessary to demonstrate a five-fold increase in cobalt levels from baseline (alpha = 0.05, beta = 0.80). A mixed model with repeated measures was used for statistical analysis.

Results

Mean Harris Hip Scores improved from 54.1 (SD 20.5) to 91.2 (SD 10.8) at two years postoperatively (p < 0.001). All patients had radiologically well-fixed components, no patients experienced any instability, and no patients required any further intervention. Mean cobalt levels increased from 0.065 ug/l (SD 0.03) preoperatively to 0.30 ug/l (SD 0.51) at one year postoperatively (p = 0.01) but decreased at two years postoperatively to 0.16 ug/l (SD 0.23; p = 0.2). Four patients (9.3%) had a cobalt level outside the reference range (0.03 ug/l to 0.29 ug/l) at two years postoperatively, with values from 0.32 ug/l to 0.94 ug/l. The mean femoral BMD ratio was maintained in Gruen zones 2 to 7 at both one and two years postoperatively using this stem design. At two years postoperatively, mean BMD in the medial calcar was 101.5% of the baseline value.

Conclusion

Use of a modular DM prosthesis and cementless, tapered femoral stem has shown encouraging results in young, active patients undergoing primary THA. Elevation in mean cobalt levels and the presence of four patients outside the reference range at two years postoperatively demonstrates the necessity of continued surveillance in this cohort.

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Instability following total hip arthroplasty (THA) remains a significant concern, with reported incidences of up to 7% after primary THA and 25% after revision THA.[1] The risk of dislocation is multifactorial and includes both surgeon- and patient-related factors. The use of larger femoral head sizes increases range of movement prior to impingement and the jump distance necessary to displace the modular femoral head, thus decreasing the risk of dislocation.[2,3] Dual mobility (DM) articulations have received increased attention in the United States, as they increase femoral head size while potentially avoiding adverse reactions previously reported with large diameter metal-on-metal bearings.[4,5] Recently, the significance of pelvic motion and spinopelvic alignment on instability has received increased attention, with DM bearings often suggested as a potential solution to improve stability in 'high-risk' patients.[6-8] DM designs consist of a large-diameter highly crosslinked polyethylene insert articulating with an acetabular component with a polished inner surface or modular liner, and a smaller constrained articulation between a modular femoral head and the polyethylene liner.[9] Thus, the polyethylene liner acts as a mobile bearing articulating with both the femoral head and acetabular shell. Modular DM prostheses in which a cobalt-chromium liner is inserted into a titanium acetabular component (*vs* a monoblock acetabular component) have the advantages of providing the confidence of a standard titanium acetabular component and the option for supplementary screw fixation.

However, concerns exist with the use of a modular DM prosthesis, as there is potential for corrosion between the cobalt-chromium liner and titanium acetabular component.[10,11] The consequences of an adverse local tissue reaction are well documented, as the results for revision of this diagnosis have a high risk of early major complications.[12] Furthermore, prior investigations have focused on the use of DM bearings in patients deemed 'high risk' for instability due to increased age, neuromuscular disease, or medical comorbidities.[10] Patients less than 65 years of age constitute the fastest growing subset of patients seeking THA, and the performance of DM prostheses in younger, more demanding patients remains unknown.[13] Furthermore, the longevity of THA implants in this growing population must continue to be scrutinized. Aseptic loosening remains the primary mode of failure following THA,[14] with periprosthetic bone loss and bone resorption recognized as contributing factors.[15] Femoral stem material, size, modulus of elasticity, design, and geometry are all known to influence the degree of metaphyseal load transfer and the potential for stress shielding in the periprosthetic femoral region following THA.[16] Periprosthetic bone loss over time can increase the risk of late failure, periprosthetic fracture, and possibly thigh pain.[17] Thus, continued investigation of stem design and its impact on proximal femoral density remains crucial, as it can provide insight into the aetiology of persistent pain, and design modifications that can impact prosthesis longevity.

The purpose of this study was to assess clinical function, whole blood metal ion levels, and periprosthetic femoral bone mineral density (BMD) in young, active patients receiving a modular DM acetabular component and a recently introduced titanium, proximally coated, tapered cementless femoral stem. Our hypothesis is that patients will demonstrate significantly improved function with well-preserved femoral BMD at a minimum of two years postoperatively, but whole blood cobalt and chromium levels will be elevated *versus* baseline.

Patients and Methods

This is a prospective, Institutional Review Board (IRB)-approved study of young, active patients undergoing primary THA at a single institution with a minimum of two years' clinical follow-up. This investigation presents two-year follow-up data of a previously reported cohort of patients,[18] with additional patients having been enrolled in this prospective investigation since the time of publication. A total of 43 patients (30 male, 13 female) were prospectively enrolled in this investigation. The mean age of patients was 52.6 years (SD 6.5), with a mean BMI of 27.9 kg/m^2 (SD 3.9). Preliminary results of metal ion levels on the initial subset of these patients have previously been reported at one year postoperatively.[18] Inclusion criteria for this investigation were patients between 18 and 65 years of age with a body mass index (BMI) < 35 kg/m^2, undergoing primary THA for a diagnosis of non-inflammatory arthritis including osteoarthritis or avascular necrosis of the femoral head. Patients were required to have a University of California at Los Angeles (UCLA) activity score[19] of more than 6 points prior to the onset of hip pain limiting their activity, with the goal to capture a younger, more active patient population. Exclusion criteria were the following: patients with an active hip sepsis; bone stock considered inadequate based on radiological evaluation for cementless acetabular and femoral fixation at the surgeon's discretion; any cardiovascular, immunological, or neuromuscular disorder severe enough to compromise implant stability and postoperative recovery; a history of renal disease; a prior open operation on the affected hip; a history of metal hardware elsewhere in the body (i.e. prior or subsequent arthroplasty, spinal hardware, pacemaker, etc.); and any pregnant patient or any patient with plans to become pregnant during the course of the study.

All patients received a modular, DM acetabular prosthesis using a titanium, cementless acetabular component (Modular Dual Mobility; Stryker Orthopaedics; Mahwah, New Jersey) and a titanium, proximally coated, tapered cementless femoral stem (Accolade II; Stryker Orthopaedics). All operations were performed by one of three fellowship-trained arthroplasty surgeons (DN, RLB, RMN), with prior experience using these prostheses via a posterolateral surgical approach. Acetabular sizes < 52 mm required a 22 mm inner modular femoral head and those > 54 mm required a 28 mm inner femoral head. The 22 mm femoral heads were only available in cobalt alloy (LFIT CoCr; Stryker Orthopaedics). Thus, the acetabular component size dictated the inner femoral head composition as 14 patients received a 22 mm cobalt alloy femoral head while 29 patients received a 28 mm ceramic femoral head (Delta Ceramic; CeramTec, Plochingen, Germany). The femoral prosthesis used has several design modifications from its predecessor.[20] Preoperative templating was performed using acetate radiographs to identify patients with a proximal femoral morphology conducive to this femoral stem design, with the goal of proximal metaphyseal stem engagement prior to engagement in the diaphyseal canal.

At two years postoperatively, all patients had radiologically well-fixed acetabular and femoral components on both

anteroposterior and cross-table lateral radiographs. Baseline demographics and pre- and postoperative Harris Hip Scores (HHS)[21] and UCLA activity scores were collected. In addition, blood samples from each patient were obtained for whole blood metal ion analysis (cobalt, chromium, titanium) prior to their THA and at one and two years postoperatively. Preoperative blood metal ion levels were obtained within one month of surgery in eight patients, within one week in three patients, and on the same day of the procedure in 23 patients. All instruments used to collect specimens were verified to be free of metal contamination. All samples were processed by the London Health Sciences Department of Pathology and Laboratory Medicine. Reference ranges for metal ions tested were as follows: cobalt (0.032 ug/l to 0.290 ug/l, parts per billion), chromium (0.40 ug/l to 1.60 ug/l, parts per billion), and titanium (0.00 ug/l to 1.40 ug/l, parts per billion), as recommended by the testing facility.

Periprosthetic BMD was measured using dual-energy x-ray absorptiometry (DXA; Discovery A model; Hologic, Bedford, Massachusetts), which is a well-validated method to assess BMD in patients who have undergone THA.[22,23] The same technician (CRN) obtained scans and measurements at six weeks, one year, and two years postoperatively using the same template each time for the patient, and standard foot and knee supports. Prosthetic hip software (Hologic) was used to measure BMD in the seven Gruen zones of the femur.[24] The six-week BMD values were used as the baseline to calculate the percentage change in BMD at one and two years postoperatively as previously reported.[25,26] Use of an early postoperative baseline measurement is more accurate *versus* a preoperative BMD measurement, given the sensitivity of DXA analysis software to changes in the template area to be measured along with bone removed and bone compacted to the periphery during the actual procedure. Comparison of DXA images preoperatively *versus* postoperatively (after THA implantation) is unreliable due to the loss of some preoperative bony landmarks used for standardization. In addition, the metal implant can distort the actual quality of bone to be measured.[27]

Patients also completed a previously described pain-drawing questionnaire.[17] The questionnaire asked study participants to identify whether or not they experienced pain in eight anatomical areas of interest based on the intensity of their activity. Pain with activity was rated using a pain scale scored from 0 to 5 (0 = no pain, 5 = pain at night that wakes you up, or pain all the time), with scores between 2 and 5 considered to have "moderate-to-severe" symptoms.

Statistical analysis. Power analysis indicated that 40 patients were necessary to demonstrate a five-fold increase in the primary outcome measure of whole blood cobalt levels from baseline (alpha = 0.05, beta = 0.80). Statistical analyses were performed using chi-squared tests for categorical variables and independent-samples and repeated-measures Student's *t*-tests for continuous variables. To examine change in BMD during the study period (at six weeks, one year, and two years), a mixed model with repeated measures was constructed. Compound symmetry covariance structure was used when taking into consideration with-subject correlations. All p-values < 0.05 were considered statistically significant.

Results

The mean HHS improved from 54.1 preoperatively (SD 20.5) to 91.2 postoperatively (SD 10.8) ($p < 0.001$). Patients did have a decrease in their UCLA activity score from their mean pre-symptomatic level (8.3 (SD 2.2) *vs* 7.1 (SD 2.3); $p = 0.02$), but the mean postoperative UCLA score at two years postoperatively demonstrated this cohort to be highly active. To date, no patients have required any further surgical intervention.

Preoperative, one-year, and two-year postoperative metal ion levels are presented in Table I. There were no statistically significant differences in mean chromium levels at each follow-up interval. However, there were statistically significant increases in mean cobalt and titanium levels *versus* preoperative levels, although the actual differences were small. At one year postoperatively, no patients had a chromium value outside of the reference range. Five patients (11.6%) had a cobalt level outside of the reference range with values from 0.34 ug/l to 2.1 ug/l, and three patients (7.0%) had a titanium level outside the reference range with values from 1.5 ug/l to 3.1 ug/l. At two years postoperatively, again no patients had a chromium value outside the reference range. Four patients (9.3%) had a cobalt level outside the reference range with values from 0.32 ug/l to 0.94 ug/l, and two patients (4.7%) had a titanium level outside the reference range with values from 1.5 ug/l and 5.2 ug/l, respectively. Of the four patients with elevated cobalt levels, three had a ceramic femoral head while one had a cobalt alloy femoral head. Of the five patients with elevated cobalt levels at one year postoperatively, three showed a decrease in cobalt levels and two patients had approximately the same cobalt level (within 0.04 ug/l) at two years postoperatively. No patient had a cobalt level greater than 1.0 ug/l at two years postoperatively. When comparing those patients receiving a cobalt alloy femoral head *versus* a ceramic femoral head, the mean preoperative chromium level was statistically increased in the ceramic cohort, but this was not likely clinically significant. There was no difference in postoperative whole blood metal ion levels between those patients receiving a cobalt alloy femoral head *versus* a ceramic femoral head (Table II). However, there was a trend towards increased mean cobalt levels in patients receiving a ceramic head at two years postoperatively (0.08 ug/l (SD 0.04) in cobalt *vs* 0.23 ug/l (SD 0.30) in ceramic; $p = 0.08$).

The mean BMD ratio was decreased in Gruen zone 1 at one year and two years postoperatively *versus* the baseline value. In Gruen zone 2, the mean BMD ratio initially decreased slightly at one year postoperatively, but then subsequently increased *versus* the baseline value at two years postoperatively. The mean BMD ratio was maintained in Gruen zones 3 to 7 at both the one-year and two-year postoperative intervals. In Gruen zone 7 (medial calcar), there was a non-significant decrease in BMD ratio at one year postoperatively, but then there was a subsequent increase exceeding 100% of the baseline at two years postoperatively, demonstrating maintenance of BMD in this region (Table III). There was no correlation in proximal femoral BMD over time with age, gender, UCLA activity level, or BMI.

A total of 32 patients completed the pain-drawing questionnaire (Table IV). Six patients (18.8%) reported the presence of

Table I. Comparison of mean and standard deviation (SD) of preoperative, one-year, and two-year postoperative whole blood metal ion levels. p-values represent a comparison with the baseline preoperative level

Metal ion	Preoperative, ug/l (SD; range)	1 yr, ug/l (SD; range)	p-value	2 yrs, ug/l (SD; range)	p-value*
Chromium	0.18 (0.1; 0.00 to 0.52)	0.17 (0.20; 0.07 to 1.20)	0.85	0.14 (0.053; 0.07 to 0.26)	0.07
Cobalt	0.065 (0.03; 0.00 to 0.19)	0.30 (0.51; 0.04 to 2.10)	0.01*	0.16 (0.23; 0.04 to 0.94)	0.02†
Titanium	0.35 (0.13; 0.00 to 0.61)	1.03 (0.47; 0.52 to 3.10)	< 0.001*	1.005 (0.84; 0.48 to 5.20)	< 0.001†

*Repeated-measures Student's *t*-test
†Statistically significant

Table II. Comparison of mean and standard deviation (SD) of preoperative, one-year, and two-year postoperative whole blood metal ion levels between patients receiving a 22 mm cobalt alloy femoral head or a 28 mm ceramic femoral head. p-values represent a comparison with the baseline preoperative level

Metal ion	22 mm cobalt alloy (n = 14)	28 mm ceramic alloy (n = 29)	p-value*
Chromium, ug/l (SD)			
Preoperative	0.14 (0.8)	0.21 (0.12)	0.05
1 yr	0.19 (0.26)	0.14 (0.08)	0.5
2 yrs	0.14 (0.05)	0.14 (0.06)	0.9
Cobalt, ug/l (SD)			
Preoperative	0.07 (0.04)	0.06 (0.03)	0.9
1 yr	0.11 (0.07)	0.34 (0.56)	0.1
2 yrs	0.08 (0.04)	0.23 (0.30)	0.08
Titanium, ug/l (SD)			
Preoperative	0.32 (0.13)	0.37 (0.14)	0.2
1 yr	0.97 (0.32)	1.1 (0.59)	0.5
2 yrs	0.85 (0.24)	1.20 (1.2)	0.4

*Independent-samples Student's *t*-test

Table III. Mean bone mineral density (BMD) ratios in the proximal femur over time. Mean BMD ratios were compared with the previous time interval in this table

Gruen zone	6 wks, %	1 yr, %	p-value	2 yrs, %	p-value*
1	*100*	*90.3*	0.003*	*91.0*	0.4
2	*100*	*98.4*	0.3	*101.8*	0.02†
3	*100*	*102.1*	0.2	*102.5*	0.6
4	*100*	*99.5*	0.8	*99.4*	0.9
5	*100*	*100.6*	0.5	*100.0*	0.4
6	*100*	*101.7*	0.2	*101.8*	0.9
7	*100*	*98.9*	0.1	*101.5*	0.5

*Repeated-measures Student's *t*-test
†Statistically significant

Table IV. Results of the pain-drawing questionnaire. Patients rating the severity of pain from 2 to 5 were considered to have moderate-to-severe pain

Location, n (%)	None (0)	Mild (1)	Moderate-to-severe (2 to 5)
Groin	25 (*78.1*)	4 (*12.5*)	3 (*9.4*)
Anterior thigh	26 (*81.3*)	5(*15.6*)	1 (*3.1*)
Lateral thigh	29 (*90.6*)	3 (*9.4*)	0 (*0*)
Lower back	24 (*75*)	2 (*6.3*)	6 (*18.8*)
Buttock	32 (*100*)	0 (*0*)	0 (*0*)
Posterior thigh	30 (*93.8*)	1 (*3.1*)	1 (*3.1*)
Trochanter	25 (*78.1*)	5 (*15.6*)	2 (*6.3*)

moderate-to-severe pain in the lower back, three patients (9.4%) reported moderate-to-severe pain in the groin, and two patients (6.3%) reported moderate-to-severe pain in the trochanter. Only one patient (3.1%) reported moderate-to-severe pain in the anterior thigh, and no patient reported moderate-to-severe pain in the lateral thigh.

Discussion

Dual mobility articulations have received an increased interest in the United States, as several investigations have noted their ability to decrease the rate of instability following both primary and revision THA.[28-33] DM articulations have primarily been indicated for those patients deemed to be at increased risk of dislocation,[10] undergoing revision THA,[34] after femoral neck fracture[35], and after tumour resection.[34] However, their performance in young, active patients undergoing primary THA has not been investigated. There is a concern that the use of modular DM articulations may lead to fretting corrosion between the cobalt-chromium liner and titanium acetabular shell.[10,36] The results of a subset of our patients were previously reported at one year postoperatively, and found four patients to have a cobalt level that exceeded the reference range.[18] Given the recent introduction of this modular DM design, we felt it was important to increase the size of this cohort and prospectively follow these patients for a longer time period. At two years postoperatively, this cohort of patients showed significant improvements in clinical function, well-preserved femoral BMD, and minimal patient-reported pain.

Patients between 18 and 65 years of age constitute the fastest growing group of patients seeking THA, and concerns remain regarding both the risk of instability and prosthetic longevity.[13] Recent failures of metal-on-metal bearings and modular cobalt alloy neck-stem junctions have heightened awareness of the risk of adverse local tissue reactions secondary to metal ion

release.[37-40] DM bearings have shown encouraging results,[29-33] but concerns exist with the use of a modular liner due to the potential for fretting corrosion between the cobalt-chromium liner and titanium acetabular shell.[10,36] In a review of 100 consecutive patients undergoing primary THA using the same modular acetabular component as this investigation, Matsen Ko et al[10] noted 21% of patients to have a serum cobalt level above the normal range, with 9% significantly above normal (> 1.6 ug/l) at a mean of 27.6 months postoperatively. However, their cohort was limited to patients perceived to have a high risk of instability due to increased age, neuromuscular disease, high Charlson Comorbidity Index,[41] or American Society of Anesthesiology grade.[42] In contrast, in our investigation of young, active patients undergoing THA, 4/43 patients (9%) were found to have a serum cobalt level above the reference range at two years postoperatively. Interestingly, three patients with elevated cobalt levels at one year postoperatively showed a decrease in their level at two years postoperatively. It is possible that in some patients the modular liner stabilizes or cold welds to the acetabulum over time, but this is purely conjecture and will remain unclear until a retrieval analysis is performed.

The clinical significance of an elevated mean cobalt level and four patients with a cobalt level above the reference range in our cohort also remains unclear. In a prior investigation using the same methodology, a cohort of 17 patients with a conventional polyethylene bearing were found to have a mean chromium level of 0.61 ug/l (SD 0.44), mean cobalt level of 0.15 ug/l (SD 0.07), and mean titanium level of 1.70 ug/l (SD 0.71) at one year postoperatively.[11] These values are very close to those seen in our investigation at two years postoperatively. Recently, Fillingham et al[43] reported the serum cobalt level to be the best test to diagnosis the presence of an adverse local tissue reaction in a conventional metal-on-polyethylene bearing. They found a threshold cut-off of greater than 1.0 ug/l to have a sensitivity of 100%, a specificity of 90%, a positive predictive value of 96%, and a negative predictive value of 100%. In our cohort, at two years postoperatively, the range of elevated cobalt levels was 0.32 ug/l to 0.94 ug/l. While the report by Fillingham et al[43] pointed to corrosion at the head-neck junction and its relevance to a modular cobalt-chromium liner cannot be confirmed, no patients in our cohort crossed this threshold. However, given the elevation in mean whole blood cobalt levels and 9% of patients with a two-year cobalt level above the reference range, it is clear that continued surveillance is necessary to ensure these levels do not rise or become clinically significant. Furthermore, the clinical significance of elevated titanium levels must also continue to be elucidated.

A secondary aim of this investigation was to assess periprosthetic BMD following implantation of a recently introduced titanium, proximally coated, tapered cementless femoral stem. Younger age and increased activity have both been associated with increased patient-reported pain and symptoms following THA.[44,45] While a direct relationship between periprosthetic BMD and clinical symptoms has not been established, numerous prior investigations have shown a decrease in proximal femur BMD after THA, with the greatest extent of bone loss in the calcar region even with the use of a titanium alloy, proximally coated cementless stem design.[16,46,47] In a similarly designed study of 45 THAs receiving a cementless femoral stem of one of three designs (Synergy; Smith & Nephew, Memphis, Tennessee; Anthology, Smith & Nephew; Versys Fiber Metal Taper, Zimmer Biomet, Warsaw, Indiana), a consistent decrease in periprosthetic BMD was noted in Gruen zones 1, 2, and 7 at up to five years postoperatively, with the greatest decrease occurring in the medal calcar (zone 7; mean 89.2% of baseline at five years).[48] While the relationship of BMD and thigh pain must be defined, it is important to note that 15% of those patients reported the presence of moderate-to-severe anterior thigh pain and 12% lateral thigh pain. Use of a self-reported pain-drawing questionnaire has inherent limitations, including reliance on patients to accurately report their symptoms. However, of the 32 patients in the current study who completed the pain-drawing questionnaire, only one patient (3.1%) reported moderate-to-severe anterior thigh pain and no patient reported lateral thigh pain. As noted earlier, at two years postoperatively there was 100% maintenance of periprosthetic BMD in Gruen zones 2 through 7 using this femoral prosthesis. While the decreased incidence of self-reported thigh pain cannot be directly attributed to preservation of BMD, these preliminary results are encouraging and the potential for improved symptoms and survivorship warrants further investigation.

This study has several limitations that must be recognized prior to interpretation of our results. First, the size of our cohort is relatively small given the difficulty in finding patients willing to enroll in this prospective study and who met its strict inclusion criteria for age, BMI, and activity level. Second, the exact source of metal ions cannot be determined, as implant retrievals have not been performed in these well-functioning prostheses. However, it can be inferred that in the three patients with a ceramic femoral head and elevated cobalt level at two years postoperatively, the source of cobalt is from the cobalt-chromium modular liner, as exclusion criteria for this investigation included the presence of prior hardware elsewhere in the body. Third, advanced imaging modalities such as MRI were not performed in our cohort of patients. However, patients in our cohort were high functioning and those with elevated cobalt levels were asymptomatic, thus advanced imaging is not recommended. Fourth, the clinical impact of maintenance of periprosthetic BMD of the femur in Gruen zones 2 to 7 remains unclear, although it can be anticipated that maintenance of bone density in the calcar region could have a positive long-term impact on both pain and survivorship. Finally, it is important to note that only young, active patients were included in this investigation, and thus our finding might not be generalizable.

At two years postoperatively, use of this modular DM prosthesis and cementless, tapered femoral stem in young, active patients has shown encouraging results. However, it is important to note that all procedures were performed by surgeons with experience using these prostheses. In addition, there is the potential that use of a modular cobalt-chromium acetabular liner may be more technique-dependent, as any prominence of screws or tissue interposed between the liner and shell could lead to inappropriate seating and potentially increased micromotion. Therefore, continued investigation and surveillance is necessary to determine if whole blood concentrations of metal

ions will change over time and be of clinical significance. The advantage of increased stability of a DM prosthesis must continue to be weighed against the unknown long-term outcomes of using this bearing design.

Take home message

- Use of a modular dual mobility prosthesis and cementless, tapered femoral stem has shown encouraging results in a cohort of young, active patients undergoing total hip arthroplasty (THA).
- An elevation in mean cobalt ion levels with four patients outside of the reference range demonstrates the necessity of continued surveillance of this cohort.

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