INTRODUCTION: Venous thromboembolism (VTE) is a common complication following total joint arthroplasty, ranging from the frequently benign deep vein thrombosis (DVT) to the distressing and at times fatal pulmonary embolism (PE). The aim for prophylactic treatment of VTE is prevention of PE. However, it has often been assumed that DVT is a proxy for PE. Based on this assumption, aggressive DVT prophylaxis is currently recommended at the expense of a higher proportion of bleeding complications. This study investigates whether inferior vena cava (IVC) filter protects against PE. METHODS AND MATERIALS: We identified 209 patients that underwent orthopaedic procedures at a single institution with concurrent IVC filter placement between 2004 and 2008. Fifty-one of these patients had an IVC filter placed following diagnosis of DVT to prevent “migration” of thrombus to the lungs and formation of PE. These patients had an average age of 71.5 years and 30 (59%) were female. These patients were investigated for presence of DVT and PE. RESULTS: Two patients (3.9%) receiving IVC filter developed PE after placement of the filter. There were no fatal PE in this cohort. One of these patients had concomitant atrial fibrillation. CONCLUSION This study identifies a high rate of PE despite IVC filter placement. This finding, once again, brings to question the “propagation theory” that assumes that PE arises from a thrombus in the extremity. Considering the fact that IVC filter has been shown to be very effective in prevention of migration of thrombus, our study demonstrates that a portion of PE may arise independently and as part of a hypercoagulable state. Thus, strategies that are aimed at reducing DVT, by assuming DVT is a proxy for PE, needs to be reexamined. We believe patients are placed at high risk of bleeding with administration of aggressive anticoagulation for treatment of DVT and attempts to prevent its “propagation.”

PAPER NO. 32

Is Previous Varicose Vein Surgery Associated with Deep Vein Thrombosis within 90 Days of Hip and Knee Replacement?

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INTRODUCTION: Although varicose veins are an established risk factor for deep vein thrombosis (DVT) there is a paucity of literature detailing the association between prior varicose vein surgery and DVT or pulmonary embolism (PE) in high-risk populations such as patients undergoing knee or hip arthroplasty. The objective of this study was to determine the rate of DVT and PE after total knee arthroplasty (TKA) and total hip arthroplasty (THA) in patients with a diagnosis of varicose veins who have or have not had previous varicose vein (VV) surgery, in an attempt to determine if prior VV diagnosis or surgery alters the risk of DVT or PE after arthroplasty. METHODS: Data on 57,364 patients who had total hip arthroplasty (THA) and 51,859 patients who had total knee arthroplasty (TKA) were identified from the Scottish Arthroplasty Project (SAP) along with patients who had recorded DVT or PE events (Scottish Morbidity Database), varicose veins, and varicose vein interventions. Statistical analysis was conducted to determine a significant correlation between varicose vein surgery and resulting DVT or PE post THA or TKA. RESULTS: Of the patient cohort that underwent THA, 462 (0.8%) had a diagnosed DVT within 90 days of orthopedic intervention. The DVT rate in patients who had previous VV surgery was 0.8% (27), and in those with no previous VV diagnosis or surgery was 0.8% (428). In patients with a previous VV diagnosis but no VV surgery, the DVT rate was 3.1% (7) (Pearson Chi square test 14.8, df 2, p = 0.001). In the TKA cohort, 304 (0.6%) patients had a 90-day DVT diagnoses. The DVT rate in patients who had previous VV surgery was 0.6% (22), and in those with no previous VV diagnosis or surgery was 0.6% (281). In patients with a previous VV diagnosis but no VV surgery, the DVT rate was 0.4% (1), a difference that did not reach statistical significance (Pearson Chi square test 0.1, df 2, p = 0.95). Of the patient cohort that underwent THA, 403 (0.7%) had a diagnosed PE within 90 days of surgery. The PE rate in patients who had previous VV surgery was 0.7% (26), and in those with no previous VV diagnosis or surgery was 0.7% (376). In patients with previous VV diagnosis but no VV surgery that PE rate was 0.4% (1), a difference that did not reach statistical significance (Pearson Chi square test 0.3, df2, p = 0.85). In patients who had TKA, 411 (0.8%) had 90-day PE diagnoses. The PE rate in patients who had previous VV surgery was 0.9% (35), and in those who did not have a VV diagnosis was 0.8% (374). In patients with a VV diagnosis but no surgery the PE rate was 0.9% (2), a difference that did not reach significance (Pearson Chi square test 0.8, df 2, p = 0.66). CONCLUSION: DVT and PE is a major contributor worldwide to morbidity and mortality with one of the highest risk factors being knee and hip surgery. Our study concluded that DVT and PE are major contributors worldwide to morbidity and mortality, with one of the highest risk factors being lower limb arthroplasty. Untreated varicose veins are associated with an increased risk of DVT after hip arthroplasty, and it may be that patients with varicose veins presenting for hip arthroplasty should consider treatment of varicose veins prior to undergoing orthopaedic intervention. This is the largest series of its kind reported to date. Further research detailing relationships between known risk factors and the decreased risk of DVT or PE post risk factor alleviation need to be conducted in order to ascertain the best DVT/PE preventative approach.

For full information refer to page 14. An alphabetical faculty financial disclosure list can be found starting on page 19.
INTRODUCTION: Synovial fluid leukocyte count and neutrophil differential have been reported to have high sensitivity and specificity in diagnosing infected knee arthroplasty. We hypothesized that neutrophils recruited into an infected joint secrete enzymes that may be used as markers for infection. In this prospective study, we determined the sensitivity and specificity of one of these enzymes, leukocyte esterase, in diagnosing periprosthetic joint infection. METHODS: From May 2007 to April 2010, knee synovial fluid was obtained preoperatively from 108 patients being investigated for possible joint infection or undergoing revision knee arthroplasty. The aspirate fluid in all cases was tested for the presence of leukocyte esterase using a simple colorimetric strip test. Color change (negative, trace, + or ++; level of the enzyme) was noted within one or two minutes. RESULTS: According to clinical, serological and operative criteria, 30 joints were deemed to be infected and 78 were determined to be uninfected. When a ++ leukocyte esterase result was considered positive, the test was 80.6% (95% CI) sensitive and 94.5% (100.0, 95% CI) specific, with a positive predictive value (PPV) of 100% (83.4-100.0, 95% CI) and a negative predictive value (NPV) of 93.3% (85.4-97.2, 95% CI). Leukocyte esterase correlated strongly with fluid polymorphonuclear counts (r=0.7769), as well as with total fluid cell count (r=0.5024) and serology including erythrocyte sedimentation rate (r=0.6188) and C-reactive protein (r=0.4719). DISCUSSION AND CONCLUSION: It appears that the simple colorimetric strip test that detects the presence of leukocyte esterase in synovial fluid is an extremely valuable addition to the diagnostic armamentarium for prosthetic joint infection. The reagent strip has the advantage of real time, simple, and inexpensive testing with an ability both to rule out and to confirm periprosthetic joint infection. However, additional multicenter studies are required to substantiate the results of our preliminary investigation before the reagent strip can be used in the clinic or intraoperative setting.

INTRODUCTION: Soluble fibrin (SF) - a composition of fibrin monomer and fibrinogen derivatives which are found in early-stage thrombosis, and plasminogen-activator inhibitor 1 (PAI-1) - a main regulator of fibrinolysis system, have been developed to determine thrombotic tendency. Highly invasive surgery has been shown to commonly result in a hypercoagulable state and to increase the risk of postoperative venous thromboembolism (VTE). Patients undergoing elective total hip arthroplasty (THA) are also at a particularly high risk for VTE. The purpose of our current prospective study was to examine acute postoperative changes of SF and PAI-1, and the usefulness of assaying these markers as predictors for early VTE following THA was evaluated. MATERIALS AND METHODS: This study consisted of two groups including intermittent pneumatic compression (IPC) group (67 patients who underwent only IPC as prophylaxis for VTE) and fondaparinux (FPX) group (103 patients who underwent IPC and FPX administration). Plasma levels of SF and PAI-1 were measured in the next early morning after THA. To diagnose postoperative VTE, multi-detector row CT (MDCT) was performed for all patients at one week after surgery. RESULTS: Postoperative MDCT revealed 17 (25.3%) cases of VTE in IPC group and 8 (5.8%) in FPX group. In IPC group, the plasma levels of SF and PAI-1 on the day after THA were significantly higher in patients with VTE (p<0.01). On the other hand, no differences in both values were observed in FPX group. Positive criterion of an increase in SF or PAI-1 above their cut-off levels (19.8µg/ml and 53.5ng/ml, respectively) provided the sensitivity of 100% and specificity of 67% in IPC group. In addition, when this criterion was applied to FPX patients, 87.5% (7/8) of patients with VTE met the criterion, and negative agreement rate of 98.0% (48/49) was observed. DISCUSSION AND CONCLUSION: Patients undergoing primary THA are at a high risk of VTE, which is possibly induced by a hypercoagulable or regulated fibrinolytic state during the early postoperative phase. Plasma SF and PAI-1 levels on day one after THA may provide an indication of the balance between coagulation and fibrinolysis and be of value in predicting VTE following THA. When high levels of SF or PAI-1 on the day after surgery are observed, a higher risk for postoperative VTE might be considerable on the patients undergoing THA.
have higher risk than ASAl<=2 (HR=2.20, 95%CI 1.55-3.13). Age, arthritis diagnoses, diabetes mellitus and race were not associated with increased risk of THA SSI. The only surgical factor associated with THA SSI was bilateral procedures which showed a 5.32 (95%CI 2.45-11.56) increased risk of SSI than unilateral procedures. Surgeon and hospital case volumes, use of antibiotic cement, fixation method, laminar flow, space suits, surgical approach and fellowship training were not associated with SSI. CONCLUSION: A comprehensive infection surveillance system, combined with a detailed TJR registry, identified patient and surgical factors associated with THA infection. Obesity and chronic medical conditions should be optimized prior to THR. The finding of increased infection risk with bilateral THA requires further investigation.

PAPER NO. 36
An Evaluation of the Effect of Low Molecular Weight Heparin Versus Rivaroxaban on Complications After Arthroplasty
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INTRODUCTION: The National Institute for Health and Clinical Effectiveness recommends both low molecular weight heparin (LMWH) and rivaroxaban for venous thromboembolic (VTE) prophylaxis following lower limb arthroplasty. Despite evidence in the literature that suggests rivaroxaban reduces VTE events, there are emerging concerns from the orthopaedic community regarding an increase in wound complications following its use. METHODS: Through the orthopaedic clinical directors forum, trusts replacing LMWH with rivaroxaban for lower limb arthroplasty thromboprophylaxis during 2009 were identified. Prospectively collected hospital episode statistics (HES) data was then analyzed for these units so as to determine rates of 90-day symptomatic deep venous thrombosis (DVT), pulmonary embolism (PE), major bleed (cerebrovascular accident or gastrointestinal haemorrhage), all-cause mortality, and 30-day wound infection and readmission rates before and after the change to rivaroxaban. A total of 2,752 patients prescribed rivaroxaban following total knee replacement (TKR) or total hip replacement (THR) were compared to 10,358 patients prescribed LMWH. Data was analyzed using odds ratios (OR).

RESULTS: There were significantly more wound infections in the rivaroxaban group (3.85% vs. 2.81%, OR=0.72; 95%CI 0.58-0.90). There were no significant differences between the two groups for PE (OR=1.52; 0.77-2.97), major bleed (OR=0.73; 0.48-1.12), all-cause mortality (OR=0.93; 0.46-1.87) and re-admission rate (OR=1.21; 0.88-1.67). There were significantly fewer symptomatic DVTs in the rivaroxaban group (0.91% vs. 3.36%, OR=2.51; 1.30-4.82).

CONCLUSION: This study is the first to describe the real impact of the use of rivaroxaban in the National Health Service. When compared with LMWH in lower limb arthroplasty patients, wound infection rates were significantly higher following rivaroxaban use while providing no reduction in symptomatic PE or all-cause mortality.

PAPER NO. 37
Pulmonary Embolism Following Total Joint Arthroplasty: When Do They Occur?
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INTRODUCTION: The elevated risk of pulmonary embolism (PE) following total joint arthroplasty (TJA) has been well established, but little is known about the natural course of the disease. Studies have shown an elevated risk of PE up to 90 days postoperatively. Thus, anticoagulation is often continued for many weeks postoperatively. However, chemical prophylaxis carries the risk of bleeding and associated periprosthetic joint infection. Current guidelines for duration of prophylaxis are nonspecific. By determining when patients are at highest risk for developing PE following TJA, we may be able to tailor anticoagulation regimens to provide an ideal risk-benefit ratio.

METHODS: We retrospectively reviewed the records of 25,660 consecutive patients that underwent primary TJA at our institution between January 2000 and December 2010. All patients were started on warfarin the evening after surgery. Patients were investigated only for symptomatic PE and were not screened. Pulmonary embolism that occurred within 90 days of TJA was documented. RESULTS: A total of 286 patients were diagnosed with PE postoperatively by multidetector computed tomography (MDCT) and/or ventilation-perfusion (VQ) scan. Median occurrence of PE was two days postoperatively (range: 1 to 87 days), with 254 of 286 PEs (88.8%) occurring within the first seven days after surgery. Average international normalized ration (INR) at time of diagnosis of PE was 1.4 (range: 0.94 to 2.61). Multiple regression analysis showed that cancer was associated with an earlier presentation of PE (p=0.013) whereas patients with obstructive lung disease presented with later PE (p=0.001).

CONCLUSION AND DISCUSSION: Risk of PE appears to be highest during the first week after TJA. Efforts must be made to minimize risk during this period. Furthermore, frequency of PE after the first postoperative week appears very low. Further studies must be done to evaluate the necessity of prolonged prophylaxis following TJA.

PAPER NO. 38
Augmentation of Vancomycin Elution from High Dose Antibiotic Loaded Bone Cement
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INTRODUCTION: Bone cement provides a medium for efficient delivery of antibiotics to eradicate and prevent local infection. The application of antibiotic cement includes spacer treatment in staged procedures of revision arthroplasty and void filling struts or bead pouches in treatment of open fractures. This study specifically investigates the effect of two variables, quantity of liquid monomer and timing of vancomycin addition, on ultimate elution of antibiotic from bone cement. METHODS: Two different types of commercially available bone cement (Cement A and B) were prepared using three different methods: a surgical control (standard preparation technique),
a mixture that doubled the standard amount of initial liquid monomer, and a novel technique that delayed antibiotic addition until after 30 seconds of polymerization elapsed. Pellets of a standardized size were created from each preparation. The elution profiles of five pellets from each preparation were measured over six weeks utilizing high-performance liquid chromatography. RESULTS: Delayed antibiotic addition created significantly higher elution profiles than the surgical control and double liquid monomer groups (p<0.0001). Vancomycin elution over six weeks from Cement A was 52% greater in the delayed antibiotic group than in the standard surgical group, while Cement B demonstrated 25% more elution within the delayed antibiotic group. Doubling the amount of liquid monomer led to a significantly lower elution profile (p<0.0001). Compared with the standard antibiotic technique, the use of double liquid monomer led to a 33% decrease in vancomycin elution over six weeks from Cement A and a 35% decrease in vancomycin elution from Cement B.

DISCUSSION AND CONCLUSION: High dose antibiotic bone cement prepared utilizing the delayed antibiotic cement technique increased vancomycin elution compared to the standard surgical preparation. Incorporation of additional liquid monomer decreased vancomycin elution from high dose antibiotic bone cement.

PAPER NO. 39

Thromboembolic Risk with Tranexamic Acid for Primary Total Hip and Knee Arthroplasty: Three Prophylactic Regimens

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INTRODUCTION: The use of antifibrinolytics (i.e., tranexamic acid) in total joint arthroplasty (TJA) has been shown to reduce intraoperative blood loss and decrease transfusion rates postoperatively. Moreover, a recent clinical trial has shown decreased mortality and blood loss in trauma patients without increased thromboembolic events. As orthopedic surgeons move to different thromboembolic (TE) prevention regimens, a concern remains about their prothrombotic potential especially when used with less aggressive TE prophylactic regimens. As orthopedic surgeons move to different thromboembolic (TE) prevention regimens, a concern remains about their prothrombotic potential especially when used with less aggressive TE prophylactic regimens. METHODS: Patients undergoing primary total hip or knee arthroplasty by three surgeons, each with a different postoperative TE prophylactic regimen, during 2008-2009 were retrospectively reviewed. The three regimens included dalteparin, warfarin, and aspirin. All patients received intraoperative tranexamic acid. Patients were stratified based on their ASA physical status score. Primary outcome measures were thromboembolic events including deep vein thrombosis (DVT), pulmonary embolism (PE), myocardial infarction (MI), and cerebrovascular accident (CVA). Postoperative hematoma rates were also recorded. RESULTS: A total of 1,497 patients were included in this study. The number of patients in each prophylactic regimen was 410, 525, 547 for aspirin, warfarin, and dalteparin therapy respectively. Most patients were ASA score two or three, 1,039 and 378 patients respectively. The percent risk for any TE complication was 1.2%, 1.13%, and 0.73% for aspirin, warfarin, and dalteparin therapy respectively (p=0.71). This did not significantly vary between stratified groups. The risk for DVT was increased at 0.48% for aspirin, and 0.19% and 0.18% for warfarin and dalteparin respectively; however, this was not statistically significant (p=0.60). The risk of PE was 0.24%, 0.56%, and 0.18% for the respective groups (p=0.51). The percent risk of MI or CVA was not statistically different between groups. Lastly, the risk of postoperative hematoma for the respective groups was 0.96%, 1.13%, and 0.54%. CONCLUSION: Despite the use of less aggressive TE prophylaxis with aspirin, there was no statistically significant increase in TE complications with intraoperative use of tranexamic acid. Risk of hematoma postoperatively while on aspirin therapy, however, was not statistically lower when compared to warfarin and dalteparin. Physicians may consider the use of tranexamic acid to decreased blood loss and transfusion rates concomitantly with aspirin therapy for TE prophylaxis after primary joint arthroplasty if the patient has no other comorbidities necessitating the use of warfarin or low molecular weight heparin.

PAPER NO. 40

Efficacy of Perioperative Irrigation and Debridement for Prosthetic Infection

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INTRODUCTION: The results of irrigation and debridement for periprosthetic infection are mediocre at best with a failure rate averaging 68%. Factors that may influence these results are organism type, host factors, and timing of intervention. While the influence of organism type and host factors have been clarified, the timing of intervention remains an unresolved question. The purpose of this study was to determine the efficacy of irrigation and debridement (I&D) for periprosthetic infection performed within the perioperative period. METHODS: A multi-center retrospective analysis of patients undergoing irrigation and debridement for periprosthetic infection within 90 days of primary surgery was performed. Charlson Comorbidity Index (CCI) was used as a host factor surrogate. A multiple logistic regression was conducted to determine the associations between CCI, age, sex, joint, organism, timing between index and I&D (≤4 weeks, between 4 and 12 weeks) and repeat surgery due to infection. RESULTS: Of the 82 patients who underwent I&D within three months of primary surgery, 51 failed (62%). Of the 56 patients (29 hips/27 knees) who underwent I&D within four weeks of primary surgery, 32 failed (57%). Eight of 11 patients who underwent I&D within 10 days of surgery failed (73%). Nineteen of 26 patients (73%) who underwent I&D between one and three months failed. Of the 40 staph organisms, 24 failed (60%). Of the seven strep organisms, five failed (71%). Of the 22 resistant organisms, 14 failed (64%). No covariates included in the regression model were significantly associated with revision surgery due to infection, with the numbers available. DISCUSSION AND CONCLUSION: I&D for prosthetic hip and knee infection is an attractive, frequently used procedure in the majority of cases. Unfortunately the data presented here contradicts this assumption.
Renal Injury Due to Prophylactic Flucloxacillin and Gentamicin in Hip and Knee Replacement (Protocols and Practice)
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David Hamilton, MB, ChB, BS, Dumfries, United Kingdom
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Sue Robertson, Dumfries, United Kingdom
Chris Isles, MD, Dumfries, United Kingdom

Background: We switched our antibiotic prophylaxis for elective hip and knee surgery from cefuroxime to flucloxacillin with single dose gentamicin in order to reduce the incidence of C. Diff diarrhea. More patients subsequently appeared to develop acute kidney injury (AKI).

METHODS: During a twelve month period we examined the incidence of AKI sequentially in 198 patients undergoing elective hip or knee surgery: cefuroxime (n = 48); high dose flucloxacillin (median 8g) (n = 52); low dose flucloxacillin (median 4g) (n = 46); and cefuroxime alone (n = 52).

RESULTS: There were no statistically significant differences between the four groups by chi-square tests for age, gender, nature of operation (hip or knee surgery), American Society of Anaesthesia (ASA) grade, mode of anaesthesia (spinal ± general anaesthetic), baseline serum creatinine, pre-operative co-morbidity (hypertension, diabetes), pre-operative medication (NSAIDs, ACEI/ARBs or beta-blockers) and post-operative hypotension. Patients receiving high dose flucloxacillin required more vasopressors during surgery (p = 0.02 by Kruskal-Wallis test).

The proportion of patients in each antibiotic group with any form of AKI by RIFLE criteria was: first cefuroxime group (8%), high dose flucloxacillin (52%), low dose flucloxacillin (22%), second cefuroxime (14%) (p < 0.0001). Odds ratios (OR) for AKI derived from a multivariate logistic regression model and arbitrarily assigning an OR of 1 to first cefuroxime group, were: high dose flucloxacillin 14.5 (95% CI 4.2-49.7); low dose flucloxacillin 3.0 (0.8-10.8); cefuroxime again 2.0 (0.5-7.7). Three patients required temporary haemodialysis. Biopsies in two of these showed acute tubulo-interstitial nephritis. All three patients belonged to the high dose flucloxacillin group. None of the patients developed C. Diff diarrhea.

Summary: We have shown a strong association between high dose flucloxacillin prophylaxis and subsequent development of AKI which was not confounded by any of the co-variates we measured.

In-hospital Surgical Site Infections after Primary Hip and Knee Arthroplasty - Incidence and Risk Factors
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Ya-Lin Chiu, MS, New York, NY
Licia Gaber-Baylis, Hillsborough, NJ
Madhu Mazumdar, PhD
Thomas Sculco, MD, New York, NY
Stavros Memtsoudis, MD, PhD, New York, NY

INTRODUCTION: Perioperative Surgical Site Infections (SSI) after orthopedic surgeries have a great clinical and economic impact. Knowledge of risk factors for SSI can facilitate physicians to inform their patients and to focus measures for prevention.

METHODS: Data of hospitalizations for total hip arthroplasty (THA) or total knee arthroplasty (TKA) were analyzed for each year between 1998 and 2007 from the National Inpatient Sample. Patients’ demographics, comorbidities, incidence of morbidity and mortality, length of hospitalization, and overall cost were compared for infected and non-infected groups. Multivariate regression analysis was performed to determine independent risk factors for SSI.

RESULTS: Perioperative SSI rate was 0.36% for THA and 0.31% for TKA (412,356 and 784,335 patient entries respectively). For both THA and TKA groups, patients with SSI had a significantly higher overall comorbidity burden (P < 0.0001) - reflected in the significantly increased prevalence of alcoholism, chronic pulmonary disease, congestive heart failure, cancer and complicated diabetes (P < 0.0001), a considerably higher perioperative mortality rate (THA: 2.5% vs. 0.3%, TKA: 1.2% vs. 0.1% (P < 0.0001)) and a longer average length of hospital stay (THA: 13.4 vs. 4.2 days, TKA: 9.7 vs. 4 days (P < 0.0001)). Postoperative complications including deep vein thrombosis, acute respiratory distress syndrome, and pulmonary embolism, and surgical site hematomata occurred more frequently in SSI patients (P < 0.0001). Overall average cost of in-hospital care was approximately double for SSI patients (P < 0.0001). Independent risk factors for perioperative SSI included male gender, minority race, cancer, liver disease, coagulopathies, fluid and electrolyte disorders, congestive heart failure, and pulmonary circulatory disease (table).

CONCLUSION: Perioperative SSI after TJA is associated with increased morbidity, mortality, length of hospital stay and overall cost. Comorbidities subjecting patients to an immunocompromized state or predisposing them to hematoma formation were associated with the highest odds for SSI.

Table. Independent risk factors for surgical site infections after multivariate regression analysis

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<td>1.90 2.92</td>
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</tbody>
</table>
Effect of Rivaroxaban on Return to Theatre Rates Following Total Hip and Knee Replacement

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Rebecca L. Morrell, MBBS, Newcastle-upon-Tyne, United Kingdom
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INTRODUCTION: Rivaroxaban has been recommended for routine use as a thromboprophylactic agent in patients undergoing lower limb arthroplasty. Trials supporting its use have not fully evaluated the risks of wound complications related to rivaroxaban.

METHODS: A retrospective cohort analysis of 1,558 consecutive patients who underwent total hip or knee replacements within the same hospital during a 19-month period (2009-2010) was performed. The first 489 patients (Group 1) were given tinzaparin postoperatively as per NICE guidance. The following 559 patients (Group 2) were given rivaroxaban. Concerns regarding wound complications prompted a change back to tinzaparin for the next 510 patients (Group 3). Other than the thromboprophylactic agent used, there were no other differences in the pre and postoperative treatments of all these patients.

RESULTS: Nine of the 489 patients in Group 1 (tinzaparin) (1.8%, 95% CI 0.9-3.5%) returned to theatre (RTT) with wound complications within 30 days compared with 22 out of 559 patients in Group 2 (rivaroxaban) (3.94%, 95% CI 2.6-5.9%). This increase in RTT rate was statistically significant (p=0.046). After reverting back to tinzaparin, eight out of 510 patients in Group 3 (tinzaparin) (1.6% 95% CI 0.74-3.1%) returned to theatre. This reduction in RTT rate was statistically significant (p=0.02). Combining the tinzaparin groups (1 and 3) and comparing with the rivaroxaban group (2) further increases the significance of our observations.

Tinzaparin RTT was 1.7% (95% CI 1.0-2.7%) compared with rivaroxaban RTT of 3.94% (95% CI 2.6-5.9%) (p=0.01). DISCUSSION AND CONCLUSION: We observed a significant rise in wound complication necessitating further surgery after a change in thromboprophylactic agent from tinzaparin to rivaroxaban, followed by a significant reduction after reverting back to tinzaparin. We call for further independent randomized controlled clinical trials examining wound related complications with respect to new pharmacological treatments.

Thromboembolic and Bleeding Events Following Elective Hip and Knee Arthroplasty Using Oral Factor Xa Inhibitor

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INTRODUCTION: Rivaroxaban is an oral Factor Xa inhibitor which is licensed in Canada for the prevention of thromboembolic events following total hip and total knee arthroplasties. Multicenter research trials have shown clinical efficacy for prevention of deep venous thrombosis (DVT) and pulmonary embolism (PE) and all cause perioperative mortality. The aim of this study was to prospectively document the incidence of thromboembolic and bleeding events in patients who received rivaroxaban as the primary prophylaxis in clinical practice.

METHODS: Prospective, observational study of patients given oral Factor Xa inhibitor (rivaroxaban) following primary and revision total hip arthroplasty (THA) and total knee arthroplasty (TKA). All patients were approached to participate and consent obtained. Patients treated with rivaroxaban 10 mg po daily starting post-operative day (POD) #1 and continued for 15 days. All participants were followed up at six weeks and three months. Doppler ultrasound or venograms used to diagnose proximal DVT. Spiral CT, CT Angio or V/Q scan were used to diagnose PE. Bleeding complications were documented as ‘on prophylaxis’ starting two hours after first dose of anticoagulant therapy until 24 hours after the 15th dose. Event rates are reported. Data reported on consented patients only. Research ethics approval was obtained for this study.

RESULTS: From June to Dec. 2010, 1,010 patients underwent total joint arthroplasty. Nine hundred and twenty-seven patients (92%) agreed to participate in the study. Nine hundred and ten patients were followed up at three months (98%). Seventeen patients were lost to follow-up. Complete data on 910 patients is reported: 378 men, 532 women with mean age 66 years. Total knees 517 (primary 477, revision 40). Total hips 393 (primary 358, revision 35). Eight hundred and sixty-one of these patients received rivaroxaban. DVT: One in-hospital Doppler was indeterminate. One DVT was reported at six weeks. Four DVTs were reported at three months: one primary TKA and three Primary THAs. Total DVT= 5/861= 0.6%. PE: There were three confirmed PE during hospital stay: one revision THA and two primary TKA. One confirmed PE occurred in primary THA by six weeks. There was one case with an indeterminate result. Two PE reported at three months. Total PE 6/861=0.7%. Bleeding: Two major and six non-major surgical-site bleeds occurred. One major and two non-major non-surgical site bleeds occurred in patients who received rivaroxaban. Transfusion: Fifty patients (5%) received blood transfusions with no difference between patients who received rivaroxaban and those who did not (Fisher's exact test: 0.17, p=0.17). There was one perioperative death which was not related to surgery, DVT, pulmonary embolism, bleeding or cardiovascular event by autopsy.

DISCUSSION AND CONCLUSION: The incidence of thromboembolic events within a period of three months was 5/861 (0.6%) for DVT and 6/861 (0.7%) for PE. The incidence of major bleeding was 3/861 (0.3%). There were no deaths related to DVT, PE or bleeding. Preliminary results are surprising for the number of pulmonary emboli which occurred while patients were still in hospital and for the number of DVT’s which occurred between six weeks and three months. Further work is required to see if these trends are maintained. This study is ongoing.

Periprosthetic Joint Infection Following Total Joint Arthroplasty

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Max Greenky, Philadelphia, PA
Matthew Austin, MD, Philadelphia, PA
James Purtill, MD, Philadelphia, PA
Javad Parvizi, MD, Philadelphia, PA

INTRODUCTION: Periprosthetic joint infection (PJI) is one of the most devastating causes of implant failure following total joint arthroplasty (TJA). Studies have found various associations with development of PJI, such as poor nutritional status, diabetes, postoperative bleeding and hematoma, and...
immunocompromised status. However, since infection is relatively rare with a reported incidence of around 1% following primary TJA, definitive risk factors have not been identified. The present study utilizes prospective, single-institution, large database to assess predisposing risk factors for PJI following modern TJA.

**METHODS:** Records of 22,878 consecutive patients undergoing primary TJA at our institution between January 2000 through February 2011 were reviewed. Patients operated on for acute trauma were excluded, and patients that developed PJI on their operated joint within 90 days following surgery were identified. Extensive number of patient related factors, preoperative blood test results, surgical factors, and postoperative parameters were evaluated to identify those predisposing the patients to PJI. Univariate and multivariate regression analyses were used.

**RESULTS:** Among all factors examined, history of diabetes, smoking, and BMI were found to be important patient-related factors predisposing them to PJI. Among laboratory tests, high perioperative blood glucose above 126 mg/dL was found to be a significant risk factor for PJI. Longer hospital stay and increased intraoperative blood loss were found to be significant predisposing factors to PJI.

**DISCUSSION AND CONCLUSION:** This single institution study utilizing prospective database has confirmed the importance of some patient-related and surgical factors in increasing risk of PJI. In addition, the study has identified a number of other unknown factors which seem to be important risk factors for PJI. Better knowledge of risk factors that result in increased incidence of PJI enables surgeons to optimize patients and address some of these reversible factors prior to elective arthroplasty. With the increasing cost of health care and increasing burden of infection on the society, we need to implement strategies that will reduce the incidence of this dreaded complication.

**PAPER NO. 211**

**Clinical and Radiological Features of 100 Painful Large Diameter Metal-on-Metal Hip Arthroplasties**

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Barry Sampson, MD, London, United Kingdom

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Adam Mitchell, MD, London, United Kingdom

Donald McRobbie, PhD, London, United Kingdom

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**INTRODUCTION:** Many studies now cite unacceptably high failure rates for large diameter metal-on-metal total hip arthroplasty (LD MOM THA) and surprisingly, higher than MOM hip resurfacing. The mechanism of failure is uncertain, but thought to involve surgical positioning, implant design and a patient-specific response to metal wear debris. The aim of this study was to compare clinical and radiological findings between two groups of patients with painful MOM hips: hip resurfacing and LD MOM THA. The primary outcome was the prevalence of pseudotumors (adverse soft tissue reactions).

**METHODS:** We performed a well-powered matched case-control study of 100 consecutively referred patients with painful MOM hips (sufficient to require revision). Cases were defined as patients with LD THA and controls as hip resurfacings. We compared whole blood metal ion levels, findings on metal artefact reduction sequence (MARS) MRI, and cup position as measured from 3D-CT scans. A logistic regression model was used to analyze the data.

**RESULTS:** A total of 63% of patients demonstrated a pseudotumor on MARS MRI, an example of which is shown in Figures 1 and 2. However, there was no significant difference in prevalence when hip resurfacing was compared to LD MOM THA (p = 0.52). There were also no significant differences observed in whole blood metal ion levels, cup inclination and cup version. Patients with well-positioned hips demonstrated a similar prevalence of pseudotumors as those with cup positions outside of Lewinnek’s ‘safe zone’ (62% and 67% respectively, p = 0.69).

**DISCUSSION AND CONCLUSION:** In symptomatic patients with MOM hips, the prevalence of pseudotumor was greater than 60% and was neither restricted to any specific manufacturer (Figure 3) nor resurfacing or LD THA devices. Adverse soft tissue reactions were commonly associated but not synonymous with adverse cup position and raised metal blood ion levels.

**Figure 1.** Axial T2-weighted image of a pseudotumor surrounding a LD THA.

**Figure 2.** Coronal T2-weighted image of a pseudotumor surrounding a LD THA.

**Figure 3.** Distribution of pseudotumors according to hip type (manufacturer)

**PAPER NO. 212**

**Economic Burden of Periprosthetic Joint Infection in the United States**

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Heather Watson, PhD, Menlo Park, CA

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Javad Parvizi, MD, Philadelphia, PA

**INTRODUCTION:** Few studies consider the economic burden of periprosthetic joint infection (PJI) to the inpatient health care system. The purpose of this study was to characterize the patient and clinical factors influencing the economic burden of PJI in the US.

**METHODS:** The 2001-08 Nationwide Inpatient Sample (NIS) was employed to identify primary and revision total hip (THA) and knee replacement (TKA) procedures using ICD-9 procedure codes (THA: 81.51 and 81.53, 00.70-00.73, 80.05; TKA: 00.80-00.84, 80.05, 81.54-81.55). Procedures with PJI were identified by the 996.96 ICD-9 diagnosis code. Hospital
Charges were converted to costs using the NIS-supplied charge-to-cost ratio and inflation-adjusted to $2011 using the Medical Care CPI. General linear modeling and paired t-tests were used to evaluate annual trends and differences in procedure cost and length of stay (LOS) as a function of patient (e.g., age, gender, comorbidities) and hospital factors (e.g., census region, bed size).

**RESULTS:** There were 137,400 infected revisions (47,100 THA; 90,300 TKA) treated in U.S. hospitals between 2001-2008. The relative incidence of PJI ranged between 2.0 and 2.4% of THAs and TKAs and increased over time for THA (p=0.0248) but not for TKA (p=0.147). Overall, the mean cost to treat hip PJI was $6,376 greater than the mean cost per knee PJI (p<0.0001, regression-adjusted for differences in age, gender, race, and region of the two populations, Table 1). Because of the growing incidence of PJI, the annual cost of infected revisions to US hospitals increased from $3345M to $642M during the study period and was projected to exceed $1B by 2020.

**DISCUSSION AND CONCLUSION:** We estimated the national direct costs of PJI to the hospital health care system in the U.S. Although the costs per case of PJI were mitigated between 2001-2008 by reducing the length of stay, the overall national burden of PJI is increasing due to the expanding utilization of hip and knee arthroplasty. The results of this study, though limited to treatments and costs during hospitalization, will be useful for developing policy related to PJI. As the demand for joint arthroplasty is expected to increase substantially over the coming two decades, so too will the burden of infections.

**Table 1: Inpatient Cost and LOS for Infected THA and TKA in the US**

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Infected THA Procedures in US</th>
<th>Mean Cost Per Case of Infected THA (2011 US$)</th>
<th>Mean LOS per Infected THA (d)</th>
<th>Number of Infected TKA Procedures in US</th>
<th>Mean Cost Per Case of Infected TKA (2011 US$)</th>
<th>Mean LOS per Infected TKA (d)</th>
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<td>7,113</td>
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**PAPER NO. 213**

**Preoperative Anemia in Joint Replacement Patients: Prevalence and Implications for Transfusion Risk and Cost**

Christopher J. Utz, MD, Rocky River, OH
Mary Lograsso, RN, Cleveland, OH
Deanna Trihas, Cleveland, OH
Bernard N. Stulberg, MD, Cleveland, OH
Mark I. Froimson, MD, Cleveland, OH

**INTRODUCTION:** Patients facing hip and knee arthroplasty may present with preoperative anemia that can increase the risk of requiring post-operative blood transfusion. The prevalence of anemia in this patient population varies widely in the literature. This study was undertaken to assess the prevalence of anemia in a tertiary referral center and its impact on the relative risk of post-operative transfusion, hospital length of stay and unplanned readmission.

**RESULTS:** Anemia was present in 32% of patients undergoing elective THA, with a similar incidence among hip and knee patients. Females were statistically more likely to be anemic than males (37% vs 23%). Anemic patients, whether undergoing hip or knee replacement, had a higher incidence of transfusion (49% vs. 25%), a longer average length of stay (4.3 vs. 3.8 days) and a higher rate of readmission within 30 days (17% vs. 8%).

**DISCUSSION AND CONCLUSION:** Anemia is common among elective joint replacement patients and significantly increases a patient’s risk of receiving an allogeneic blood transfusion. As post-operative allogeneic blood transfusion may be associated with increased morbidity and cost, early identification and appropriate treatment of pre-operative anemia may improve outcomes in these patients.

**PAPER NO. 214**

**Compliance with Surgical Care Improvement Project Measures and Hospital-Associated Infections following THR**

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**INTRODUCTION:** Hospital compliance with Surgical Care Improvement Project (SCIP) measures has increased recently for patients undergoing hip arthroplasty. However, reductions in postoperative infections were less than expected and concern remains about complications associated with prophylaxis against venous thromboembolism (VTE). We sought to examine the association between hospital adherence to SCIP measures against infections or VTE and the outcomes of postoperative infections.

**METHODS:** Observational study of 17,714 patients following hip replacement in 2008 from 128 New York State hospitals. Facility- and patient-level analyses were conducted using the New York State Department of Health annual report and the State Inpatient Database, respectively. Hospital-reported SCIP measures were used to dichotomize hospitals based on the median value of compliance. Outcomes were postoperative infections reported from each hospital and ascertained from individual patient’s discharge records.

**RESULTS:** During 2008, the mean hospital compliance increased averaged VTE prevention measure (range: 67.3% to 100%) and from 91.4% to 97.1% for the averaged infection prevention measure (range: 80.2% -100%), and from 93.5% to 96.0% for the averaged infection prevention measure (range: 93.5% to 96.0% for the averaged infection prevention measure (range: 80.2% -100%), and from 91.4% to 97.1% for the averaged infection prevention measure (range: 80.2% -100%). Higher adherence to any infection prevention measures was not associated with significant reduction in infection (all Ps > 0.05). However, hospitals with greater than 99% of patients who had general VTE prophylaxis ordered (VTE-1), or at least 97% compliance with timed VTE prophylaxis (VTE-2), reported significantly higher infection rate compared to hospitals with lesser compliance (VTE-1, 1.52% vs. 1.00%, p=0.003; VTE-2, 1.60% vs. 0.98%, p<0.001). Based on patient-level analysis, hospitals highly compliant with
timely prophylaxis (VTE-2), but not with general prophylaxis ordered (VTE-1), were found to be associated with increased risk of postoperative infection following hip replacement (adjusted odds ratio, 1.39; 95% confidence interval, 1.05-1.86, p=0.02).

**DISCUSSION AND CONCLUSION:** Targeting complete compliance with SCIP infection prevention measures was not linked to lower infectious outcomes following hip replacement. Increased adherence to timely VTE prophylaxis was associated with a higher risk of postoperative infections. Future trials of VTE prophylactic agents should include infections as an outcome.

PAPER NO. 215

**Variables Influencing the Functional Outcome Scores of the Hip**

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**INTRODUCTION:** Functional outcome scores of the hip are often used to assess the functional results of a hip procedure. However, little is known about the variables that might influence these functional outcomes. We aimed to (1) set up a baseline functional score of 1.037 “healthy” subjects without any complaint of the hip joint and (2) to assess whether age, musculoskeletal co-morbidities or body mass index (BMI) would influence these outcome scores.

**METHODS:** A total of 1,037 volunteers without any complaint in the hip region were requested to fill in the modified Harris Hip Score, the HOOS, the UCLA and the Tegner activity score. The subjects were assessed for age, BMI, pain in the knee, lower back or any other musculoskeletal pain. Forty-seven volunteers did not fill in the questionnaires completely. The scores of in total 337 male and 653 female subjects were collected and age categories of 10 years were sampled. Statistical analysis with a two-way-ANOVA model and Mann-Whitney U tests were used. P-values <0.05 were considered significant.

**RESULTS:** All scores decreased significantly with increasing age (p<0.001). Other significant negative correlations were found between hip scores and knee or lower back pain (p<0.001). No significant correlation was found between the scores and BMI below 30. BMI above 30 was significantly associated with lower scores (p<0.05). Gender was not a determinant variable for outcome score.

**DISCUSSION AND CONCLUSION:** Outcome scores of the hip should take age, knee or lower back pain and BMI into account. This study presents baseline scores that can be used to compare outcome scores following total hip arthroplasty (THA) with age and co-morbidity matched cohorts.

PAPER NO. 216

**The Relationship of Sporting Activity and Survivorship after Hip Resurfacing**

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Regina Woon, Los Angeles, CA
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**INTRODUCTION:** The effect of sports on the durability of the prosthesis after hip resurfacing has not yet been studied. This study correlates sporting activity levels computed as impact and cycle scores (ICS) with the survivorship of the procedure.

**METHODS:** A total of 445 patients filled out a sport-specific survey between one and five years after surgery and were then followed clinically for a mean of 10 years. The mean age of the patients was 48.7 years and 74% were male. The ICS included two scores: an Impact Score (IS) and a Hip Cycle Score (HCS). All patients were also evaluated with the UCLA activity score. Twenty-three patients (27 hips) underwent revision surgery after filling out the survey.

**RESULTS:** The mean time of follow up at the time of survey data collection was 1.8 years (1.0 to 4.9) and the mean time of the follow-up period was 10.1 years (6.1 to 13.7). The mean IS was 28.1 (0 to 128) and the mean HCS 33.1 (0 to 144). Positive correlations were found between UCLA activity score and IS (r=0.535) or HCS (r=0.497). After adjustment for femoral component size, body mass index (BMI) and femoral defect size, a 10-point increment in IS corresponded to a 37% (95% CI 1.18 to 1.59) increase in the risk of revision while a 10-point increment in HCS increased the risk of revision by 22% (95% CI 1.06 to 1.41). Patients with an IS less than 50 had a risk of revision 3.8 times (95% CI 1.6 to 8.9) lower than the patients with an IS of 50 or greater, with a survivorship rate at eight years of 96.4% (95% CI 93.6% to 98.0%) vs. 88.8% (95% CI 74.7% to 95.3%). No association was found between UCLA activity score and survivorship of the procedure.

**DISCUSSION AND CONCLUSION:** High levels of sporting activities can be detrimental to the long-term success of hip resurfacing arthroplasty, independently from other risk factors. Patients seeking hip resurfacing are usually young and should limit their involvement in sports to levels that the construct will be able to sustain.

PAPER NO. 217

**Predictors of Discordance in Expectations of Total Hip Arthroplasty between Patients and Surgeons**

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Alejandro M. Gonzalez Della Valle, MD, New York, NY
Michael M. Alexiades, MD, Manhattan, NY
Charles N. Cornell, MD, New York, NY
Thomas P. Sculco, MD, New York, NY
Alvin I. Mushlin, MD, New York, NY

**INTRODUCTION:** Dissatisfaction with total hip arthroplasty (THA) outcomes has been linked to unmet preoperative expectations. Aligning patients’ expectations with their surgeon’s expectations preoperatively may lead to better compliance with postoperative medical and rehabilitation instructions and increase satisfaction. We compared preoperative patient and surgeon expectations and investigated predictors of discordantly high patient expectations.

**METHODS:** A total of 249 patients awaiting THA by seven specialized adult reconstruction surgeons in a single orthopedic hospital completed a validated expectations questionnaire as part of their preoperative assessment. The surgeon separately addressed expectations of postoperative pain relief, function and well-being (score range 0-100, 100 being highest expectation). The surgeon separately addressed expectations of postoperative pain relief, function and well-being (score range 0-100, 100 being highest expectation). Using validated criteria, patients had discordantly high expectations if their scores were ≥ 7 points higher than the surgeon. Using generalized estimating equations (GEE), we estimated the effect on discordance of age, gender, education, comorbidity, BMI, and patient-reported SF-36 PCS and MCS scores, WOMAC function, stiffness and pain subscale scores, preoperative assessments of peri- and post-operative risk of complications. We also included an indicator for whether the patient expectations survey was completed before or after a required preoperative educational class.

**RESULTS:** Patients (51.0% female, average age = 62.1 ± 11.8

*The FDA has not cleared the drug and/or medical device for the use described in this presentation (i.e. the drug or medical device is being discussed for an off label use). For full information refer to page 14. An alphabetical faculty financial disclosure list can be found starting on page 19.*

PAPERS, POSTERS & SCIENTIFIC EXHIBITS AR HIP
yrs) had an average expectations score of 80.2±14.9. 34.5% of patient scores were ≥ 7 points higher than those of their surgeon. GEE analysis showed that patients were more likely to have discordantly higher expectations if they had graduate education vs. high school education or less (OR=2.57, CI [1.14, 5.80], p<0.02), perceived 0% peri- and post-operative risk of complications (OR=2.09, CI [1.12, 3.91], p<0.02), had higher WOMAC stiffness scores (OR =1.32, CI [1.13, 1.55], p<0.01) and filled out the expectations survey before the preoperative educational class (OR =1.75, CI [2.1, 2.54], p<0.01). They were, however, less likely to have discordantly higher expectations if they had more comorbidities (OR =0.68, CI [0.49, 0.94], p<0.02).

DISCUSSION AND CONCLUSION: In this study, 34.5% of patients had discordantly higher expectations than their surgeon. Multivariable analysis showed the importance of the educational class in aligning patient expectations and identified other predictors of discordantly higher patient expectations that could be addressed through pre-operative patient education and patient-physician dialogue.

PAPER NO. 218
Incidence and Predictors of Unplanned Readmission Following Total Joint Arthroplasty
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Camilo Restrepo, MD, Philadelphia, PA
Javad Parvizi, MD, Philadelphia, PA
Richard H. Rothman, MD, Philadelphia, PA

INTRODUCTION: Recent studies have exhibited an alarming increase in national readmission rates following total hip arthroplasty over the past decade. This increase is concerning for quality of patient care and clearly places a financial burden on healthcare. This study aims to identify factors predicting readmission following total joint arthroplasty (TJA).

METHODS: The institutional arthroplasty database was utilized to identify those patients undergoing total knee or hip arthroplasty from January 2004 to January 2009. A total of 10,641 patients were admitted for primary arthroplasty (5,212 knees and 5,432 hips). From the same database, patients requiring unplanned readmission within 90 days of discharge were identified. Multivariate logistic regression was utilized to determine the independent predictors of readmission within 90 days.

RESULTS: A total of 672 patients (6.3%; 672/10,641) were readmitted within 90 days during this time period. Age, gender and simultaneous bilateral versus unilateral replacement were not associated with early readmission. Charlson comorbidity index, ethnicity, discharge disposition, knee versus hip, and length-of-stay (LOS) were associated with readmission in univariate analysis and included in multivariate regression. Black race, discharge to inpatient rehabilitation or skilled nursing facility, increased LOS and knee replacement were independent predictors of early readmission.

DISCUSSION AND CONCLUSION: This study identifies the risk factors for unplanned readmission within 90 days of discharge following arthroplasty at a high volume institution. It is likely that an increased LOS is a reflection of postoperative complications that increases the risk of readmission. As well, increased readmission following knee arthroplasty is likely a result of early return to surgery for manipulation under anesthesia. These findings provide a path for understanding the etiology of readmission following TJA and can be used to direct future resources to prevent this costly problem and improve care.
before surgery may play a key role in management and education of patients eligible for THR. Our findings add knowledge to preoperative risk assessment. Cases at risk for poorer outcomes may be identified through review of the patient’s medical record. Antidepressant usage, gender, age and Charnley class could all play a part in predicting PROMs after THR.

PAPER NO. 220

Ultrasound Screening of Periarticular Abnormalities around Metal, Ceramic, and Polyethylene Bearings
Takashi Nishii, MD, Osaka, Japan
Takashi Sakai, MD, Suita, Japan
Masaki Takao, MD, Suita, Japan
Satoru Tamura, MD, Osaka, Japan
Korio H Abe, MD, Osaka, Japan
Nobuhiko Sugano, MD, Suita, Japan

INTRODUCTION: There are concerns of soft-tissue reactions such as metal hypersensitivity or pseudotumors for metal-on-metal (MoM) bearings in hip arthroplasty, however, such reactions around ceramic or polyethylene bearings are incompletely understood. The present study was conducted to examine the capabilities of ultrasound screening and to compare the prevalence of periarticular soft-tissue lesions among various types of bearings.

METHODS: Ultrasound examinations were conducted in 171 hips (161 patients) with arthroplasty after mean follow-up of 8.1 years (range, 1-22 years). This included 40 MoM hip resurfacings (M-THR), 37 MoM total hip arthroplasties (M-THA) with a large femoral head, 21 ceramic-on-ceramic total hip arthroplasties (THA) (C-THA), 25 THAs with a conventional polyethylene liner (cPE-THA) and 48 THAs with a highly cross-linked polyethylene liner (hxPE-THA). Periarticular soft-tissue reactions on ultrasound were classified into normal pattern, joint-expansion pattern, cystic pattern and large mass pattern (Fig. 1). Magnetic resonance imaging (MRI) was subsequently performed in 48 hips with high-frequency encoding bandwidths. Reliability of ultrasound screening for detection of periarticular abnormal reactions was estimated using the MRI findings as a reference. The frequencies of periarticular abnormal patterns on ultrasound were compared among the five bearing groups.

RESULTS: Periarticular abnormal lesions were detected in 26 hips (54%) on MRI. Using the abnormal lesions on MRI as a reference, positive predictive value, negative predictive value and the accuracy of ultrasound examination for the detection of soft-tissue lesions were 84%, 78% and 85%, respectively. Abnormal ultrasound lesions with joint expansion, cystic or mass patterns were most frequently observed in the cPE-THA group (48%), followed by the M-THA (24%), hxPE-THA (21%), M-THR (17%) and C-THA groups (14%). Compared to the hxPE-THA group, the frequency of abnormal patterns did not differ significantly in the two MoM groups. A mass pattern was detected in three hips of the M-THA group and one hip of the C-THA group. Abnormal ultrasound lesions were significantly associated with the presence of symptoms (p<0.0001).

DISCUSSION AND CONCLUSION: Ultrasound examination provides reliable screening of periarticular soft-tissue abnormalities in patients with hip resurfacing and THA. Various soft-tissue reactions could be observed other than those for MoM bearings, and pseudotumors may not be a specific feature of MoM bearings.

PAPER NO. 221

Developing a Novel Risk Stratification Model to Predict Resource Utilization after Total Joint Replacement Surgery
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INTRODUCTION: Spending on healthcare continues to rise at a significant rate, stimulating renewed interest in providing healthcare reform through the concept of value based purchasing. One key approach to offering value in healthcare delivery is the episode of care (EOC) model that identifies the resources required to manage a specific condition, for example lower extremity arthroplasty, over a finite period of time. Central to this approach is the ability to clearly delineate the relationship between the input variables, including disease severity and comorbidities, which influence the resources necessary to deliver desired outcomes. Although several studies have investigated the role of those various factors responsible for adverse outcomes following lower extremity total joint replacement (TJR) surgery, we are unaware of any reports examining the impact of such risk factors on resource utilization, cost and outcomes. The purpose of this study was to evaluate whether increase in resource utilization was due to presence of comorbidities and whether this was correlated with impact on outcomes. Methods: This study’s primary outcome, resource utilization and outcomes following TJR surgery, was evaluated by investigating the effect of socioeconomic characteristics, comorbidities, intraoperative factors and patient preferences. We utilized the hospital system’s claims database to evaluate pertinent charges and payments levied specific to our patient population of joint replacement patients during their EOC. Data was mined from the claims database and this financial data for an episode was linked to the specific medical information obtained from the electronic medical record systems within our health system. Each patient chart encounter for their EOC was reviewed for perioperative complications, intraoperative factors, compliance with SCIP measures, discharge disposition and interval changes in health.
status. A multivariate analysis was utilized for all data elements to determine which potential outcome predictors were significant. Using this approach, a risk stratification nomogram was developed to predict resource use and outcomes in prospectively enrolled patients undergoing TJR surgery during their EOC.

RESULTS: A total of 573 hospital system employees underwent a total of 653 primary TJR surgeries from 2007 to 2010. The patients were grouped into the following categories based on procedure: 223 total hip arthroplasty (THA), 372 total knee arthroplasty (TKA), 53 unilateral knee arthroplasty (UKA), five with previous hip surgery with conversion to THA. There was wide variability in the resources required to complete an EOC among this cohort, not all of which could be attributed to patient and process specific variables. Obesity was the most commonly occurring comorbidity followed by diabetes, hypertension and anemia. The presence of multiple comorbidities yielded higher costs and increased resource care without improving outcomes. Variability was found among surgeons’ use of resources. Variations in operating room use, hospital length of stay and discharge disposition could not be explained by variance in patient or disease characteristics.

DISCUSSION AND CONCLUSION: Although variability exists among EOC for the same disease and treatment dyad, only a portion of the variability can be explained based on a model that accounts for patient specific comorbidities. This information is of significant benefit to health systems and payers as they attempt to predict the resources required to deliver care. Such modeling can help manage expectations with regard to clinical course and cost, and can serve as a basis for discussions to eliminate variability in care pathways that are not reflective of underlying clinical need.

PAPER NO. 222
Early Results of Systematic Screening for Complications in Patients Operated on with ASR Hip Replacements
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INTRODUCTION: Both hip resurfacing arthroplasty (HR) and conventional cementless total hip arthroplasty (THA) using large-diameter head metal-on-metal bearing gained popularity in treatment of symptomatic osteoarthritis of the hip in young and active patients in the early 2000s. On September 7th, 2010 UK medicines and healthcare products (MHRA) announced a medical device alert regarding the ASR hip replacement implants with metal-on-metal articulation. After this alert all such patients operated on at our hospital were scheduled to undergo a specific workup to reveal possible articulation-related problems. We report the early results obtained thorough this protocol.

METHODS: Between September 2004 and December 2009, 476 patients (543 hips) underwent cementless THA using ASR cup, and 408 patients (490 hips) HR arthroplasty with ASR resurfacing implant. Five patients had received both implants. Informed consent was obtained from all patients. At a mean of 4.0 years postoperatively, all patients received an Oxford Hip Score (OHS) questionnaire and their whole blood chrome and cobalt levels were analyzed. Further, all patients with femoral head size less than 50 mm, acetabular inclination >50 degrees, and patients with elevated metal ion levels (>7 µg/l) were referred to magnetic artifact reduction sequence (MARS) MRI. We analyzed outcome of those patients who have completed all these medical tests to date. Adverse reaction to metal debris (ARMeD) was defined as pseudotumour (PT) seen in the MRI, or diagnosed in a revision operation.

RESULTS: To date, MARS MRI has been performed for 272 patients (101 HR, 171 THA, 322 hips). Pseudotumour has been found in 36 patients (43 hips, 13.2%). Further ARMeD has been diagnosed in revision operation in five patients. One patient has been revised due to aseptic loosening of the cup. Among those patients who have undergone our workup, incidence of ARMeDs has been 14.9% in HR patients and 15.2% in THA patients. ARMeD patients did not differ by age from non-ARMeD patients (p=0.4). The former group had significantly higher number of women (p=0.03). Preoperative range of motion or prosthesis type did not differ between hips with ARMeD and hips without ARMeD (p=0.36). Significantly higher inclination, however, was seen in hips with ARMeD (48.7 versus 51.3, p=0.02). Patients with ARMeD had significantly higher metal ion levels compared to those without ARMeD (Cr: 16.0 µg/l vs 4.4 µg/l; Co: 38.7 µg/l vs 9.8 µg/l, p<0.01). Ten (23.2%) ARMeD patients had both blood chrome and cobalt level lower than 7 µg/l. These patients had significantly higher preoperative range of motion compared to other ARMeD patients (p<0.05). Nine PT patients (11 hips) reported no pain in the first question of the OHS. No difference was seen between these patients compared to other ARMeD patients in age, femoral diameter, preoperative ROM or AI. Cumulative survival rate for ARMeD at six years was 70% (95% CI 66 to 74). When adjusted for age, sex, AI, femoral diameter and preoperative range of motion in Cox regression analysis, hips with THA had a 2.9-fold risk (95% CI 1.5 to 5.9) of having an ARMeD as compared to hips with HR.

DISCUSSION AND CONCLUSION: With systematic screening protocol, ARMeD was found to be alarmingly common in patients operated on with an ASR hip implant. The clinical picture in ARMeD patients is variable. It must be considered a worry that relatively many of patients who developed ARMeD were symptomless or had metal ion levels regarded as normal. Thus, diagnosing ARMeD in metal-on-metal hip replacement patients may require both clinical examination, measuring metal ion levels in whole blood and cross-sectional imaging.

PAPER NO. 223
Smoking is a Harbinger of Early Failure with Ultraporous Metal Acetabular Reconstruction
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INTRODUCTION: Acetabular reconstruction with newer ultraporous metal in both complex primary and revision total hip arthroplasty (THA) has increased survivorship with stable fixation and few failures. Smoking is considered a risk factor for surgical complications including transfusion, infection and cardiac. We hypothesized that the early results of ultraporous metal acetabular reconstruction would be unaffected by smoking in complex primary and revision THA.

METHODS: Between 1999 and 2009, ultraporous acetabular components were used in 535 hips (500 patients) for 160 complex primary and 375 revision cases. Of these patients 17% were smokers, 29.5% previous smokers, 49.0% non-smokers and 4.5% unknown. Early failures possibly related to negative effects of smoking were considered any infection, failure of in-growth or periacetabular fracture. Failures not considered related to smoking included dislocation and implant breakage.
RESULTS: There were 33 failures at an average of 18 months post-operative for a failure rate of 6.2%: 15 infections, 13 failure of ingrowth, three dislocations, and one each liner fracture and periprosthetic fracture. The failure rate in smokers was 11%, in non-smokers 3.8%, and in previous smokers 5.3% (Pearson’s 6.5; p=0.01). With only smoking related failures included, the rate was 9% in smokers and 3.6% in non-smokers (4.6; p=0.03). With previous smokers included as smokers failure is 9.2% (6.2; p=0.01) and included as non-smokers 5.8% (3.7; p=0.05).

DISCUSSION AND CONCLUSION: Even with ultraporous metal technology, smoking is a significant risk factor for early failure in complex primary and revision THA. Quitting smoking reduces the inherent risk. Smoking cessation should be considered during pre-operative education.

PAPER NO. 224 The Association of Socioeconomic Factors with Surgical Site Infection Following Total Hip Arthroplasty

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INTRODUCTION: Several co-morbidities including diabetes and rheumatoid arthritis (RA) are associated with an increased risk of surgical site infection (SSI) following total hip arthroplasty (THA) but the influence of socioeconomic factors such as race and household income on SSI is not fully understood.

METHODS: We conducted a five-year retrospective cohort study of hip arthroplasty patients using administrative records at a 1,250 bed, teaching hospital. SSI cases were defined using National Healthcare Safety Network (NHSN) surveillance criteria.

RESULTS: A total of 3,490 procedures were identified between July 2005 and July 2010. Some 1,646 (47.2%) of patients were male, 439 (12.6%) were African-American, 1,126 (32.3%) had body mass index (BMI) ≥ 30 kg/m² [median BMI = 27.9, (range 10.1-62.4)], 359 (10.3%) had diabetes, 113 (3.2%) had RA and median age = 58 years (range 13-102). A total of 632 (18.1%) were revision cases; 38 (1.1%) patients developed SSI. A nested case-control study compared 38 SSI cases to 114 randomly selected controls. Univariate risk factors for SSI included revision surgery [12 (31.6%) cases vs. 16 (14.0%) controls, P=0.018] and a patient home zip code in the lowest quartile of median household income [16 (42.1%) vs. 22 (19.3%), P=0.028].

In a multivariate logistic regression model, African-American race was significantly associated with SSI [21.1% of cases vs. 8.8% of controls; adjusted odds ratio = 5.8; 95% confidence interval, 1.7-19.5] after adjusting for RA, ASA score and surgery duration.

DISCUSSION AND CONCLUSION: Both socioeconomic and patient factors significantly impact the incidence of SSI following THA and both should be considered in risk adjusting THA SSI rates between centers.

PAPER NO. 225 Web-Based Joint Replacement Follow Up Assessments: Are Routine Clinic Visits Necessary?

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INTRODUCTION: It has been recommended that patients undergoing total hip or total knee arthroplasty be seen for routine follow up at regular intervals to monitor the performance of the implant and bearing. The vast majority of these follow-up clinic visits however are routine, with no change in clinical outcomes. The technology and resources now exist to enable follow-up assessment without the patient physically coming to see the surgeon. The purpose of this study was to measure the feasibility and costs associated with a web-based assessment compared to the usual method of follow up.

METHODS: We randomized patients who were at least 12 months post-operative to either complete a web-based follow up (which included completion of an online form and an x-ray done at the nearest web-enabled facility) or to have their appointment at the clinic as usual. We recorded travel distances, travel costs, time in x-ray, time in clinic and time taken off paid employment to attend the appointment.

RESULTS: A total of 210 patients (96 THA, 114 TKA) completed the study with a mean age of 68.5 years. Patients in the web-based group travelled less (29.1 km vs. 110.2 km, (p<0.01)), had lower associated travel costs ($4.00 vs. $21.41, (p<0.01)) and reduced associated time (44.6 minutes for online form completion vs. 55.6 minute clinic visit). Patients in the usual care group missed 5.7 hours from work and their caregivers missed 6.4 hours on average to attend the clinic appointment.

DISCUSSION AND CONCLUSION: There were significant time and costs savings to patients in the web-based group compared to those who had their appointment in person at the clinic. Other potential advantages of web-based follow ups include decreased wait times in clinic for existing patients with problems, decreased wait times for new patients waiting for surgery and reduced patient and caregiver burden by decreasing travel distances, financial and time requirements.

PAPER NO. 301 Retrieval Analysis Reveals Damage Modes for Metal-on-Metal Total Hip Replacements

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INTRODUCTION: Recent clinical concerns have arisen regarding metal-on-metal (MoM) total hip replacements. While volumetric wear of MoM hip implants has been described, the damage modes accompanying volumetric wear of MoM hip implants has been described, the potential advantages of web-based follow ups include decreased wait times in clinic for existing patients with problems, decreased wait times for new patients waiting for surgery and reduced patient and caregiver burden by decreasing travel distances, financial and time requirements.

PAPERS, POSTERS & SCIENTIFIC EXHIBITS AR HIP
of corrosion pits at the rim of three cups. A loss of the metallic sheen, termed wear patch, was found within 40° of the superior pole in 5% of the cups and 40% of the heads. Wear patches beyond 40° from the pole were seen in only 2% of the heads. DISCUSSION AND CONCLUSION: Despite the claim that MoM bearings are wear resistant, qualitative analysis of retrieved femoral and acetabular MoM components showed considerable surface damage in terms of both extent and severity. Scratching is consistent with metal-on-metal articulations, in which carbides serve as abrasive features whether fixed in the surface or released as third bodies. The high occurrence of wear patches around the pole is consistent with the location of the highest contact force. The wear patches and severe scratching suggest boundary lubrication conditions with little or no fluid between the MoM surfaces. Corrosive pitting located at the rim of three cups implies a corrosive, possibly galvanic process, that could result in direct release of ionic metallic species. Though further investigation is necessary to understand the clinical implications of these damage modes, our findings suggest mechanisms for creation of substantial wear debris.

PAPER NO. 302
The Eight Year Wear of Highly Cross-linked Polyethylene in Hip Arthroplasty: A Double Blind RCT
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Harinderjit Gill, PhD, Oxford/Oxon, United Kingdom
David W. Murray, MD, Oxford, United Kingdom
Sion Glyn-Jones, MA MBBS, Oxford, United Kingdom

INTRODUCTION: Highly cross-linked polyethylene (HXLPE) is commonly used in total hip arthroplasty; however there is no long-term data to support its use. Hip simulator studies suggest that the wear rate of HXLPE is superior to conventional polyethylene (UHMWPE). The outcomes of hip simulator studies are not always reproduced in vivo and there is some evidence that HXLPE wear may increase between five and seven years. In addition the wear rate in relation to implant position is not known.

METHODS: A prospective double blind randomized control trial was conducted using radiostereometric analysis (RSA). Fifty-four subjects were randomized to receive hip replacements with either UHMWPE liners or HXLPE liners. All subjects received a cemented CPT stem and uncemented acetabular component. The 3D penetration of the head into the socket was determined to a minimum of eight years. Implant position was determined using the RSA data.

RESULTS: The total liner penetration was significantly different at eight years (p=0.005) with values of 0.33 mm (SE 0.05 mm) for the HXLPE group and 0.55 mm (SE 0.05 mm) for the UHMWPE group. The steady state wear rate from one year onwards was significantly lower for HXLPE (0.005 mm/yr, SE 0.007 mm/yr) than for UHMWPE (0.037 mm/yr, SE 0.009 mm/yr) (p=0.007). The direction of wear was supero-lateral. Implant position was closely correlated to wear in standard polyethylene (p=0.002)

DISCUSSION AND CONCLUSION: We have previously demonstrated that the penetration in the first year is creep-dominated; from one year onwards, the majority of penetration is probably due to wear. This study confirms the predictions from hip simulator studies which suggest that the wear rate of this HXLPE approaches that of metal-on-metal and ceramic-on-ceramic articulations. HXLPE may have the potential to reduce the need of revision surgery, due to wear debris induced osteolysis. It may also enable surgeons to use larger couples, thus reducing the risk of impingement and dislocation. However, wear in standard polyethylene may be more sensitive to implant position than with HXLPE.

PAPER NO. 303
One Third of Patients Diagnosed with Pseudotumors after Metal-on-Metal Total Hip Arthroplasty
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Harmen B. Ettema, Zwolle, Netherlands
Martijn F. Boomsma, MD, Zwolle, Netherlands
Boudewijn Kollen, Groningen, Netherlands
Mario Maas, Amsterdam, Netherlands
Cees Verheyen, PhD, Zwolle, Netherlands

INTRODUCTION: Periarticular tumors occur following large-size femoral head metal-on-metal resurfacing and conventional total hip replacement. Reports until now are based on symptomatic outcomes. We intended to assess the true incidence of both symptomatic and asymptomatic cases and to identify predicting factors for the development of a pseudotumor. This is a design retrospective cohort study set in a teaching hospital in the Netherlands. METHODS: We included all patients who underwent hip arthroplasty with large-size femoral head metal-on-metal conventional prostheses in our clinic (2005-2010). We collected data on hip outcome scores, metal ion levels and conventional pelvic and hip radiographs. All patients were scheduled for CT scan examination.

RESULTS: Between January 2005 and July 2010, primary uncemented large-size femoral head total hip arthroplasties was performed in 649 patients (732 hips). A total of 671 hips in 614 patients were evaluated with a mean follow up of 2.7 years (range 1-6.5 years). Pseudotumor was diagnosed in 207 hips (31%) in 202 patients (33%). To date, 39 (6%) of these hips were revised to a polyethylene acetabular component with small diameter metal head. We identified the following risk factors for developing a pseudotumor: female gender, swelling around the hip, discomfort around the hip, clicking sensations and anterolateral surgical approach. Patients with a pseudotumor had, on average, higher levels of cobalt and chromium in serum (10 µg/l vs 4 µg/l and 8 µg/l vs 4 µg/l respectively). No difference in clinical outcome scores was detected between the pseudotumour and non-pseudotumour group. No relation with component size or orientation could be identified.

DISCUSSION AND CONCLUSION: This study showed a substantially higher incidence of pseudotumors and subsequent revisions in patients with metal on metal total hip arthroplasties than previously reported. Because most revision (27 of 39) cases were identified only after applying an intensive screening protocol, we recommend close monitoring of patients with a metal on metal hip arthroplasty.

PAPER NO. 304
Pseudotumors are Common in Well Positioned, Low Wearing Retrieved Metal-on-Metal Hip Arthroplasties
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Johann Henckel, BM, London, United Kingdom
John Skinner, FRCS, London, United Kingdom
Alister Hart, FRCS, London, United Kingdom

INTRODUCTION: Pseudotumors are sterile inflammatory lesions found in the soft tissues surrounding metal-on-metal (MOM) hip arthroplasties. These lesions are thought to represent an adverse tissue response to metal wear debris and

The FDA has not cleared the drug and/or medical device for the use described in this presentation (i.e. the drug or medical device is being discussed for an off label use). For full information refer to page 14. An alphabetical faculty financial disclosure list can be found starting on page 19.
may explain the high rates of failure widely cited in the current literature. However, the etiology remains unclear, with recent studies suggesting that pseudotumors can occur in patients with well functioning prostheses. We sought to investigate further the relationship between pseudotumors, wear rate and component orientation in a large series of retrieved MOM hips.

METHODS: We performed a well-powered study of 105 consecutively revised patients with current generation large diameter MOM hip arthroplasties. We performed both cross-sectional and matched case-control analyses to compare component position, pre-revision blood metal ion levels and component wear rates between two groups of patients according to findings on metal artefact reduction sequence (MARS) MRI scanning. Patients demonstrating evidence of a pseudotumour were compared with those that did not (Table 1). Component wear was measured in our retrieval laboratory using a roundness measuring machine.

RESULTS: In this series, 69% of patients demonstrated a pseudotumour on pre-revision MARS MRI. No significant differences were observed for whole blood metal ion levels or component wear rates when patients with pseudotumors were compared to those without (Table 2). Additionally, patients with well-positioned hips demonstrated a similar prevalence of pseudotumors as those with cup positions outside of Lewinnek’s ‘safe zone’ (67% and 66% respectively; p = 0.64). The distribution of pseudotumors according to cup position is shown in Figure 1.

DISCUSSION AND CONCLUSION: Pseudotumors were commonly diagnosed prior to revision of current generation MOM hip arthroplasties, but were not associated with component malposition, raised blood metal ion levels or high component wear rates. This would suggest that patient specific factors are likely to be more influential in the etiology of adverse tissue reactions in patients with MOM hip arthroplasty.

Table 1. Demographic and clinical data for each of the study groups: (1) No Pseudotumor, (2) Pseudotumor, (3) Matched Pseudotumor

<table>
<thead>
<tr>
<th></th>
<th>No Pseudotumor (Control Group)</th>
<th>Pseudotumor</th>
<th>Pseudotumor (Case Group)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Patients</td>
<td>33</td>
<td>72</td>
<td>33</td>
</tr>
<tr>
<td>Number of Components</td>
<td>66</td>
<td>144</td>
<td>66</td>
</tr>
<tr>
<td>Age (years)</td>
<td>51 (22 to 68)</td>
<td>58 (33 to 83)</td>
<td>58 (33 to 83)</td>
</tr>
<tr>
<td>Male / Female</td>
<td>8 M / 25 F</td>
<td>21 M / 51 F</td>
<td>8 M / 25 F</td>
</tr>
<tr>
<td>Time Implanted (months)</td>
<td>37 (12 to 69)</td>
<td>40 (9 to 95)</td>
<td>35 (11 to 71)</td>
</tr>
<tr>
<td>Femoral Diameter (mm)</td>
<td>46 (40 to 54)</td>
<td>46 (38 to 58)</td>
<td>46 (40 to 54)</td>
</tr>
<tr>
<td>Implant Type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adept</td>
<td>1</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>ASR DePuy</td>
<td>7</td>
<td>12</td>
<td>7</td>
</tr>
<tr>
<td>BHR Smith &amp; Nephew</td>
<td>13</td>
<td>38</td>
<td>17</td>
</tr>
<tr>
<td>Cormet</td>
<td>5</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>Durom (Zimmer)</td>
<td>5</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>M2a-Magnum (Biomet)</td>
<td>2</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Acetabular Inclination (°)</td>
<td>44 (27 to 63)</td>
<td>50 (33 to 78)</td>
<td>49 (32 to 63)</td>
</tr>
<tr>
<td>Acetabular Version (°)</td>
<td>17 (-34 to 42)</td>
<td>19 (-14 to 45)</td>
<td>19.5 (-17 to 42)</td>
</tr>
<tr>
<td>Clinical Cause of Failure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Component Mismatch</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Fracture</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Infection</td>
<td>0</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Loosening (acetabular)</td>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Loosening (femoral)</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Malalignment</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Unexplained Pain</td>
<td>23</td>
<td>48</td>
<td>20</td>
</tr>
</tbody>
</table>

Table 2. Results for whole blood (WB) metal ion levels and component wear rates for the matched case-control comparison.

<table>
<thead>
<tr>
<th></th>
<th>No Pseudotumor</th>
<th>Pseudotumor</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>WB Cobalt (ppb)</td>
<td>2.9 (0.5 to 162.3)</td>
<td>7.6 (1.4 to 88.0)</td>
<td>p = 0.07</td>
</tr>
<tr>
<td>WB Chromium (ppb)</td>
<td>3.2 (0.4 to 50.0)</td>
<td>4.7 (2.0 to 70.0)</td>
<td>p = 0.07</td>
</tr>
<tr>
<td>Cup Wear Rate (μm/yr)</td>
<td>1.9 (0.0 to 31.5)</td>
<td>3.3 (0.0 to 31.2)</td>
<td>p = 0.31</td>
</tr>
<tr>
<td>Head Wear Rate (μm/yr)</td>
<td>1.3 (0 to 62.12)</td>
<td>3.5 (0.0 to 22.6)</td>
<td>p = 0.26</td>
</tr>
</tbody>
</table>

Figure 1. This shows the distribution of hips according to acetabular orientation. Hips in red indicate those associated with a pseudotumor. The blue box represents Lewinnek’s ‘safe zone’ for acetabular orientation.

PAPER NO. 305

Nine-Year Comparative Study of Highly Crosslinked and Traditional Polyethylene in Total Hip Arthroplasty

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INTRODUCTION: To compare the linear penetration rates of a highly cross-linked ultra-high-molecular weight polyethylene (PE) to those in traditional polyethylene in total hip arthroplasty (THA).

METHODS: A total of 27 THA patients with highly cross-linked inserts were matched to 27 THA patients that received traditional polyethylene inserts with respect to age, gender, body mass index (BMI) and level of activity. Linear penetration for radiographs was measured using the Martell’s computerized technique. Patients were evaluated at follow up for pain, motion and function (Harris Hip Score).

RESULTS: Minimum follow up for inclusion in study was nine years. Both groups were comparable in terms of demographics, preoperative pain, preoperative motion and motion as rated per the Harris Hip Score. Postoperative penetration rate for the traditional PE group was 0.098mm/yr. Penetration rate for the highly cross-linked PE group was 0.037mm/yr. This represented a 62% decrease in wear which correlated with our previous data which showed a 59% decrease in wear at five years. There were not catastrophic failures of the polyethylene in either group.

DISCUSSION AND CONCLUSION: This follow up study reinforces previous findings that highly cross-linked polyethylene shows improved wear characteristics compared to traditional polyethylene. This study also shows that the previous concerns regarding long term durability of highly cross-linked polyethylene
INTRODUCTION: Highly crosslinked polyethylenes (HXLPEs) have been in use in total hip arthroplasty (THA) for over a decade. There is consensus in the literature that these materials show improved wear in vivo and significantly reduce osteolysis. However, questions remain regarding the long-term oxidative stability of HXLPEs and the influence of mechanical behavior on THA clinical performance. The purpose of this multicenter study was to assess the oxidative stability, mechanical behavior, wear and reasons for revision of second generation HXLPEs and compare them to our ongoing retrieval collection of first generation annealed and remelted HXLPEs\([5, 6]\). We hypothesized the sequentially annealed components would exhibit wear rates similar to first generation HXLPEs. We also hypothesized that the second generation HXLPEs would be more oxidatively stable than first generation HXLPEs.

METHODS: Hip liners (n=376) were consecutively retrieved during revision surgeries at seven surgical centers and have been continuously analyzed over the past 12 years in a prospective, multicenter study of THA revision and retrieval analysis. The liners were revised predominantly for loosening, instability and infection. Twenty-five liners were sterilized using non-ionizing methods (gas sterilized; implanted 8.1±3.5 years), 46 liners were sterilized in an inert environment (gamma inert; implanted 6.2±3.8 years), 177 were highly crosslinked and remelted (annealed 1; implanted 3.7±2.8 years) and 45 were highly crosslinked and annealed in three sequential steps (annealed 2; implanted 1.2±0.9 years). Oxidation was characterized in accordance with ASTM 2102 using transmission FTIR performed on thin sections (~200µm). Mechanical behavior was assessed via the small punch test (ASTM 2183).

RESULTS: The mean 2-D vector wear was 0.101±0.30 mm in the XLPE group and the CPE was 56±10 and 60±8, respectively (P<0.05). RESULTS: The mean 2-D vector wear was 0.101±0.30 mm (0.02±0.05 mm/yr) in the XLPE group and 0.22±0.38 mm (0.04±0.06 mm/yr) in the CPE group (P<0.05). The volumetric wear was 82.4±106.5 mm³ in the XLPE group and 118.9±106.1 mm³ in the CPE group (P<0.05). The annual penetration rate of the XLPE was 50% reduction compared to that of the CPE. The mean bedding-in penetration for first year was 0.109±0.26 mm/yr in the XLPE group and 0.09±0.40 mm/yr in the CPE group. The subsequent penetration rate, with elimination of the bedding-in wear, resulted in the annual wear rate of -0.001±0.07 mm/yr in the XLPE group and 0.03±0.08 mm/yr in the CPE group (P<0.05). Small localized osteolysis was recognized in the two cases of CPE group. DISCUSSION AND CONCLUSIONS: Several studies showed the percent reduction of XLPE in the rate of femoral head penetration have ranged from 30% to 90%, depending on which CPE was used as a control. The reduction rate of this study was rather little that may not be clinically significant.
of the earlier studies. The CPE liners that were gamma-sterilized have a corresponding amount of cross-linking so that the liner would result in wear rates that were lower than those of non-cross-linked PE liners. And the total penetration of THA was due to a combination of creep (bedding-in penetration) and wear. In this study, the XLPE liner showed distinctive improvement of wear performance, especially after bedding-in penetration, compared to the CPE liner at medium term. The reduction rate was estimated more than 95%. The effect may lead to better longevity of THA as a result of less wear and osteolysis. We will continue to follow this cohort of patients, because long term in vivo mechanical properties of the XLPE remain unknown.

PAPER NO. 308

Pseudotumour Following Metal on Metal Hip Replacement can Progress after Revision Surgery

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INTRODUCTION: Solid or cystic pseudotumour is a potentially destructive complication of metal on metal (MoM) couples, usually needing revision surgery to improve function and also to prevent further soft tissue/bony damage. However, complete clearance of the pseudotumour at the time of revision is unlikely at times. It is not known whether the remnant pseudotumour will progress and cause further symptoms. This prospective case-controlled study reports cases which had disease progression after revision surgery for pseudotumour related to metal on metal hip couples.

METHODS: A total of 37 hips (33 MoM hip resurfacing and four big head MoM total hip arthroplasty (THA)) were revised for pseudotumour during the last 10 years. The patient demographics, time to revision, cup orientation, operative and histological findings were recorded for this cohort. Patients were divided into two groups - group R (needing re-revision for disease progression) and group C (control - no evidence of disease progression).

RESULTS: Nine of 37 (24%) patients identified with worsening Oxford hip scores (OHS, 0-48, 48 best outcome) were used to monitor the performance of the bearings. Therefore, it is important to determine the appropriate sample collection protocol to assess implant wear. This study's aim was to determine the distribution of chromium and cobalt in blood fractions.

METHODS: The distribution of metal ions in the whole blood and serum fractions: Whole blood Cr and Co samples were compared to the corresponding serum Cr and Co samples in patients with unilateral hip resurfacings. Univariate linear regression was used to examine the relationship between matched blood Cr and serum Cr samples. In vitro study of chromium species distribution in human blood: Blood was collected from a healthy adult volunteer into (i) a container with EDTA as anticoagulant and (ii) a plain container. The anti-coagulated blood was divided into a series of portions and each was spiked with solutions of Cr3+ or Cr6+ so as to increase the concentration by 0, 2, 5, 10, or 40 µg/L. These samples were further divided into four aliquots, which were separated into plasma and washed red blood cells (RBCs) after 45 min, 24, and 48 hours at room temperature. The non anti-coagulated blood was immediately divided into portions, similarly spiked with Cr3+ or Cr6+, allowed to clot and the serum separated. The concentrations of Cr were measured in RBCs and serum by ICPMS.

RESULTS: The distribution of metal ions in whole blood and serum fractions: A total of 450 blood samples were sent for whole blood and serum metal ion analysis. There was a highly significant correlation between increasing whole blood Cr concentrations and an increasing serum Cr to blood Cr ratio (r = -0.485, p < 0.001). Serum Co correlated well with blood Co (r = 0.953 p < 0.001) and the concentrations of Co in the two fractions showed less variability than the Cr samples. Results of in vitro study: Blood samples spiked with Cr3+ showed preferential increase in Cr concentrations in the serum fractions. This was in contrast to blood samples spiked with Cr6+, where there was a preferential increase in Cr in the RBCs. The time from sampling to removal of plasma cells had a very small effect on overall measured Cr concentrations and the distribution of the Cr species between the RBCs and plasma/serum.

DISCUSSION AND CONCLUSION: The results suggest that as wear increases, metal ions are taken preferentially into the serum fraction of blood. It has been shown that Cr6+ ions generated from corrosion processes are preferentially taken into red blood cells, a result which was replicated in the current study. Cr3+ is believed to have a greater affinity for serum proteins and is thought to be the predominant Cr species produced by mechanical wear. This leads us to speculate that the increase of serum Cr concentrations to levels greater than those found in whole blood is secondary to an increased rate of wear rather than corrosion processes.
Five-year Metal Ion Levels After Metal-on-Metal Total Hip Arthroplasty (THA): A Prospective, Randomized Trial

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INTRODUCTION: The FDA has requested post market surveillance data on metal-on-metal (MOM) modular total hip arthroplasty (THA) from multiple manufacturers. That request includes data on metal ion levels. An analysis of five-year results of ion levels in erythrocytes, serum and whole blood for 28-mm and 36-mm metal-on-metal and metal-on-polyethylene (MOP) THA is presented.

METHODS: Investigators enrolled 120 patients in a prospective trial, 105 of whom were eligible at the time of surgery and subsequently randomized into one of three groups. Group 1 received a MOP THA, Group 2 received a 28-mm MOM THA and Group 3 received a 36-mm MOM THA. Patients were blinded to their treatment group. Blood samples were obtained preoperatively, at six-month, one-year, two-year, three-year and five-year follow-up visits.

RESULTS: At five-year follow up, the MOM ion levels were significantly lower than each of the two MOM groups (p<.001) for all blood samples tested for cobalt and chromium, with the exception of erythrocyte chromium (p=0.194). Serum and erythrocyte cobalt showed significant increases (p=.029, p=.002) from two to five years in the 36-mm MOM group; similar increases were not seen in the 28-mm MOM group. At six months, one 36-mm MOM patient had serum or erythrocyte ion levels greater than 7 ppb. At five years, there were five patients. None of the patients in the 28-mm MOM group had ion levels greater than 7 ppb. Correlations between cobalt serum, erythrocyte and whole blood were stronger than in chromium. One 36-mm MOM patient was revised due to an adverse local tissue reaction.

DISCUSSION AND CONCLUSION: Contrary to our hypothesis that the larger 36-mm MOM group would have lower ion levels compared to the 28-mm MOM group, our findings showed that cobalt serum and erythrocyte ion levels leveled off in the 28mm MOM group but continued to increase in the 36-mm MOM group.

Balancing Competing Considerations for Optimal Orientation in 36-mm Metal-on-Metal Total Hips

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INTRODUCTION: Concerns have mounted regarding adverse reactions to metal wear debris and ions in metal-on-metal (MoM) total hip arthroplasty (THA), presumably associated with excessive wear. However, positioning of MoM bearings involves significant tradeoffs, as cup orientations most favorable in terms of stability are not necessarily ideal in terms of reduction of contact stress and wear potential. Therefore, investigation continues to identify the optimal cup orientation for MoM implants.

METHODS: A physically and analytically validated THA finite element (FE) model (Fig. 1) was used to identify optimal cup orientations by assessing femoral head subluxation and generation of contact stresses on both the cup liner and femoral head, for four posterior-dislocation prone kinematic challenges and one anterior-dislocation challenge. Eighty-one distinct cup orientations (radiographic definition) were investigated, with cup inclination varied between 25° and 65° in 5° increments and anteversion between 0° and 40°, again in 5° increments. Three values of femoral stem anteversion were considered: 0°, 12.5° and 25°. Stability and peak surface stresses were reported for each of the 1,215 distinct FE simulations, with stability and avoidance of high edge loading being given identical weights for purposes of assessing overall performance.

RESULTS: With this equal weighting, cups oriented in approximately 46° ± 10° inclination and 16° ± 5° anteversion were found to strike the ideal balance between stability and high contact stress avoidance (Fig. 2). Cup anteversion and femoral anteversion were found to independently influence predicted THA performance.

DISCUSSION AND CONCLUSION: The optimal cup orientations determined in the present study are similar to those which have empirically evolved clinically. However, the present data for 36mm MoM implants suggests a tighter tolerance for cup anteversion (± 5° vs. ± 10°), indicating the continued need for precise surgical positioning even with large head THAs. Additionally, the current data challenge the notion of an equivalent summed (combined) anteversion, as both the cup and stem anteversion independently influenced stability and contact stress. Besides representing among the most comprehensive computational analyses of cup positioning effects on predicted THA outcomes, the present work is notable in terms of being the first combined/concurrent balancing of considerations of stability and avoidance of adverse surface contact stress.

PAPERS, POSTERS & SCIENTIFIC EXHIBITS  AR HIP
Cross-linked Polyethylene: Life Tested 13 Years and 37 Million Cycles

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INTRODUCTION: Cross-linked polyethylene (XL poly) is intended to decrease wear and particle-induced osteolysis. We have previously reported on a cohort of patients with a five Mrad cross-linked polyethylene (re-melted and gas plasma sterilization) at a minimum of two and five years. The clinical wear rates were similar to wear simulator studies. At five years, osteolysis was not detected on plain radiographs. We have reassessed this cohort at a minimum of 10 years post-op.

METHODS: Thirty-four patients comprised the initial cohort. Three patients are now deceased. Twenty-four patients from the initial study group were available for 10-year radiographic follow up. We assessed an average of 6.5 films per patient (range 4-11). Quantitative activity data was obtained on 18 patients; three patients were too disabled to participate and three refused. Activity was measured at a minimum of two years and again at 10 years postoperatively with a computerized two-dimensional accelerometer worn on the ankle. The two activity measures were averaged to determine total cycles at last follow up. Wear was measured using a validated, edge-detection based algorithm and wear rates were calculated by linear regression 1) as a function of time in vivo and 2) per million cycles of measured patient activity. Serial AP and lateral radiographs were reviewed independently by three orthopaedic surgeons for presence and location of osteolysis.

RESULTS: At a minimum of 10 years (max. 13), linear and volumetric wear rates were 0.026mm/yr (-0.096-0.134) and 17.8mm/3/million cycles (0.0-78.8), respectively. As a function of activity, linear wear averaged 0.014mm/million cycles (-0.413-0.092) and 12.7mm/3/million cycles (1.5-50.2). Osteolysis was not observed on any radiograph.

DISCUSSION AND CONCLUSION: At 10 years postoperative, this five Mrad XL poly demonstrates a wear rate that is similar to pre-clinical wear simulator studies. The wear rate at 10 years is slightly lower than that observed at five years, likely because patient activity has declined. At a minimum of 10 years, this amount of polyethylene wear did not result in radiographically apparent osteolysis. This has favorable implications for bearings larger than the 28 and 32mm diameters in this study. The occurrence of osteolysis also depends on the design of the modular acetabular component and CT scanning is more sensitive for the detection of small lesions. If in vivo oxidation of the polyethylene has occurred in any case, no adverse effect was detected by this longitudinal study. Multiple hips in this series have been life tested to greater than 25 million cycles (max. 37 million) without evidence of impending failure. These observations are promising for the 20 year result in the average-activity patient. We will continue to follow this cohort to assess the performance of this bearing over time and relative to patient activity.
metal ion levels also have a higher number of chromosomal aberrations; with time it is intuitive to believe that this trend will continue and subsequently lead to a carcinogenic risk to the patient. The results of this study show that the levels of chromium, cobalt and titanium are significantly higher in the MoM group compared to the MoP group. This corresponds to increases in chromosome aberrations in these groups with increases in structural chromosome damage particularly after two years.

METHODS: A total of 218 (123M: 95F) consecutive patients with minimum two serum ion measurements (ICPMS protocol) were included. The mean age at surgery was 52.3 years (SD: 10), the first assessment was made at a mean of 2.5 years (11 months to eight years) and the last assessment at a mean of 4.6 years post resurfacing (two to 12 years). Ion level change was defined as ion level at last assessment minus ion level at first assessment. Ten different resurfacing designs were implanted, the majority being BHR (n=104), Conserve plus (n=55) and ASR (n=25). The median femoral component size was 50 mm (38 - 59mm). Radiological assessment of acetabular component orientation was made with EBRA. Optimum acetabular component orientation was defined as ± 10° about an inclination/anteversion of 45°/20°.

RESULTS: For the whole cohort a significant reduction in chromium (Cr) levels between initial [2.6 µg/ml (SD: 6.8)] and last assessment [1.9 µg/ml (SD: 8.3)] was found (p = 0.004). Cobalt (Co) levels were similar at initial [1.7 (SD: 7.7)] and last [1.8 (SD: 10.6)] follow up (p=0.78). Cr levels increased in 31% and Co increased in 46% of patients. There was a significant ion level increase (> 3 µg/ml of both Cr and Co) in 5% of patients. There was no significant difference in the change of ion levels between genders (p=0.4). Although there was no significant difference between implant designs (p = 0.07), there was a trend of higher ions being seen at last follow up in patients with the ASR implants in comparison to the BHR and the C+. Component size did not correlate with change in ion levels (p=0.4). Acetabular component orientation did not influence ion level change (p=0.46). However, a CPR distance (contact patch-rim) of <10mm was associated with an increase in Cr levels over time (p = 0.042). Patients whose ions increased at follow up had significantly lower Harris Hip Scores (p=0.038).

DISCUSSION AND CONCLUSION: The analysis of the evolution of ion levels in unilateral hip resurfacing after the run-in phase demonstrates an overall decrease of Cr levels but no significant change in Co levels. This in vivo finding is consistent with tribocorrosion studies showing the formation of a passive protective film on the articulating surfaces after the initial wear-in, preventing further corrosion. From that point on, provided there is no edge loading causing increased surface wear, ions are mainly formed by corrosion of the particulate debris generated during the run-in phase. In vitro studies have shown a higher dissolution of the more soluble Co from the debris while Cr remains in solid form with less ion formation. In a number of cases in our study, ion levels continued to increase, indicating surface wear is probably ongoing. These increasing ion levels were correlated with hip resurfacing designs with a lower coverage angle more prone to edge loading and with the development of clinical symptoms. In well-performing hip resurfacing, Cr ions are reduced with time while Co levels remain similar.

PAPER NO. 314

The Evolution of Ion Levels during Steady-state Wear in Resurfaced Hips

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INTRODUCTION: Tribological and clinical studies have described a characteristic wear pattern of metal-on-metal hip resurfacements (MoMHRAs) with a run-in period followed by a lower-wear steady-state. The duration of the run-in period varies but is found to be up to 1 million cycles in hip simulator studies. The steady-state is followed by a 'bedding-in' phase minimizing wear or by an increasing wear patch with edge loading. The use of metal ions as surrogate markers of in-vivo wear is recommended as a screening tool for the in-vivo performance of MoMHRAs. The aims of this retrospective, single-surgeon study were to measure ion levels in unilateral MoMHRAs at different stages during the steady-state in order to study the evolution of wear and describe factors affecting it.

PAPER NO. 315

High Serum Metal Ions (> 7µG/l) Cannot Be Used as an Indirect Screening Test in Metal on Metal Bearing Hip Surveillance

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INTRODUCTION: In the presence of emerging evidence about adverse reaction to metal debris (ARMD), there is an urgent need of an effective surveillance program. A threshold for further cross
section imaging in such patients based on raised serum metal ions remains an important issue due to implications of cost and resources. METHODS: A total of 209 consecutive, symptomatic unilateral hips underwent Metal Artefact Reduction Sequence (MARS) MRI scans and serology for cobalt and chromium levels between January 2009 and June 2011. RESULTS: There was wide variation in serum cobalt and chromium levels in these patients with median serum cobalt value at 4.2 µg/L (Range: 0.4 - 335.4 µg/L). Median serum chromium value was 4.9 µg/L (Range: 0.2 - 163.0 µg/L). Thirty-six (40%) MARS-MRI scans were positive for ARMD. There was significant correlation between serum cobalt and chromium levels (Correlation coefficient: 0.775). There was also significant difference in serum metal ion levels between two groups with positive and negative MARS-MRI scans for numbers available (p<0.001 and 0.001 for serum cobalt and chromium respectively, Mann Whitney U test). Compared to MARS-MRI as potential gold standard for the diagnosis of ARMD, the sensitivity of serology (>7 µg/L) for serum cobalt and chromium was 57%, specificity was 64%, positive predictor value was 52% and negative predictor value was 69% in symptomatic patients. A lowered threshold of >3.5 µg/L for serum cobalt and chromium levels improves the sensitivity and negative predictor value to 86% and 74% but at the expense of specificity (27%) and positive predictive value (44%). The receiver operating characteristic (ROC) curve analysis from our data suggests that serum cobalt and chromium cut off level of >2 µg/L would give sensitivity of 90%. To achieve 90% specificity, serum cobalt and chromium cut off levels have to be >16 µg/L and >11 µg/L respectively. DISCUSSION AND CONCLUSION: Compared to MARS MRI as potential gold standard for the diagnosis of ARMD, high serum metal ions had low sensitivity and positive predictor values; and moderate specificity and negative predictor values. We suggest that, raised metal ion serology (>7 µg/L) should not be used as a sole indirect screening test for surveillance of MoM bearings. The investigating clinician should have a low threshold for obtaining cross sectional imaging in symptomatic MoM bearing hips, even in the presence of low serum metal ions.

PAPER NO. 346

Randomized Comparison of Oxinium Versus Metal Against Conventional and Highly Cross-linked Polyethylene in THA

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INTRODUCTION: The purpose of this study was to compare the effect of femoral head material (oxinium versus metal) on polyethylene wear in two consecutive prospective randomized series of low friction total hip arthroplasty. METHODS: A total of 100 patients (mean age 60.9 years) were randomized to receive either oxinium (50 hips) or metal (50 hips) femoral head. The polyethylene socket was EtO sterilized in the first 50 patients, whereas it was highly cross-linked and remelted (XLPE) in the 50 following patients. All other parameters were identical in both groups. The primary criterion for evaluation was linear head penetration measurement using the Martell system (Hip Suite). RESULTS: Complete data were available for analysis in 44 hips (22 in each study group) at a median follow up of 4.8 years (3.0 to 5.3), and in 43 hips (22 oxinium and 21 metal) at a median follow-up of 4.0 years (2.0 to 4.7) in the EtO sterilized and XLPE series, respectively. In the EtO sterilized series, the median penetration rate was 0.25 mm/year in the oxinium group versus 0.33 mm/year in the metal group (p = 0.20). In the highly cross-linked series, the median penetration rate was 0.061 mm/year in the oxinium group versus 0.11 mm/year in the metal group (p = 0.23). Femoral head material did not significantly influence femoral head penetration in either group, whereas highly cross linked polyethylene significantly reduced penetration when compared to EtO sterilized material (median of 0.036 versus 0.288 mm/year. Mann-Whitney test, p < 0.0001). DISCUSSION AND CONCLUSION: This study demonstrated that up to five-year follow up, femoral head penetration was mainly influenced by polyethylene processing method rather than femoral head material. Although the reduction associated with oxinium in both study groups was not statistically significant, longer follow up is necessary to evaluate the clinical significance of such a reduction.

PAPER NO. 347

New Polyethlenes in Total Hip Replacement: A 10-12 Follow-up Study

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INTRODUCTION: A significant reduction in wear using highly cross-linked polyethylene (HXLPE) versus polyethylene sterilized with nitrogen (PE) at five years was described previously. We ask if the improvement observed at the earlier follow up continues at 10 years. METHODS: Between 1999 and 2001, 90 patients underwent surgery using the same cementless cup and stem: 45 had cups with PE liner and 45 with HXLPE liner, both associated with the same stem (28 mm metallic femoral head). This prospective randomized study assessed 83 patients with a minimum follow up of 10 years. The linear femoral head penetration was estimated at six weeks, at six and 12 months and then annually thereafter, using the Dorr method, given the nonspherical cup shape. All radiographs were evaluated by the same author, who was not involved in surgery. RESULTS: There was one hip in the PE group that showed proximal femoral osteolysis. There was no loosening of any prosthetic component. Femoral head penetration in the early postoperative radiographs was 0.16 mm (0.05-0.28) for the PE group and 0.08 mm (0.02-0.15) for the HXLPE group (p<0.001). The mean yearly linear femoral head penetration was 64.8% lower for the HXLPE group: 0.05 mm/year for the PE group and 0.02 mm for the HXLPE group (p<0.001). Mean linear femoral head penetration at 10 years was 61% less in the HXLPE group than in the PE group. DISCUSSION AND CONCLUSION: There is a significant reduction in yearly linear femoral head penetration with the HXLPE. Confirmation that this reduction will result in less osteolysis requires continued follow-up studies.

PAPER NO. 348

Cementless Dual Mobility Sockets in Primary THA at a Mean Seven-Year Follow Up

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INTRODUCTION: Several designs based upon the dual mobility (DM) concept have been recently FDA approved. The aim of this retrospective study was to report on the minimal five-year follow-up results of a cementless DM socket. METHODS: Between January 2000 and June 2002, 168 primary consecutive non selected THAs were performed in 92 females and 76 males. The average age at surgery was 67.3 years. A single DM socket design was used consisting of a Ti-sprayed and HA-coated CoCr shell with a highly polished inner surface articulating
with a mobile polyethylene component. The femoral head was captured in the polyethylene component using a snap-fit type mechanism, the latter acting as a large unconstrained head inside the metal cup. In 115 hips, the modular femoral head completely covered the Morse taper, whereas a long-neck option left the base of the Morse taper uncovered in the remaining 53 hips.

RESULTS: At the minimum five-year follow up, 119 patients were still alive and had not been revised at a mean of 7.2 years, four hips were revised for dislocation between the femoral head and the mobile insert (intra-prosthetic dislocation) at a mean of 5.9 years, 22 patients were deceased and 23 patients were lost to follow up. Intra-prosthetic dislocation occurred in four of the 53 hips (7.5%) with an incompletely covered Morse taper, whereas no case of dislocation was reported in the remaining 115 hips (Fisher exact probability, \( p = 0.009 \)).

DISCUSSION AND CONCLUSION: A current cementless DM socket was highly effective in the prevention of dislocation following primary THA. However, fatigue damage and wear of the mobile insert at the capturing area can lead to intra-prosthetic dislocation requiring revision. Surgeons should be aware of this specific complication and aggressive contact at the femoral neck to mobile insert articulation (“third articulation”) should be avoided.

PAPER NO. 349

RSA Study of Tantalum vs. Titanium Acetabular Shells and Crosslinked vs. Conventional Liners in Young THR Patients

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INTRODUCTION: In the active total hip replacement (THR) population, maintaining acetabular component stability and limiting polyethylene wear are crucial components to preventing premature implant failure. Titanium with fiber metal coating is among the most common materials used in cementless THR. Trabecular metal, composed of porous tantalum, has a metallic strut design resembling trabecular bone, designed to improve tissue infiltration and limit migration. It is unknown if tantalum offers an advantage over titanium in the biologic fixation of porous-coated acetabular shells. Highly cross-linked ultra high molecular weight polyethylene (UHMWPE) liners were designed to improve the durability of the weight bearing surface of total hip replacements and prevent osteolysis, which can contribute to premature implant failure. Characterization of early wear patterns of commonly available acetabular liners in active THR patients with high functional demands is needed. Radiostereometric analysis (RSA) provides highly precise measurements of femoral head penetration and micromotion at the bone-acetabular shell interface that are otherwise not detectable by routine radiographs.

METHODS: In this Institutional Review Board-approved, prospective, randomized, blinded study, 46 patients received a primary THR by a single surgeon. Each patient was randomized to receive a titanium (n=23) or tantalum (n=23) uncemented hemispheric cup and a highly cross-linked (n=25) or conventional polyethylene liner (n=21). At the time of surgery, tantalum RSA markers were implanted around the liner periphery and 12 markers were implanted into the patient’s femur and periacetabular bone. RSA examinations, Harris Hip, WOMAC and SF-12 scores were obtained at two weeks, six months and annually with the furthest patients evaluated through five years.

RESULTS: The randomized groups had comparable mean age (58 +/- 7 years), preoperative UCLA activity score (5 +/- 2) and body mass index (BMI) (30 +/- 4). In evaluating cup stability, the tantalum and titanium shells demonstrated no statistically significant difference in micro-motion at the bone-metal interface. At six months median vertical translation of tantalum and titanium was -0.01mm and 0.044mm respectively, and reMed stable with median translation of -0.02mm and 0.044mm at four years. Evaluation of polyethylene wear demonstrated statistically significant less femoral head penetration in the highly crosslinked UHMWPE liners compared to the conventional group through five years. At one year the femoral head penetration was 0.06mm for the highly crosslinked UHMWPE and 0.16mm for the conventional liner. This difference reMed at two years (0.08mm vs. 0.12mm), three years (0.03mm vs. 0.32mm) and four years (0.08mm vs. 0.34mm) (p<0.01 all four years). Mean UCLA, WOMAC, Harris Hip and SF-12 scores improved similarly in both groups.

DISCUSSION AND CONCLUSIONS: Following THR, both cohorts of patients have excellent clinical outcomes with statistically significant improvements in function and pain relief with no significant difference between the two groups. The femoral head penetration rates were highest for both groups of liners in the first six months, consistent with the “bedding-in” period. Thereafter, the femoral head penetration was statistically significantly less in the cross-linked UHMWPE liners from one year through five years of follow up. Highly cross-linked polyethylene liners are therefore more capable of withstanding wear than conventional UHMWPE liners. There was no statistically significant differences in shell migration between the titanium and tantalum shells with both shells demonstrating excellent stability at the bone-metal interface and exhibiting minimal micromotion at five years follow up.

PAPER NO. 350

Long-term Comparative Survivorship of Uncemented Acetabular Components in Revision Total Hip Arthroplasty

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David G. Lewallen, MD, Rochester, MN

INTRODUCTION: It is unknown whether there are differences in long-term effectiveness of different types of uncemented acetabular components in revision total hip arthroplasty (THA). The purpose of this study was to compare the survivorship of historical and current uncemented acetabular components following revision THA. METHODS: The study population included 3,236 patients with 3,448 revision THA procedures with an uncemented acetabular component performed at a large U.S. medical center between 1/1/1984 and 12/31/2004. Patients were actively followed up at regular intervals to ascertain details of subsequent revision surgeries, including cup (metal shell plus liner) and liner only revisions. Overall and cause-specific (aseptic...
loosening, wear/osteolysis, infection, instability) survival of 10 different acetabular components was compared using Cox proportional hazards regression models adjusting for age and sex.

RESULTS: A total of 605 re-revisions, including 386 cup revisions were performed, corresponding to overall survival of 69% (CI: 67%, 72%) at 15 years. In comparison to titanium wire mesh designs, cup revisions for aseptic loosening were significantly more common with the beaded (HR 2.01, 95% CI: 1.44, 2.80) designs, but less common with trabecular metal designs (HR 0.25, 95% CI: 0.06, 1.04). There were no liner revisions for wear or osteolysis over a median 5.2 years of follow-up of 534 THA surgeries with crosslinked polyethylene liners, resulting in a significantly lower risk of wear-related revisions with crosslinked polyethylene than with conventional liners. Head size and use of elevated liners were not associated with the risk of re-revisions.

DISCUSSION AND CONCLUSIONS: In the setting of revision THA, cup survival is worse with beaded acetabular designs than with titanium wire mesh or highly porous designs. Crosslinked polyethylene liners are associated with a reduced risk for wear-related liner revisions.

INTRODUCTION: Large wear rate reductions have been shown for crosslinked polyethylene (PE) in simulators and short- to mid-term clinical wear studies. However, concerns persist about a) long-term in-vivo oxidation (especially with annealed PE), b) late accelerating wear due to degradation and c) the possibly higher osteolytic potential of its wear debris was not deteriorate but increased. Also with Duration PE, the incidence of acetabular osteolysis (cysts) on the AP x-ray were less frequent in the Duration (9/27= 33%) than in conventional group (24/34= 71%, p<0.01). Only in the conventional group, one revision was performed (cup for wear). Total wear, wear rates, reductions and signs of osteolysis were similar for both centers.

DISCUSSION AND CONCLUSIONS: At long-term FU the annual wear rate of Duration did not increase but in fact it decreased so that the wear relative reduction over conventional (now 'historic') PE did not deteriorate but increased. Also with Duration PE, the incidence of osteolysis was significantly less. Thus no clinical evidence of PE degradation or the elevated osteolytic potential of its wear debris was found for this first generation moderately crosslinked and annealed PE at 13yrs in-vivo. References [1] Geerdink et al. JBJS-B 2008 Jul;90(7):839-46 [2] http://www.eors.info/WearRomanManual. pdf [3] Geerdink et al. Acta Orthop. 2006 Oct;77(5):719-25

PAPER NO. 352
The Implant Designer Series: Are These Favorable Results Believable?
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INTRODUCTION: The performance of hip and knee implants as reported by the designing surgeon or center is often felt to be more optimistic than those observed in the orthopaedic community at large. With the maturation of several national joint registries, these reported results can be compared to the experience of large numbers of surgeons. The purpose of this study is to compare the survivorship results of different hip and knee arthroplasty prostheses in case series reported by the designing

For full information refer to page 14. An alphabetical faculty financial disclosure list can be found starting on page 19.
surgeon or center with those reported in national joint registries and to investigate any potential patterns within a reported series that may lead towards a discrepancy with national registry data. METHODS: Reported results of 16 different hip and knee arthroplasty implants published by the designers of that implant were identified and compared to results in four national registries (Swedish, Australian, New Zealand, England/Wales). The time to follow up between the reports and registries was normalized. Revision for any reason was considered a failure. Specifics of each study design (number of patients, surgeons, centers, etc.) were compared to identify factors that led to higher correlation with registries. RESULTS: The study results of 11 hip implants were compared to 28 registry reports and five knee implants to 12 registry reports. Three of 16 (19%) implants performed worse in three of the four registries compared to the published study. Two implants performed worse in one of the four registries. In addition, two implants performed better in the registries than in the published study. There did not appear to be any consistent predictors of correlation. There were many implants that did not have comparable data in the registries for comparison. DISCUSSION AND CONCLUSIONS: Contrary to popularly held beliefs, reported results by the designers of an implant seem to correlate favorably with the results of large numbers of surgeons.

PAPER NO. 353

Ten to 15 Year Clinical and Radiographic Results for a Compression Molded Monoblock Elliptical Acetabular Component

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INTRODUCTION: Polyethylene wear rates correlate with osteolysis. Modular acetabular components may fail because of backside polyethylene wear or liner/shell dissociation. A monoblock acetabular component avoids these problems, and we report the long-term results from previously published midterm follow up. METHODS: A total of 258 primary total hip arthroplasties (212 patients) with a titanium monoblock, elliptical acetabular component, performed by one surgeon, were followed up for a mean period of 11.1 years (range, 10-15 years) (table 1). Radiographs were scanned, digitized and examined for acetabular osteolysis. Wear rates were determined with the Martell hip analysis software. RESULTS: Average yearly wear rate was 0.08 mm/yr (range, 0.0009-0.32 mm/yr) (table 2). Acetabular radiolucencies were present in six hips (2.4%). All radioluencies were non-progressive, and were present in acetabular zone I. Acetabular osteolysis was present in five patients (five hips, 1.9%); all cups were stable. Four acetabular components were revised, all for recurrent instability; no acetabular components were revised for polyethylene wear or dissociation, acetabular osteolysis, loosening or deep infection. Three femoral components were revised due to aseptic loosening. DISCUSSION AND CONCLUSION: The monoblock titanium porous coated acetabular component has a very low complication rate at minimum 10 years follow up. Furthermore, it is associated with the lowest polyethylene wear rate reported in the current literature, and a very low incidence of acetabular osteolysis, thus demonstrating excellent long term survival.

Table 1. Patient demographics

| Mean age at surgery, y (range) | 61.2 (29-87) |
| M/F | 79/133 |
| Mean follow-up, y (range) | 11.1 (10-15) |
| BMI, (range) | 26.2 (17.7 - 37.7) |
| Diagnosis | Osteoarthritis, 200; avascular necrosis, 19; rheumatoid arthritis, 10; other, 29 |
| Mean annual wear rate, mm/y (range) | 0.08 (0.0009 - 0.32) |

Table 2. Annual wear rates and incidence of acetabular osteolysis for different noncemented acetabular components.

<table>
<thead>
<tr>
<th>Investigator</th>
<th>THA Acetabular Component Type</th>
<th>Mean follow-up, years (range)</th>
<th>Acetabular Annual Wear Rate, mm/y (range or SD)</th>
<th>Incidence of Acetabular Osteolysis (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present study</td>
<td>Monoblock Elliptical (Impax, Allendale, NJ)</td>
<td>11.1 (10-15)</td>
<td>0.08 (0.0009 - 0.32)</td>
<td>1.9</td>
</tr>
<tr>
<td>Mayman et al [JOA 2007, previous study]</td>
<td>Monoblock Elliptical (Impax, Allendale, NJ)</td>
<td>7.2 (5-9)</td>
<td>0.079 (0-0.31)</td>
<td>0</td>
</tr>
<tr>
<td>Young et al [JBJS Am 2002]</td>
<td>Monoblock Porous-coated (DePuy, Warsaw, IN)</td>
<td>5.3 (3.8-6.8)</td>
<td>0.11 (±0.13)</td>
<td>0</td>
</tr>
<tr>
<td>Delta Valle et al [JBJS Am 2003]</td>
<td>Modular Trilogy (Zimmer, Warsaw, IN)</td>
<td>5.3 (4-7)</td>
<td>0.09 (0-0.45)</td>
<td>1.7</td>
</tr>
<tr>
<td>Chen et al [CORR 2006]</td>
<td>Modular Hemispheric Duraloc (DePuy, Warsaw, Ind)</td>
<td>6.8 (5-8.2)</td>
<td>0.10 (±0.14)</td>
<td>2.2</td>
</tr>
<tr>
<td>Ito et al [CORR 2004]</td>
<td>Modular Omnifit PSL(Howmedica Osteonics,Allendale, NJ)</td>
<td>8.5 (5.2-12.1)</td>
<td>0.18 (0.02-0.42)</td>
<td>5</td>
</tr>
<tr>
<td>Kim et al [JBJS Am 2003]</td>
<td>Modular Hemispheric Duraloc (DePuy, Warsaw, Ind)</td>
<td>9.8 (8-11)</td>
<td>0.12 (0.01-0.24)</td>
<td>9</td>
</tr>
<tr>
<td>Udomkiat et al [JBJS Am 2002]</td>
<td>Modular Anatomic Porous Replacement (APR, Sulzer Orthopaedics, Austin, Tex)</td>
<td>10.2 (7-11.9)</td>
<td>0.16 (±0.13)</td>
<td>3.6</td>
</tr>
<tr>
<td>Young et al [JBJS Am 2002]</td>
<td>Modular Hemispheric Duraloc (DePuy, Warsaw, Ind)</td>
<td>5.5 (3.8-8)</td>
<td>0.16 (±0.08)</td>
<td>5</td>
</tr>
<tr>
<td>Archibeck et al [JBJS Am 2001]</td>
<td>Modular Hemispheric Harris-Galante II (Zimmer, Warsaw, Ind)</td>
<td>10 (8-11)</td>
<td>0.16 (0-0.47)</td>
<td>16</td>
</tr>
<tr>
<td>Barrack et al [CORR 1997]</td>
<td>Modular Hemispheric (CoCr) Long-term Stable Fixation (LSF, Implant Technology, Secaucus,NJ)</td>
<td>6 (5-8)</td>
<td>0.10 (0-0.5)</td>
<td>11</td>
</tr>
<tr>
<td>Crowther et al [JBJS Am 2002]</td>
<td>Modular Harris-Galante I (Zimmer, Warsaw, IN)</td>
<td>11 (9-14)</td>
<td>0.15 (0.02-0.59)</td>
<td>23</td>
</tr>
</tbody>
</table>

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PAPER NO. 354

Prospective Randomized Multicentre Study of a “New” Approach to MIS THA: Stem Subsidence an Issue

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INTRODUCTION: This study examined the potential superiority of a “new” intermuscular surgical approach to limited incision total hip replacement (THR).

METHODS: After a learning curve which included a hands-on course and a combined number of 95 cases (minimum 10 per surgeon), five subspecialized hip surgeons, at three academic centers, participated in the study of a “new” anterolateral minimally invasive (MIS) approach to THR. It was a multicenter, prospective, randomized trial, comparing it to the “standard” limited incision approaches already in use (direct lateral or posterolateral).

Cup and stem alignment were satisfactory with the new approach in all cases. There were no differences in stem migration or subsidence. Two patients developed aseptic femoral loosening, requiring revision surgery at 26 months (p = 0.02 and 0.06). Similarly, the incidence of early infection was slightly lower with the new MIS approach, with a single episode at 24 months in the MIS cohort (p = 0.06).

DISCUSSION AND CONCLUSION: We reject our hypothesis that the new anterolateral MIS approach will demonstrate superiority with the “new” MIS approach. The study failed to demonstrate superiority with the new MIS approach. There were no differences in stem migration or subsidence. Two patients developed aseptic femoral loosening, requiring revision surgery at 26 months. The incidence of early infection was slightly lower with the new MIS approach.

PAPER NO. 355

Retrieval Analysis on the Effects of Head Size on Performance of Crosslinked Polyethylene for Total Hip Replacement

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INTRODUCTION: Larger diameter femoral heads provide increased stability and range of motion. However, due to increased surface area, larger heads also increase the risk of polyethylene wear. Highly crosslinked polyethylenes (HXLPEs) were introduced in total hip arthroplasty more than a decade ago to improve wear resistance. There is consensus in the literature that these materials show improved wear in vivo and significantly reduce osteolysis. Due to the increased wear performance of HXLPEs, heads larger than 32 mm are now widely used. The goal of this prospective multicenter retrieval study was to investigate the wear performance of HXLPEs coupled with standard heads (≤28mm) and large heads (≥32mm). We hypothesized that the large heads would have greater femoral penetration rates than the standard heads.

METHODS: Consecutively retrieved liners (n=376) were collected during revision surgeries at seven surgical centers and continuously analyzed over the past 10 years in a prospective, multicenter study of THA revision and retrieval analysis. Loosening, infection and instability were the primary reasons for revision for both the ≤28mm heads and the ≥32mm heads (p<0.2). Of these, 219 articulated against a large femoral head (≥32mm), while 158 articulated against standard heads (≤28mm). The femoral heads articulated against five polyethylene formulations: 25 liners were sterilized using non-ionizing methods (Gas Sterilized-control; Implanted 8.1±3.5 years), 46 liners were sterilized in an inert environment (Gamma Inert-control; Implanted 6.2±3.8 years), 177 were highly crosslinked and remelted (Remelted; Implanted 1.8±2.1 years), 83 were highly crosslinked and annealed (Annealed one; Implanted 3.7±2.8 years), and 45 were highly crosslinked and annealed in three sequential steps (Annealed two; Implanted 1.2±0.9 years). Femoral penetration was assessed using a calibrated micrometer (accuracy = 0.001 mm). We excluded liners that were in vivo for less than one year, where creep is expected to be dominant. The control groups had limited numbers of large heads (n = 1 and 2; in the Gamma Inert and Gamma Inert, respectively), while the annealed cohort had only one standard head, thus they were eliminated from the head size analysis.

RESULTS: Penetration rates were dependent upon polyethylene formulation with the gas sterilized and Gamma Inert groups having the highest penetration rates (p≤0.005). Femoral head penetration rates were similar among the three different highly crosslinked polyethylene formulations (p>0.05). In the first generation highly crosslinked groups, femoral head penetration rates were similar between the large diameter heads and the standard heads (p<0.29).

DISCUSSION AND CONCLUSION: We reject our hypothesis that larger heads would have increased penetration rates as compared to 28mm head sizes. In fact, the HXLPE formulation was the most important factor in determining femoral head penetration rates. This supports the safety of use of larger femoral heads with highly crosslinked polyethylene. This study is limited by insufficient power (power = 0.25) and because we only measured linear penetration into the liner, not volumetric penetration. Larger head sizes that have similar linear penetrations should generate larger wear volumes. Further studies using volumetric methods are warranted to investigate the effects of larger head sizes.
Long-Term (20-25 Year) Results of an Uncemented Tapered Femoral Stem and Factors Affecting Survivorship

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Moritz Innmann, MD, Heidelberg, Germany
Tobias Gotterbarm, MD, Heidelberg, Germany
Peter Aldinger, MD, Stuttgart, Germany

INTRODUCTION: Excellent intermediate-term results with use of uncemented tapered femoral components in primary total hip arthroplasty have been reported. Little is known about factors that influence the survival of uncemented stems in the long-term. Therefore we report the minimum 20-year (mean, 22 years; range, 20-25 years) results and analyzed the independent effects of several factors on the long-term survivorship.

METHODS: We retrospectively evaluated the clinical and radiographic results of a consecutive series of 354 total hip arthroplasties using an uncemented grit-blasted, tapered femoral stem in 326 patients. Mean time of follow-up evaluation was 22 years (range, 20-25 years), mean age at surgery was 57 years (range, 13-81 years). Kaplan-Meier survivorship analysis was used to determine long-term survival rates for different end points. Multivariate survivorship analysis using Cox’s regression model was performed with an end point of aseptic loosening of the femoral component for the risk factors age (continuous variable), male gender, diagnosis, canal fill index (CFI) <80%, type of acetabular component and cup revision.

RESULTS: At final follow up, 126 patients (136 hips) had died, and four patients (five hips) were lost to follow up. Forty-two hips (12%) underwent femoral revision - 10 (3%) for infection, 12 (3%) for late periprosthetic fracture due to trauma, and 20 (6%) for aseptic loosening of the stem. Kaplan-Meier analysis, with revision of the femoral component for any reason as the end point, revealed that the survival rate at 22 years was 85% (95%-confidence limits, 80%-89%). The survival rate with femoral revision for aseptic loosening as the end point was 93% at 22 years (95%-confidence limits, 89% - 96%). No femoral component showed radiographic evidence of definite loosening. Osteolysis was limited to Gruen zones 1 (8%, Ø 1.44 cm²) and 7 (13%, Ø 0.97 cm²). Undersized stems (CFI <80%) and stems after previous cup revision were at higher risk for aseptic loosening (relative risk 4.2 (p<0.01) and 4.3 (p=0.02), respectively). Age at time of surgery (p=0.91), male gender (p=0.42), type of acetabular component (p=0.88) and diagnosis (p=0.96) had no significant influence on the risk of long-term aseptic loosening in this cohort.

DISCUSSION AND CONCLUSION: The long-term results with this type of uncemented femoral component are encouraging and compare to the best reported series in primary cemented total hip arthroplasty. Young age and male gender were not associated with a higher risk of aseptic loosening in the long term.

A Study of Taper Corrosion in 111 Current Generation Large Diameter Metal-on-Metal Hip Components

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John Skinner, FRCS, London, United Kingdom
Johann Henckel, BM, London, United Kingdom
Gordon W. Blunn, MD, Middlesex, United Kingdom
Ferdinand Lali, PhD
Ashley Matthies, BSc, London, United Kingdom

INTRODUCTION: In 2009 it was reported that 35% of all hips in the United States were large diameter head metal-on-metal total hip replacements (LHMoM THR). However, there are several recent reports of unacceptably high rates of failure of this type of hip: up to 49% at five years that have been attributed to corroded taper junctions. There are no studies that have quantified the corrosion of the taper junctions from current generation MoM hips. We aimed to characterize the taper junctions from the three most commonly used LHMoM THRs and investigate the influence of design and femoral diameter.

METHODS: Corrosion was qualitatively assessed for 111 components of three different designs; the ASR XL (DePuy), the BHR (Smith and Nephew) and Durom (Zimmer) devices. A peer-reviewed qualitative grading system was used. An unexpected finding was a ridged appearance on most female taper surfaces, which corresponded with the ridges of the trunnion surface. A subjective grading system was devised to quantify this imprinting phenomena.

RESULTS: We found that 92% of components were corroded to some extent with at least moderate corrosion observed in 61%. There was no significant difference in corrosion between the different manufacturers both in terms of the head components (p=0.52) and trunnions (p=0.20). Increasing head size showed a weak but significant positive correlation with corrosion (r=0.241, p=0.02). The imprinting scores and corrosion scores showed a strong and significant positive correlation (r=0.776, p=0.01).

DISCUSSION AND CONCLUSION: Corrosion was not manufacturer dependent, with no difference observed between the ASR XL device and other hip types. An unexpected finding was that the corrosion was strongly associated with the presence of ridges on the female taper surface. We believe the rough surface of the trunnion is causing considerable mechanical wear at the female taper surface and creating an aggressive corrosive environment. Larger head diameters experienced greater corrosion, which is of clinical significance given the evolution towards larger femoral head sizes. We recommend review of the use of ridged trunnions in combination with cobalt-chrome head components and believe large head diameters should be used with caution until greater understanding of the mechanical forces on the head-trunnion junction is achieved.
The FDA has not cleared the drug and/or medical device for the use described in this presentation (i.e. the drug or medical device is being discussed for an off label use).

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INTRODUCTION: Large femoral head sizes provide an increased range of motion, decreased implant impingement and protection against dislocation. However, increased wear with large diameter femoral heads against ultra-high molecular weight polyethylene (UHMWPE), necessitated the use of femoral heads of 32 mm diameter or less. The introduction of highly cross-linked polyethylene (HXLPE) has shown improvement in wear performance. This study combines data from three centers to determine if the wear rates of HXLPE depend on head size.

METHODS: We identified 487 patients (534 hips) who underwent primary total hip arthroplasty (THA) with radiographic follow up at a minimum of five years. Martell Hip Analysis Suite was used to analyze all pelvic radiographs resulting in head penetration values. Linear and volumetric wear rates were calculated by dividing the head penetration between the longest follow up and the one-year film. Wear rates for the standard head sizes (28-32 mm) and large head sizes (36 mm) were compared using a Mann-Whitney U Test. A second analysis method used a group regression to calculate the slope of the head penetration rates for the different head sizes. The slopes were compared using a Zar test.

RESULTS: Radiographic follow up was gathered for THAs using standard and large head sizes (238 hips and 296 hips). Standard head sizes include 130 hips with 28 mm femoral heads and 108 hips with 32 mm femoral heads, while large head sizes included 296 hips with 36 mm femoral heads. At longest follow up, there was a significant difference in linear head penetration rates between the standard and large head sizes (17.0 ± 9.2 µm/year and 76.0 ± 16.7 µm/year, respectively, p<0.00005). There was also a significant difference in volumetric head penetration rates between standard and large head sizes (8.79 ± 2.72 mm³/year and 51.8 ± 8.19 mm³/year, respectively, p<0.00005). By the group regression, the slope of the regression line for standard head sizes was 3.7 µm/year and for large head sizes was 26.7 µm/year. There was not a significant difference between these linear penetration rates (p=0.19). For volumetric head penetration rates by the group regression, there was no significant difference (p=0.51) between standard and large heads (2.0 mm³/year and 15.2 mm³/year, respectively).

DISCUSSION AND CONCLUSION: The differing statistical analysis for significant differences among the various methods for calculating wear rates makes interpretation difficult. While penetration rates should be lower with larger femoral heads, it is important to note that the magnitude of penetration and volumetric wear rates are much lower than reported for conventional polyethylene and there have been no reported cases of osteolysis with the use of large heads with highly cross-linked polyethylene. Further studies of the creep behavior of this material, further analysis of the direction of wear and volumetric calculations and further clinical follow up is required.

### TABLE 1: Details of the components used in this study

<table>
<thead>
<tr>
<th>Detail</th>
<th>ASR</th>
<th>BHR</th>
<th>Duram</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of components</td>
<td>59</td>
<td>28</td>
<td>24</td>
</tr>
<tr>
<td>Head components</td>
<td>52</td>
<td>19</td>
<td>18</td>
</tr>
<tr>
<td>CoCrMo taper sleeve adapter used</td>
<td>52</td>
<td>19</td>
<td>18</td>
</tr>
<tr>
<td>No taper sleeve adapter</td>
<td>6</td>
<td>14</td>
<td>2</td>
</tr>
<tr>
<td>Head-Stem material combination</td>
<td>52</td>
<td>21</td>
<td>13</td>
</tr>
<tr>
<td>CoCrMo head - Ti6Al4V stem</td>
<td>41</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>CoCrMo head - CoCrMo stem</td>
<td>41</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>Patient Demographics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>19</td>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td>Female</td>
<td>32</td>
<td>9</td>
<td>13</td>
</tr>
<tr>
<td>Mean patient age in years (range)</td>
<td>48.6 (23-70)</td>
<td>57.6 (40-70)</td>
<td>50.5 (41-79)</td>
</tr>
<tr>
<td>Mean months implanted (range)</td>
<td>51.7 (12-72)</td>
<td>43.4 (13-99)</td>
<td>30.8 (6-102)</td>
</tr>
<tr>
<td>Median head diameter in mm (range)</td>
<td>47 (38-65)</td>
<td>55 (38-84)</td>
<td>45 (28-64)</td>
</tr>
<tr>
<td>Cause of failure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aseptic Loosening (femoral)</td>
<td>10</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Aseptic Loosening (acetabular)</td>
<td>2</td>
<td>2</td>
<td>2</td>
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<tr>
<td>Infection</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Unexplained pain</td>
<td>21</td>
<td>10</td>
<td>7</td>
</tr>
</tbody>
</table>

*Articular Surface Replacement (Deltaplate): Burring type Hip Resurfacing (Smith and Nephew); Duram (Zimmer)
† There was insufficient information to reliably define the material combination in 10 cases
‡ Gender was not provided by the institution in 1 case
†† There was insufficient information to reliably define the cause of failure in 16 cases

**FIGURE 1. Conservative Corrosion and Imprinting Scores**

<table>
<thead>
<tr>
<th>Comparison between ASR and non-ASR</th>
<th>P value</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrosion</td>
<td>0.523</td>
<td>No statistical significant difference</td>
</tr>
<tr>
<td>Imprinting</td>
<td>0.891</td>
<td>No statistical significant difference</td>
</tr>
</tbody>
</table>
**INTRODUCTION:** Hip resurfacing arthroplasty (HRA) has gained popularity during the last decade in treatment of symptomatic hip osteoarthritis (OA) in young and active patients. Advocates of hip resurfacing believe it has several theoretical advantages: bone stock preservation on the femoral side, more physiological loading of the proximal femur, a low risk of dislocation due to large head and an easier revision operation than with conventional total hip arthroplasty (THA). Most of these advantages of hip resurfacing are theoretical and evidence from clinical trials is still lacking.

**METHODS:** We randomized prospectively 152 consecutive patients (92 males, 60 females) aged 60 years of age or less undergoing surgery for severe hip OA in three university hospitals to either cementless large diameter metal-on-metal THA or HRA. Clinical, radiological and functional outcome was assessed pre-operatively, at three months, at one and two years.

**RESULTS:** Between RHA and THA groups there were no difference in Harris hip score preoperatively (62.7 (SD, 14.2) vs. 60.1 (SD, 11.4) (ns)) or at the final follow up (96.3 (SD, 8.8) vs. 97.8 (SD, 4.5)) (ns). Corresponding numbers of UCLA activity score were preoperatively 5.7 (SD 1.5) and 5.2 (SD 1.7) (ns) and postoperatively 7.2 (SD 1.5) and 6.7 (SD 1.6) (ns) for RHA and THA groups respectively.

**DISCUSSION AND CONCLUSION:** Outcome after large diameter THA and RHA was similar in this prospective randomized controlled trial. It is unclear if HRA have any benefits over conventional cementless large diameter THA.

**The Use of Femoral Stems with Modular Necks in Total Hip Replacement Increases the Risk of Revision**

**INTRODUCTION:** Femoral stems with modular (exchangeable) necks were introduced to enable surgeons to have increased choice with respect to determining femoral neck version, offset and length during total hip arthroplasty (THA). It was hoped that this would reduce complications in particular dislocation. There has, however, been little published on the impact of introducing this new technology.

**METHODS:** The data was obtained from a comprehensive national database that prospectively recorded procedures using a range of prostheses with exchangeable femoral necks. Only procedures with a primary diagnosis of osteoarthritis were included. Analyses were undertaken to examine the impact of age, gender, articulation bearing and the type of prosthesis used. The reasons for revision were also determined. The principal outcome measure was time to first revision using Kaplan-Meier estimates of survivorship. The principal outcome measure was time to first revision using Kaplan-Meier estimates of survivorship.

**RESULTS:** The average blood levels of cobalt were 28.7 µg/L preoperatively and 6.4 µg/L postoperatively (p=0.004). The average blood levels of chromium were 16.9 µg/L preoperatively and 12.2 µg/L postoperatively (p=0.009). Following revision, levels of both cobalt and chromium were decreased in all patients. The concentration of cobalt decreased greater than that of chromium.

**DISCUSSION AND CONCLUSION:** The use of femoral stems with exchangeable necks in routine primary THA increases the rate of revision by at least two fold. This appears to be true for all prostheses with longer than three years follow up.
levels decreased more than chromium levels in both groups. Serum metal ion levels decreased rapidly following the conversion of MOM to MOP THA. The significance of cobalt declining more rapidly in both groups remains to be determined. Longer follow up is warranted in order to evaluate the clearance of serum cobalt and chromium ions following conversion of MOM to MOP THA.

PAPER NO. 557

Metal Ion Levels after Revision of Large Head Metal-on-Metal Hip Replacements with Abnormal Wear

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INTRODUCTION: Cobalt and chromium metal ion levels significantly decrease after revision of an abnormally wearing metal-on-metal hip replacement (patients with metal ion levels above 7µg/L). There have been recent concerns regarding high metal ion levels and adverse reaction to metal debris (ARMD) in patients with metal-on-metal (MOM) hip replacements. Both the Medicines and Healthcare products Regulatory Agency (MHRA) in the United Kingdom and the Food and Drug Administration (FDA) in the United States released warnings, and metal ion testing has been recommended to monitor patients with MOM hip replacements. Studies have shown metal ions to correlate with component wear, and can be used as a diagnostic tool for monitoring bearing wear. High metal ions have been associated with the presence of pseudotumors, gross metallosis, and reports of cobalt toxicity have been reported. Currently, it is unknown whether revising patients with high metal ions and its associated problems return to normal after revision.

METHODS: Twenty-eight patients with large-head MOM hip replacements (average femoral size 44mm) were included in the study. The study cohort included 24 female and four male patients, whose metal ion levels were above 7µg/L in at least one blood fraction. The 7µg/L was chosen as the cut-off, as this was the suggested level by the MHRA where the patient may have problems associated with abnormal wear. There were 21 unilateral patients and seven bilateral MOM patients. Eleven were total hip replacements and 17 were hip resurfacings. Serum and whole blood metal ion levels were taken pre-revision and post-revision. Statistical analysis was performed using SPSS.

RESULTS: Cobalt and chromium in both serum and whole blood decreased significantly post-revision (table 1) (all p<0.0001) after an average time of 4.3 months post-revision (range: 1-41mos). Pre-revision metal ion levels significantly correlated with the rate of cobalt and chromium ion level decrease in all blood fractions (all p<0.0001). Whole blood cobalt decreased significantly faster compared to whole blood chromium (p=0.03); however, there was no significant difference in the rate of change between serum cobalt and chromium (p=0.24).

Table 1.

<table>
<thead>
<tr>
<th></th>
<th>pre revision</th>
<th>post revision</th>
<th>% change</th>
<th>rate of change</th>
</tr>
</thead>
<tbody>
<tr>
<td>serum Cr</td>
<td>43.4µg/L (5.6-115)</td>
<td>9.5µg/L (3.3-41.5)</td>
<td>65.70%</td>
<td>5.6µg/L/month</td>
</tr>
<tr>
<td>whole blood Cr</td>
<td>30.6µg/L (7.7-75.5)</td>
<td>8.48µg/L (4.3-28.8)</td>
<td>59.50%</td>
<td>3.5µg/L/month</td>
</tr>
</tbody>
</table>

DISCUSSION AND CONCLUSION: Metal ion levels come down relatively quickly after revision of a malfunctioning implant, especially if metal ion levels are high. This is consistent with reports in the literature where symptoms associated with elevated metal ions subsided after removal of the metal implant prosthesis, but this is the first to report on large group of large-head (>36mm) MOM prosthesis.

PAPER NO. 558

Are Metal Ion Levels a Useful Trigger for Surgical Intervention?

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INTRODUCTION: Adverse local tissue reactions have been reported with a variety of metal on metal (MOM) implants. These reactions range from metallic staining of tissues to pseudotumors with periarticular necrosis. It has been suggested that metal ion levels may have prognostic value in determining timing or need for surgical intervention. The British Orthopedic Association’s alert concerning MOM implants chose ion levels of 7ppb as a threshold for concern. The purpose of this study was to determine if cobalt and chromium ion levels can predict soft tissue damage at the time of revision.

METHODS: This study included patients undergoing revision of a MOM hip and who had pre-operative Co and Cr ion levels. Tissue damage noted at the time of revision surgery was graded on a four-point scale. Damage scores were compared to ion levels and time in situ independently and in combination to determine a time/dose correlation. The data were also analyzed to determine an ion level threshold that could serve as a trigger for surgical intervention.

RESULTS: Eighty-four patients had Co and Cr ion levels obtained prior to revision of a symptomatic MOM hip. Ion levels ranged from 0.8-236ppb for Co, and 0-112ppb for Cr. There was a trend toward higher ion levels in cases with more severe tissue damage (Co p=0.50, Cr p=0.99). Both Co and Cr ion levels had poor sensitivity and specificity values as predictors of soft tissue damage (Co- 60%, 62%; Cr- 36%, 80%). The positive predictive values for intervention. The British Orthopedic Association’s alert concerning MOM implants chose ion levels of 7ppb as a threshold for concern. The purpose of this study was to determine if cobalt and chromium ion levels can predict soft tissue damage at the time of revision.

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REFERENCES:

*all values reported are medians

For full information refer to page 14. An alphabetical faculty financial disclosure list can be found starting on page 19.
Survivorship and Revision Analysis Among Primary Metal on Metal Total Hip Arthroplasty Using 36 mm Diameter Heads

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INTRODUCTION: It has been estimated that 35% of total hip arthroplasty (THA) in the United States during the last decade used metal on metal (MOM) bearings. However, there has been a sharp decline in its use recently due to implant recalls, FDA surveillance and increasing reports of adverse local tissue reactions (ALTR) which can present with elevated ion levels, soft tissue/muscle damage, large fluid collections around the hip and pseudotumors. We report on the survivorship and reasons for revision among MOM bearings using a 36 mm head.

METHODS: We reviewed our institutional database and performed 1,073 THAs using 36 mm MOM bearings since 2001. We collected data on patient demographics, presence of osteolysis, dislocation rates and reason for revision. From this we calculated survivorship curves.

RESULTS: The follow up averaged 3.4 years with 24% of patients having > five years follow up and 1% deceased. The average age was 55.1 years with a body mass index of 28.9. Males accounted for 50% of the patients. Osteoarthritis was the primary diagnosis in 83% of patients. The survivorship at three years with revision as the end point was 98.6% and with reason secondary to ALTR the rate was 99.5%. At six years, the survivorship rate was 96.7% and 97.7% respectively. There were 21 (2%) revision surgeries with 13/21 (62%) secondary to an ALTR. The remaining revisions were for infection (2/21), aseptic loosening (5/21) and stem fracture (1/21). Osteolysis was present in 30 (2.8%) patients, 27 had femoral lysis and three had pelvic lysis. There were seven dislocations with a mean time to dislocation of 1.58 years. The dislocation rate was 0.65% and none of these patients required revision surgery. In this series, the incidence of ALTR was 1.21% and the mean time to revision secondary to ALTR was 5.1 years.

DISCUSSION AND CONCLUSION: The 36 mm MOM THA demonstrated good early survivorship with reoperations for dislocation reduced. Osteolysis was not eliminated with this bearing and over 60% of the revisions were MOM bearing complications secondary to the presence of an ALTR. Given the preponderance of early revisions secondary to metal bearing complications and the absence of these types of revisions with cross-linked polyethylene bearings, we no longer recommend the use of metal bearings in THA.

Cementless Acetabular Component Revision at Minimum 20-year Follow Up: Are We Improving Versus Cemented Fixation?

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INTRODUCTION: Loosening of the acetabular component has been the long-term problem associated with cemented revision total hip replacement. The authors evaluated the results of a consecutive non-selected series of revision cementless acetabular components and compared these results to the same surgeon’s consecutive non-selected series of cemented revision acetabular components at a comparable minimum 20-year follow up to determine whether cementless fixation was more durable than cemented fixation.

METHODS: Sixty-one consecutive non-selected revision total hip replacements were performed using a single cementless acetabular component and a cemented femoral component, and followed for a minimum of 20 years. These results were compared to a consecutive non-selected revision series of 83 hips performed by the same surgeon using all cemented components and followed for a minimum of 20 years. Hips were evaluated for revision related to loosening or wear, and radiographic evidence of loosening.

RESULTS: At minimum 20-year follow up, the prevalence of revision of the acetabular component for aseptic loosening was 0% in the cementless group and 18% in the cemented group (p = 0.0003). The radiographic loosening prevalence was 3.3% in the cementless group and 32% in the cemented group (p = 0.0001). In the cementless group, 11.5% required reoperation for wear of the liner (average wear 0.18 mm/yr in the revised group) and the overall linear wear rate was 0.09 mm/yr for all cases.

DISCUSSION AND CONCLUSION: This study demonstrates a marked improvement with cementless fixation compared to cemented fixation on the acetabular side of the construct in revision total hip replacement at minimum 20-year follow up.

Causes of Revision of Hip Resurfacings from a European Specialist Independent Center

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INTRODUCTION: Metal-on-metal hip resurfacing arthroplasty (HRA) has been used in increasing numbers to treat hip pathologies in young and active patients. The reasons for HRA revision have evolved with improving surgical experience and techniques. The aim of this study was to investigate the causes of failure and the operative findings in all consecutive HRA revisions performed at an independent specialist center.

METHODS: Since 2001, 113 consecutive HRA revisions were performed in 110 patients. Forty-three primary surgeries were done at our center (43/113, revision rate: 1.3%), the remaining elsewhere. Eight different HRA designs were revised mainly in females (60%). The mean time to revision was 31 months (0-101). Ion levels were used as diagnostic tool since 2006. Components’ orientation was measured from radiographs using EBRA. Histological evaluation was performed at an independent specialist laboratory.

RESULTS: All patients presented with some pain/discomfort. Mean time to revision was 31 months (0-101). Six HRAs were revised for fracture. The most common pre-operative reason for revision included cup malpositioning (50%), usually excessive abduction or anteversion. The most common intra-operative finding was a bursa (44%) followed by impingement (34%) and metallosis (31%) usually correlated with high metal ions. There were gender-specific differences in component sizes and causes of failure, with a higher incidence of component malpositioning, osteolysis, elevated metal ions, and metal sensitivity in women. Time to revision in patients with high metal ion levels was shorter in patients with the ASR (21 months, SD:10) in comparison to the BHR (38 months, SD: 25) (p=0.05).
DISCUSSION AND CONCLUSION: Component malpositioning is the most common cause of HRA failure. Metal ion measurements are an excellent tool to detect wear at an early stage. The revision analysis highlights the importance of surgical experience, indications and prosthesis design.

PAPER NO. 562
The Main Issue of Large Diameter MoM Total Hip Arthroplasty: The Taper Junction

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Jamshed N. Gandhi, MBBS, Coxhoe, Durham, United Kingdom
Antoni Nargol, FRCS, Yarm, United Kingdom
Ee Kew, London, United Kingdom
John Skinner, PhD, Newcastle Upon Tyne, United Kingdom
James Lord, MSc, Newcastle Upon Tyne, United Kingdom
Raghavendra P. Sidagamnale, Shrewsbury, United Kingdom

INTRODUCTION: The modular junction of metal on metal (MoM) total hip replacements (THR) is an important source of metallic debris. This metallic debris can precipitate an immune response leading to potentially catastrophic soft tissue damage as well as osteolysis. METHODS: We carried out a prospective study using custom techniques to analyze one of the largest collections of failed MoM THR in the world. All explants from patients who had suffered adverse reactions to metal debris (ARMID) were included in this study. These explants included: 40 36mm THR (one manufacturer), and 90 resurfacing head THRs from several manufacturers. Volumetric wear analysis of the bearing surfaces and taper junctions was carried out using a coordinate measuring machine. These values were compared to serum and whole blood pre-revision metal ion concentrations from the corresponding patients. Scanning electron microscopy was used to assess the chemical composition of the wear debris. RESULTS: All explants retrieved from ARMID patients were found to have abnormal areas of wear either at the bearing surface, the taper junction or both. Characteristic patterns of wear were identified on the internal surfaces of the tapers which appeared to reflect exactly the morphology of the mated stems. Taper wear depths reached in excess of 100 microns however rarely did taper material loss exceed a volume of 4mm3. In only 50% of patients with extensive taper damage were blood/serum metal ion concentrations greater than the threshold suggested by the MHRA. This metallic debris can precipitate an immune response leading to potentially catastrophic soft tissue damage as well as osteolysis.

DISCUSSION AND CONCLUSION: Component malpositioning is the most common cause of HRA failure. Metal ion measurements are an excellent tool to detect wear at an early stage. The revision analysis highlights the importance of surgical experience, indications and prosthesis design.

PAPER NO. 563
MRI of Well Functioning Hip Arthroplasties: Ceramic-on-Ceramic vs. Metal-on-Metal

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Ee Kew, London, United Kingdom
Shiraz Sabah, MD, London, United Kingdom
John Skinner, FRCS, London, United Kingdom
Donald McRobbie, PhD, London, United Kingdom
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Adam Mitchell, MD, London, United Kingdom
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Alexander D. Liddle, MBBS, London, United Kingdom

INTRODUCTION: Surgeons use magnetic resonance imaging (MRI) to assess periprosthetic soft tissue changes, including pseudotumors in patients with painful metal-on-metal (MOM) hip arthroplasties. Pseudotumors are thought to indicate need for revision however they have also been reported in well-functioning MOM hips. Comparing MRI findings of well functioning MOM with ceramic-on-ceramic (COC) hips will help interpret the significance of pseudotumors but there is currently no report of such a study. Therefore, we aimed to compare COC with MOM hips for: (1) the prevalence of pseudotumors; and (2) muscle changes. METHODS: We performed a case-control study to compare the MRI findings in MOM and COC hips. We defined cases as well-functioning COC hip replacements and controls as well-functioning MOM hips. All primary hip replacements were performed using posterior approach. Fifteen cases and 28 controls were recruited. All recruited patients underwent metal artefact reduction sequence (MARS) MRI. The Bal system was used to score the muscle atrophy. RESULTS: We found 18 pseudotumours in this series. There was no difference in age, gender, cup position, and Oxford Hip Score between controls and cases (Table 1). The prevalence of pseudotumours in cases (1 hip; 6.7%) and in controls (17 hips; 60.7%) were significantly different (chi square p < 0.001). Glutei muscles were mostly normal or showed mild atrophy in both groups (figures 1 & 2) while moderate to severe muscle atrophy were common in obturator internus. There were no differences between MOM and COC in all muscle groups except piriformis. DISCUSSION AND CONCLUSION: This study has increased our understanding of the clinical relevance of MRI findings in patients with hip replacements. The higher prevalence of pseudotumours in MOM hips, when compared to COC hips, suggests that they are caused by either metal wear debris or large head size. Muscle atrophy was uncommon in the glutei but common in obturator internus in patients with well-functioning MOM and COC hips. Figure 1. The Bar muscle score for Gluteus maximus in both groups was not significantly different.
**PAPER NO. 564**

**Early Periprosthetic Fracture after Operation with an Uncemented Femoral Stem**

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**INTRODUCTION:** The survival of uncemented stems has been inferior to cemented fixation in the Swedish Hip Arthroplasty Register due to the occurrence of early periprosthetic femoral fracture. However, the incidence of periprosthetic femoral fractures is low and therefore large patient cohorts are needed to study and evaluate probable causes.

**METHODS:** We used the NARA-database, a collaboration of the Arthroplasty Registries in Denmark, Norway and Sweden to evaluate whether age (<50, 50-59, 60-69, 70-79, >=80 years), gender, preoperative diagnosis and fixation play any role in the risk of periprosthetic fracture within two years from operation using Cox regression model. A total of 293,577 cemented (C) and 72,774 uncemented (UC) stems operated between 1995 and 2009 were included. We used revision due to periprosthetic fracture as endpoint.

**RESULTS:** Fifty-one of 52 patients had pain which varied in intensity from mild to moderate. Although groin pain was the most common presenting symptom, peri-trochanteric and buttock fluid was noted. More recently, serum cobalt and chromium levels and cell count and culture. At revision surgery, the character of the joint fluid was noted. Intra-operative cultures were routinely performed. At revision surgery, the character of the joint fluid was noted.

**DISCUSSION AND CONCLUSION:** Our observations suggest squeaking is a problem of lubrication in all hard-on-hard bearings. The COM articulation did not squeak more like a MOM articulation than a COC bearing.
difficult to assess radiographically. Serial x-rays were helpful in detecting subtle acetabular migration, obvious migration, gross shift, or frank shell dislocation. Only 70% of symptomatic patients showed abnormal radiographs. Twenty-eight patients underwent pre-operative aspiration. The WBC count was less than 3000/UL in 23 patients. However, in five patients the cell count ranged from 3200 to 20400/UL despite being culture negative. Twenty-one patients had pre-operative serum ion levels. Cobalt was elevated in all but one with a range of 0.8 to 60.4 mcg/L. The appearance of the peri-articular tissues varied from normal appearing to frankly necrotic. The joint fluid was cloudy in 31 of the cases and could easily be mistaken for pus. The socket was loose in 46 of the 52 cases. Histologic findings ranged from nonspecific findings of chronic inflammation (giant cell reaction, histiocytic aggregates, and amorphous debris) to pulverized bone, necrosis and infiltration of lymphocytes, plasma cells and histiocyes comparable to that of “ALVAL” or “pseudotumor” patients.

DISCUSSION AND CONCLUSION: In this series of mono-block metal on metal hip replacements, the most common reason for revision was pain associated with socket loosening. Given the likelihood of symptom persistence or progression, as well as the potential for adverse bone or soft tissue destruction, it seems appropriate to recommend early revision rather than observation. It is not possible to tell whether the loose sockets were fixed at some point in time and then loosened as a part of the biologic response to metallic wear products. The time to revision overall was quite short and it is likely that most of these sockets were never integrated. There was no correlation between extent of tissue damage and ion levels.

PAPER NO. 567

Impaction Bone Grafting in Acetabular Reconstruction for Complex Primary and Revision Hip Arthroplasty

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Stuart B. Goodman, MD, Redwood City, CA

INTRODUCTION: The reconstruction of major acetabular bone defects during revision, conversion and primary total hip replacement (THR) is challenging. We reviewed a consecutive series of 168 hip arthroplasties (108 revisions, eight conversions, and 52 primary total hip arthroplasties) performed by one surgeon between 1997-2008 using impaction bone grafting for acetabular reconstruction. METHODS: Autograft, cancellous allograft croutons, and demineralized bone matrix were used to fill bone defects as needed. Clinical data was gathered prospectively on standardized forms. The radiographs were reviewed by an independent blinded orthopaedic surgeon. The acetabular bone deficiency was classified according to the American Academy of Orthopaedic Surgeons: Type I: segmental deficiency with significant rim defect; Type II: cavitary defects either medially or posteriorly; Type III: combined cavitary and segmental deficiency; Type IV: pelvic discontinuity; and Type V: arthrodesis. This classification was based on the pre-operative radiographs and intra-operative findings after removal of the cup. According to this method, 56 hips had Type I, 31 hips had Type II, 48 hips had Type III, and 27 patients had Type IV deficiencies. An additional six hips had bone grafting of defects without removal of the stable cup. RESULTS: Of the 168 patients, 19 subsequently died of causes unrelated to the hip surgery, and 11 patients refused to return for clinical follow up and could not be contacted. All cases had at least two years of follow up. The mean follow up was 43 months [range = 24-110 months] for revision THRs. The average Harris Hip Score for patients with revision THRs improved from 45.5±17.9 [range = 9-86] preoperatively to 81.1±16.5 [range = 32-100] postoperatively [p <.05]. The mean follow up was 41 months [range = 24-52 months] for conversion THRs. The average Harris Hip Score for patients with conversion THRs improved from 40.0±11.3 [range = 28-57] preoperatively to 85.0±12.8 [range = 66-97] postoperatively [p <.05]. The mean follow up was 45 months [range = 24-120] for primary THRs. The average Harris Hip Score for primary THRs improved from 42.3±14.9 [range = 9-77] preoperatively to 85.0±12.0 [range = 51-100] postoperatively [p <.05]. All impaction grafted bone (allograft, autograft or a combination) incorporated radiographically, thus restoring bone stock. Complications included one early infection which was managed successfully with debridement and liner exchange; two late infections were managed successfully with staged revision. Two revisions required subsequent re-revision for late loosening. There were two hip dislocations, one of which required surgical treatment to place a constrained liner. DISCUSSION AND CONCLUSION: Impaction bone grafting in primary, conversion and revision total hip replacement is a reliable surgical technique that restores bone stock in cases of major acetabular bone deficiency. When autograft bone is unavailable or insufficient in volume to fill the defect, the technique of impaction bone grafting using cancellous allograft bone croutons with or without autograft is highly successful, safe and reliable.

PAPER NO. 568

Revision Total Hip Arthroplasty: Can Previous Operative Reports Be Relied on for Planning Purposes?

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INTRODUCTION: The need for revision total hip arthroplasty (THA) as a growing population of patients outlives their prosthesis cannot be ignored. Component documentation during primary hip replacement is vital to the revision surgeon for preoperative planning. In this study, we reviewed operative reports from the primary operation in patients undergoing revision THA to determine if these reports contained complete information related to components. METHODS: All patients who underwent revision hip surgery at our center by one surgeon between January 2008 and May 2011 were reviewed. Operative reports from previous hip arthroplasty performed at both our institution and outside institutions were retrospectively reviewed for completeness with regard to details of components utilized. Operative reports were considered complete if manufacturer, product and all pertinent dimensions of cup, liner, stem, and head were recorded. RESULTS: Ninety-two patients who underwent revision surgery had operative reports from the primary surgery that were available for review. Forty-seven of these patients had primary THA performed by 32 different outside hospitals/surgeons, while 45 had the primary THA performed at our institution. Of 83 patients requiring liner exchange, only 10 (12%) reports contained the required information. Some 40% (47/92) of operative reports lacked information regarding the cup manufacturer, product or dimensions, while 28% (26/92) did not report cup manufacturer and product name. A total of 18% of reports (17/92) failed to report the femoral stem manufacturer and product name. One report incorrectly recorded the product as a knee implant instead of a hip implant while one did not record any implant characteristics at all. DISCUSSION AND CONCLUSION: This study reveals the dismal nature of component documentation during primary THA. As more
patients and younger patients are considered for joint replacement, surgeons performing primary THA must be cognizant of recording detailed implant characteristics to ensure that the future revision surgeon has all the pertinent information required to optimally treat each patient.

PAPER NO. 569  
**The Clinical Implications of an Elevated Blood Metal Ion Result post MoM Hip Resurfacing**  
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INTRODUCTION: Recent medicines and Healthcare Products Regulatory Agency (MHRA) guidance suggests only patients with painful metal-on-metal (MoM) hip arthroplasties or patients who have certain prostheses should undergo blood metal ion testing. There is currently a lack of data describing the outcome of asymptomatic patients with elevated metal ion levels.  

METHODS: In 2007, following unusual soft tissue reactions in patients with MoM hip resurfacings, routine blood chromium (Cr) cobalt (Co) analysis was carried out in all senior author’s patients. Patients who gave blood samples between 2007 and 2010 who had no or “slight” pain were included in this study. Patients were assessed using the Harris hip and UCLA activity scores. Kaplan Meier survival analysis was performed with patients censored if they had undergone revision or had been listed for revision prior to March 2011. Our previous work has shown a Co concentration > 5µL to be highly sensitive and specific for abnormal wear. Patients were therefore subdivided according to Co: “Low” <2; “equivocal” 2 - 5; “increased” 5 - 10; “excessive” >10 (all µg/l). The survivorship of these groups was compared using the log-rank test.  

RESULTS: There were 297 patients in total. At time of writing, 25 joints had failed. All but one failure was attributed to adverse reaction to metal debris. Kaplan Meier survival analysis showed a significant, sequential decrease in joint survivorship in the patient groups progressing from “low” wear (99% at 80 months) compared to 32% at 80 months for the patients in the “excess” group. All patients in the “excess” group were found to have some degree of osteolysis.  

DISCUSSION AND CONCLUSION: Elevated metal ion levels are associated with early joint failure even in asymptomatic patients.  

PAPER NO. 570  
**Identifying the High Risk Total Hip Arthroplasty Patient**  
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Kevin Ong, PhD, PE, Philadelphia, PA  
Steven M. Kurtz, PhD, Philadelphia, PA  
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Daniel J. Berry, MD, Rochester, MN  

INTRODUCTION: Although individual patient risk factors have been identified for periprosthetic joint infection (PJI) and postoperative mortality in total hip arthroplasty (THA) patients, the interactions between those risk factors are poorly understood. The purpose of this study was to evaluate which combinations of risk factors are associated with the highest risk of PJI and mortality, and to develop an electronic risk calculator for PJI and mortality in Medicare THA patients.  

METHODS: The Medicare 5% sample claims database was used to calculate the relative risk of PJI and mortality within 180 days post-operatively as a function of clinical and demographic characteristics in 53,252 primary THA patients between 1998 and 2009. Logistic regression using 29 comorbid conditions, age, gender, race, and socioeconomic status (SES) were used as inputs to estimate the probability of mortality and infection.  

RESULTS: The overall risk of PJI and mortality within 180 days post-operatively was 1.31% and 2.2%, respectively. White women with hepatic and renal comorbidities, coagulopathy, and diabetes were at highest risk for PJI. White men with pulmonary comorbidities, renal disease, dementia, and metastatic tumors were at highest risk for mortality. Low SES was associated with increased risk of PJI and mortality. An electronic risk calculator was developed to estimate the risk of PJI and mortality in Medicare THA patients based on their individual demographic and clinical characteristics, compared with the rates for the entire Medicare THA population and patients with similar demographics.  

DISCUSSION AND CONCLUSION: This information is important when counseling elderly patients regarding the risks of PJI and mortality following THA and for risk-adjusting publicly reported THA outcomes.  

PAPER NO. 811  
**Mid-Term Survival of Head and Liner Exchange Revision for Well-Fixed Acetabular Components**  
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INTRODUCTION: Aseptic loosening and osteolysis are common problems. Performing a head and liner exchange (HLE) rather than full acetabular revision (AR) provides multiple advantages. We determined the importance of acetabular component position and the type of polyethylene (conventional or highly crosslinked) liner used at the time of revision on mid- to long-term survival of HLE.  

METHODS: A total of 144 patients underwent HLE for aseptic loosening, osteolysis, or polyethylene wear with minimum three-year follow-up (avg 6.3 years). Anteversion and inclination of the acetabular component were measured on pre-revision radiographs. Implant records were reviewed to determine if conventional or HXLPE polyethylene liners were used at the time of revision. All dislocations were recorded and patients requiring additional revisions were deemed failures.  

RESULTS: Average Harris Hip Score (81.4) and UCLA score (5.4) were both significantly improved from pre-operative values (p<0.05). There were 42 (30%) and 64 (46%) hips outside of the safe zones for inclination and anteversion, respectively. Nineteen of 144 hips (13%) were outside of the safe zone in both planes, six of which required a repeat revision (32%). Fifty-two hips were inside both safe zones, only two of which required repeat revisions (4%). There were 13 (9%) repeat revisions; five for instability, seven for progression of lysis, and one for infection. Seven hips that were originally revised with conventional polyethylene required additional revision surgery for progression of lysis.  

DISCUSSION AND CONCLUSION: Patients with appropriately positioned, well-fixed acetabular components can be treated with an isolated HLE rather than AR with good long term outcomes and survival. Acetabular components placed outside the safe zone for inclination and anteversion were at highest risk for failure and should be an indication for complete acetabular revision regardless of fixation. Highly-crosslinked liners when compared to...
conventional liners seem to halt or at least markedly slow the lytic process following HLE.

PAPER NO. 646

◆ Topical Bisphosphonate Augments Fixation of Bone-grafted Implants, BMP-2 causes Resorption-based Instability

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INTRODUCTION: Revision arthroplasties in osteopenic bone may need bone-grafting, but healing is inconsistent. rhBMP-2 (BMP) is a potent stimulator of new bone formation, but also accelerates bone resorption. The bisphosphonate (BP) zolendronate induces osteoclastic apoptosis and slows down bone resorption.

METHODS: In the present study the two drugs in combination and alone were studied in our canine model of impaction bone grafting. Cancellous bone grafts were soaked in either saline or zolendronate solution and then added vehicle or rhBMP-2 giving four treatment groups: A) control B) BMP C) BP and D) BMP+BP. The allograft treated with A,B,C or D was impacted into a circumferential defect of 2.5 mm around plasma spray HA on Ti PoroCoat implants. Forty implants in 10 dogs were included.

RESULTS: The group with allograft soaked in zolendronate only was biomechanically better than all other groups (p<0.05). It had less allograft resorption compared to all other groups (p<0.005) without any statistically significant change in new bone formation. The addition of BMP-2 to the allograft did not increase new bone formation significantly, but allograft resorption was accelerated. This was also the case were the allograft was treated with BMP-2 and zolendronate in combination. This caused a decrease in mechanical implant fixation in both these groups compared to the control group, however it was only statistically significant in the BMP-2 group.

DISCUSSION AND CONCLUSION: The study shows that topical zolendronate can be a valuable tool for augmenting bone grafts when administered correctly. The use of BMP-2 in bone grafting procedures seems associated with a high risk of bone resorption and mechanical weakening.

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PAPER NO. 647

Pseudotumor in Metal-on-Metal Hips: Can a Blood Metal Ion Cut-off Level Indicate When to Perform MRI?

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INTRODUCTION: The Medicines and Healthcare Regulatory Authority (MHRA) in the U.K. recommends that patients with unexplained, painful metal-on-metal hip replacements (MOM-HR) be investigated with MRI if they have whole blood metal ion levels above 7ppb. However, diagnostic test characteristics for blood metal ion levels in the diagnosis of pseudotumor on MRI have not been reported.

METHODS: Fifty-one patients with unilateral, unexplained, painful MOM-HR were prospectively imaged using metal-artifact reduction sequence MRI. Whole blood metal ions were measured using inductively-coupled plasma mass spectrometry. Cases were defined as patients with pseudotumor on MRI, while controls had no pseudotumor. Sensitivity, specificity and receiver operating characteristic (ROC) curve analyses were performed for cobalt, chromium and the maximum of either value (Max Co-Cr).

RESULTS: Thirty-four patients (67%) were diagnosed with pseudotumor. Max Co-Cr in cases was median 7.3 (range 0.6-386.5) parts per billion (ppb) and controls 3.2 (range 0.6-73.5) ppb (p<0.05). The area under the curve (AUC) was 67% (52-82%, 95% confidence intervals) for Max Co-Cr. The MHRA cut-off had sensitivity 50% (33-67%), specificity 94% (69-100%), positive predictive value 94% (71-100%) and negative predictive value 48% (31-66%) for detection of pseudotumor.

DISCUSSION AND CONCLUSION: Pseudotumor was a common diagnosis on MRI in unexplained, painful MOM-HR and was associated with high blood metal ion levels. The MHRA blood metal ion cut-off level of 7ppb increased the diagnosis rate of MRI but missed half of all pseudotumors. Further research on blood metal ions cut-off levels is needed to determine their role in monitoring of MOM-HR.
INTRODUCTION: New techniques in postoperative analgesia, including local infiltration analgesia (LIA), aim to provide good pain management and maximum muscle control while reducing side effects. The objective of this study was to investigate the use of intraarticular injections of RKA (0.2% ropivacaine, 15mg ketorolac, and 0.5mg epinephrine) mixture and continuous catheter infusions of ropivacaine as a method of postoperative pain control for total hip arthroplasty (THA) patients. The hypothesis was that, following surgery, continuous catheter infusion of ropivacaine in addition to infiltration with RKA would result in lower pain scores and less narcotic consumption than infiltration with RKA alone, and both of these techniques would be superior to patient controlled analgesia (PCA) alone.

METHODS: In this prospective, double-blinded study, 105 patients were randomized into three groups, and surgeries were performed by three high volume arthroplasty surgeons. All patients received the standard perioperative multimodal analgesia protocol consisting of celecoxib, pregabalin, acetaminophen, and a scopolamine patch. General laryngeal mask anesthesia was used for surgery. Before wound closure, the surgeon infiltrated the intraarticular space and tunneled a catheter into the joint. The experimental treatment protocol for the three groups was as follows: 1) Control group: 50cc infiltration of saline and a 5cc/hr catheter infusion of saline for 48 hours postoperatively; 2) RKA infiltration + saline infusion group: 50cc infiltration of RKA mixture and a 5cc/hr catheter infusion of saline for 48 hours postoperatively; 3) RKA infiltration + ropivacaine infusion group: 50cc infiltration of the RKA mixture and a 5cc/hr catheter infusion of 0.2% ropivacaine for 48 hours postoperatively. All patients were placed on a PCA pump which had 0.2mg of hydromorphone available to them every 10 minutes (no basal rate), for a maximum of 1.2mg/hr. Rescue medication and epidural analgesia were available for breakthrough pain. A power analysis (80% power) of data presented in previously published studies indicated that at a 95% confidence interval, 26 patients per group would be superior to patient controlled analgesia (PCA) alone.

RESULTS: The groups were demographically similar. There were two to four adverse effects noted in each group, all of which were minor (nausea, vomiting, lightheadedness, heartburn). The pain management protocol was rated good or excellent by >95% of patients. DISCUSSION AND CONCLUSION: Current literature suggests that LIA reduces postoperative pain and narcotic consumption. However, the results of this study indicate that there is no difference between the LIA and saline control groups. Our multimodal analgesia protocol provides satisfactory pain control with minimal side effects, and the addition of the LIA technique appears to provide no further benefit.
RESULTS: One of the 40 cups (2.5%) in the ultrasound-based group and 12 of the 40 cups (30%) in the imageless navigation group were outside of the defined safe zone (outlier). This was statistically significant (p = 0.001). We observed a statistical significance in the anteversion angles and in the anteversion error (p = 0.001) between the imageless navigation and ultrasound-based navigation groups. In addition, we observed a significant correlation between the body mass index and the anteversion imageless navigation system group.

DISCUSSION AND CONCLUSION: Ultrasound-based navigation improves cup positioning in total hip arthroplasty better than imageless navigation system with surface registration by reducing the percentage of outliers, achieving a higher accuracy of anteversion, reducing the mean and the range anteversion error between intraoperative displayed and postoperative measured cup orientation. The higher precision seemed to be dependent on the correctness of evaluation of landmarks, and is therefore influenced by thickness of soft tissues.

PAPER NO. 651

The Outcome of Extensively Porous Coated Stems for Revision Total Hip Arthroplasty

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INTRODUCTION: As the number of total hip arthroplasties (THA) performed continues to increase, so do the numbers of revisions. Common diagnoses for femoral revision THA include aseptic loosening, osteolysis, and periprosthetic fractures. The tenants of revision femoral arthroplasty include obtaining rotational stability, inhibiting axial implant migration implant and restoration of hip biomechanics. The procedure of choice at our institution has been the use of extensively porous coated stems in revision THA; we have previously reported a 95% survivorship at 10 years with this type of implant. The purpose of this study was to review our institutional experience to date and evaluate the longterm survivorship of femoral revision THA using extensively porous coated cylindrical prostheses.

METHODS: In order to identify our study population, we queried our institutional database for all femoral revisions using extensively porous-coated stems with a cylindrical distal geometry. Patient demographics, including gender, age at the time of revision and the original THA diagnosis were queried from our database. At the time of revision surgery, any cement residue if present was removed with curettage or high speed drill. When necessary, a trochanteric osteotomy was employed in order to gain adequate access to the femoral canal. The femoral canal was prepared with sequentially larger cylindrical reamers prior to introduction of the revision stem. The surgical goal was to obtain scratch fit over at least a 5 to 7cm segment of healthy diaphyseal bone. Stem fixation was assessed radiographically and classified as bone ingrown, fibrous stable, or loose according to previously published criteria. Kaplan-Meier survivorship was evaluated using femoral rerevision for any reason as an endpoint.

RESULTS: The mean follow up among all 1,000 cases was 6.9 ± 5.5 years (range, 0 to 26.8) years. Five-hundred-forty of the stem revisions were followed less than five years, 218 were followed five to 10 years, 160 were followed 10-15 years, and 82 were followed 15 years or longer. Radiographically, 5% of the stems were graded as loose, 7% were fibrous stable, and the remaining stems were bone ingrown. Kaplan-Meier survivorship using stem rerevision for any reason as an endpoint was 98.6± 0.8% at two years, 97.0 ± 1.3% at five years, 95.6 ± 1.8% at 10 years, and 94.5 ± 2.3% at 15 years. There were no rerevisions after 12 years. We have had 27 stems undergo rerevision; 14 for aseptic loosening, seven for implant fracture, four for infection and two in conjunction with periprosthetic femoral shaft fractures.

PAPER NO. 650

Use of an Ultrasound Based Navigation System for an Accurate Acetabular Positioning in Total Hip Arthroplasty

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INTRODUCTION: Precise identification of bony landmarks by use of pointer based navigation systems is influenced by the thickness of soft tissue. Ultrasound-based navigation systems try to overcome the problems of positional deviation associated with soft tissue. The purpose of this study was to compare an ultrasound-based navigation system with an imageless navigation system with surface registration in the postoperative acetabular cup position. Additionally, we investigated the influence of the body mass index on the accuracy of both navigation systems.

METHODS: A prospective randomized controlled study of two groups of 40 patients each was performed. In the first group, cup positioning was assisted by an ultrasound-based navigation system and the second group, the cup was assisted by imageless navigation system with surface registration. Cup abduction and anteversion angles were measured on three-dimensional computed tomography reconstructions postoperatively.

RESULTS: One of the 40 cups (2.5%) in the ultrasound-based group and 12 of the 40 cups (30%) in the imageless navigation group were outside of the defined safe zone (outlier). This was statistically significant (p = 0.001). We observed a statistical significance in the
DISCUSSION AND CONCLUSION: Mechanical loosening rates have been reported to be less than 5% at nominal 10-year follow up when the level of femoral bone damage does not extend more than 10 cm below the lesser trochanter prior to revision. When the femoral bone damage extends more than 10 cm below the lesser trochanter, revision becomes more challenging. Prerevision bone stock is a factor affecting femoral fixation. We have documented lower survivorship when the femoral bone damage extends more than 10 cm below the lesser trochanter, but the overall survivorship for these types of cases is 89% at 10-year follow up. Consistent with prior reports, failure to achieve bone ingrowth occurs in 10% to 20% of cases but the decision to rewire a stem is typically driven by patient symptoms rather than radiographic appearance. Extensively porous-coated, cylindrical stems offer a straightforward surgical technique that can be used to address the full spectrum of femoral bone defects that are typically encountered at revision. We regard the use of cementless fixation with extensively porous-coated cylindrical stems as the gold standard in the femoral revision setting.

PAPER NO. 652
◆Cumulative Risk of Dislocation after THA for Fractures Decreased with Dual Mobility or Constrained Liners
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INTRODUCTION: Total hip arthroplasty (THA) has been efficacious for treating hip fractures in healthy older patients. However, in these patients with fractures a widely variable prevalence of dislocation has been reported, partly because of varying durations of follow up for this specific end-point. The purpose of the present study was to determine the cumulative risk of dislocation in these patients with fractures and to investigate if dual mobility or constrained liners decrease the risk of dislocation.

METHODS: Between 2000 and 2005, 125 patients with neck fracture underwent primary THA using a dual mobility (50 hips) or a constrained (75 hips) liner. The results of these 125 dual mobility acetabular liners were compared with 180 THA without dual mobility or without constrained liners performed for neck fractures in the same hospital between 1995 and 2000 by the same surgical team. The mean age of the 305 patients was 75 years (65 to 85). All patients were followed for a minimum of five years for radiographic evidence of implant failure. The patients were followed at routine intervals and were specifically queried about dislocation. The cumulative risk of dislocation and recurrent dislocation was calculated with use of the Kaplan-Meier method.

RESULTS: For patients without dual mobility or without constrained liners, the cumulative risk of a first-time dislocation was 5% at one month and 12% at one year and then rose at a constant rate of approximately 1% every year to 16% at five years. For patients with dual mobility liners, the cumulative risk of a first-time dislocation was 1% at one month, 2% at one year and then did not change at five years. There were no differences in the mortality rates or in loosening rates among the treatment groups. The rate of secondary surgery was highest in the group without constrained or dual mobility (10% for recurrent dislocation) compared with 1% in the group treated with constrained or dual mobility liners. In absence of constrained or dual mobility liners, multivariate analysis revealed that the relative risk of dislocation for female patients (as compared with male patients) was 2.1 and that the relative risk for patients who were 80 years old or more (as compared with those who were less than 80 years old) was 1.5. Two underlying diagnoses occurring during follow up, cognitively impaired patients or neurologic disease, were also associated with a significantly greater risk of dislocation.

DISCUSSION AND CONCLUSION: The cumulative long-term risk of dislocation for patients with hip fractures is greater than has been reported in short-term studies. The incidence of dislocation is highest in the first year after arthroplasty and then continues at a relatively constant rate for the life of the arthroplasty. Patients at highest risk are old female patients and those with a diagnosis of neurologic disease. Dual mobility or constrained liners in these patients is an effective technique to prevent post-operative hip dislocation.

PAPER NO. 653
Gait Analysis after Total Hip Arthroplasty - Minimally Invasive Anterolateral vs. Conventional Lateral Approach
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INTRODUCTION: Minimally invasive (MIS) total hip arthroplasty is claimed to be superior to the standard technique because it reduces operative trauma. But there is still controversy as to whether minimally invasive total hip arthroplasty enhances the postoperative outcome. The aim of this study, therefore, was to compare the outcome of patients who underwent total hip replacement through an anterolateral minimally invasive approach or a conventional lateral approach.

METHODS: We performed a prospective study of 76 patients with primary hip arthritis. Only patients aged between 65 and 75 were included. Patients with a body mass index (BMI) of > 30 kg/m² or severe concomitant diseases (tumor, neuronal disease) were excluded, as were patients who had arthritis or had undergone arthroplasty of other joints. Patients underwent unilateral total hip arthroplasty with an uncemented acetabular cup and a cemented stem either through a minimally invasive anterolateral approach (n = 38) or a direct lateral approach (n = 38). Patients were evaluated clinically using the WOMAC and Harris Hip score and underwent motion capturing preoperatively and at 12 days, six and 12 weeks postoperatively. Gait analysis was carried out using the three-dimensional eight-camera system. Typical gait parameters, e.g. cadence, walking speed and step length, as well as diagrams with the characteristic of the angles, e.g. knee flexion/extension, hip flexion/extension and hip ab/adduction, were taken into account. Additionally, a three-dimensional force plate was applied to estimate ground reaction forces. A set of markers for the standard plug-in-gait marker placement for lower extremities was used for all measurements. During a single session each subject walked over the measuring path (6 m) five times. The data was processed using the manufacturer's reporting software and the object-oriented gait modeling software.

RESULTS: Postoperative gait analysis showed significantly better results in comparison to the preoperative measurements. However, the mean difference between pre- and postoperative analysis was not significantly better in MIS than in the conventional group. Physical examination also revealed no significant differences between the two groups.

DISCUSSION AND CONCLUSION: Both physical examination...
and gait analysis showed that the conventional approach and the minimally invasive approach led to equally good operation results. Therefore, both approaches can be equally recommended for hip replacement surgery. Gait analysis is a suitable method for hip research as it yields results which are equivalent to those obtained from physical examination.

PAPER NO. 654

**Examination of an Accelerated Total Hip Arthroplasty Protocol: Does the Patient Benefit?**

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**INTRODUCTION:** Since its debut over 10 years ago, minimally invasive total hip arthroplasty (THA) has often been associated with accelerated and improved postoperative rehabilitation when compared to THA performed with a traditional surgical approach. In recent years, some surgeons have taken the association to another level and introduced the “fast track” or “same day total hip.” The success of these programs continues to be debated. The objective of this study was to investigate the effect of accelerated postoperative rehabilitation and early mobilization on length of stay and hospital readmissions in patients undergoing THA at one institution.

**METHODS:** We retrospectively reviewed a consecutive series of 593 patients who underwent THA at one institution between January 31, 2011 and April 30, 2011. Six arthroplasty surgeons using varying surgical techniques participated. A total of 191 patients received accelerated rehabilitation and were mobilized on the day of surgery by physical therapy and nursing. The remaining 402 patients were mobilized on postoperative day one, which is standard protocol for the institution. Length of stay, discharge disposition and hospital readmission were assessed. Statistical analyses were performed using t-test for means and Z-test for two proportions.

**RESULTS:** Distribution of patients among the six surgeons was similar. Length of stay for the accelerated rehabilitation group was 2.16 days and for the standard group was 3.38 days. The difference was statistically significant with a confidence level of 95%. One patient was readmitted to the hospital within 30 days (.52%) in the early mobilization group compared to 19 re-hospitalizations (4.72%) in the postoperative day #1 mobilization group. Discharge disposition was similar for both groups with 78% being discharged to home versus 22% discharged to a rehabilitation facility.

**DISCUSSION AND CONCLUSION:** This study highlights the benefit of early mobilization in THA patients independent of the surgical technique used in influencing length of stay, hospital readmission and discharge disposition. Our results support the use of an accelerated rehabilitation protocol at one institution following total hip replacement surgery.

PAPER NO. 655

**Prospective Randomized Study of Anterior vs. Posterolateral Approach for Total Hip Arthroplasty**

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**INTRODUCTION:** Proponents of direct anterior approach total hip arthroplasty (THA) propose that the muscle sparing nature of this procedure results in less postoperative pain, earlier functional gains and the use of intraoperative fluoroscopy results in reduced variability of acetabular cup position. We conducted a prospective, randomized Institutional Review Board-approved clinical study comparing direct anterior THA to a contemporary posterolateral THA to test these claims.

**METHODS:** The surgeon performed 43 direct anterior approach and 45 posterior approach THAs over a 16-month period. Standardized pre-op and post-op treatment protocols were utilized. Operative time, blood loss, analgesia use and length of stay were recorded. The same acetabular and femoral components were used in all cases. Postoperative radiographs were reviewed to assess cup orientation. Harris Hip, HOOS, UCLA Scores and a timed six-minute walk test captured pain and functional outcomes pre/post operatively. Osteoarthritis was the primary diagnosis in 95% of the procedures. Age and body mass index (BMI) did not differ statistically between groups. Significantly more men were randomly assigned to the anterior approach (p=0.020).

**RESULTS:** The operative time was longer and blood loss higher in the anterior cohort (p<0.05). Pain medication usage was significantly lower in the anterior cohort during the hospital stay (p<0.05). At one month post-operatively the anterior cohort had higher Harris Hip Function, Harris Hip Total, HOOS Sports and UCLA scores (p<0.03 for all). Three month scores also favored the anterior cohort. Patients receiving the anterior approach were discharged significantly sooner (2.3 vs. 2.7 days, p<0.0004). Mean anteversion angles significantly differed between surgical approaches with a mean of 20.4° in the anterior approach and a mean of 25.3° in the posterior approach (p=0.0353). Anteversion standard deviation was also reduced in the anterior cohort (4.5° vs. 7.3°, p=0.0836). Abduction angles did not significantly differ with respect to mean or standard deviation (45.4°+3.1 in the anterior cohort and 45.8°+4.3 in the posterior cohort). Anterior approach complications included one patient with severe pain and one with delayed wound healing. Posterior approach complications included one operative calcar fracture, one dislocation and one trochanteric bursitis.

**DISCUSSION AND CONCLUSION:** The direct anterior approach THA cohort required less post-op pain medication, half-day shorter hospitalization and patients had higher functional scores at one and three months. There was less variability in the acetabular cup anteversion. There were no functional differences at one year between the anterior and posterior cohort.

PAPER NO. 656

**What are Safe Upper Limits in Well Functioning Resurfaced Hips?**

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**INTRODUCTION:** Metal-on-metal hip resurfacing arthroplasty (MoMHRA) is a surgical option in the treatment of end-stage hip pain. The FDA has not cleared the drug and/or medical device for the use described in this presentation (i.e. the drug or medical device is being discussed for an off label use). For full information refer to page 14. An alphabetical faculty financial disclosure list can be found starting on page 19.
Hip Resurfacing Arthroplasty Enables Faster Walking and Longer Stride Length than Total Hip Arthroplasty

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INTRODUCTION: Hip resurfacing arthroplasty (HRA) has been promoted as an alternative to standard total hip arthroplasty (THA), enabling patients with coxarthrosis to pursue higher levels of function. However, patient reported outcome measures and gait analysis have failed to distinguish between them at normal walking speeds. Our null hypothesis was that the type of arthroplasty would not predict postoperative top walking speed, and that there would be no difference between the operated and un-operated hip. The study was powered to detect a 5% difference.

METHODS: A case control study was performed using 63 subjects (21 THA, 21 HRA, 21 healthy controls, all matched for age and gender.) The experimental groups were a minimum of 24 months after their hip arthroplasty. All had been performed through a posterior approach, and had been discharged from routine follow up by the two senior authors, one who performs HRA when appropriate, and the other who has always used THA. On an instrumented treadmill, each subject was measured by a researcher blinded to which procedure the patient had undergone. After a six-minute acclimatization period at 4km/hr, the speed was then increased incrementally until either the subject felt uncomfortable, or gait symmetry had deteriorated. At all intervals, measurements were taken for both limbs including: speed, cadence, stride length, step length, impulse, progression angle, base of support, maximum forces at heel strike, mid-stance and push off. The procedure generally took 12 minutes of continuous walking and was completed without difficulty by all subjects.

RESULTS: The two experimental groups were well matched for age, sex, Oxford Hip Score (HRA 45 vs. THA 46), BMI (29.4 vs. 29.5), leg length (91.7 vs. 91.5cm) and at preferred walking speeds were indistinguishable. However at top walking speed (TWS) the HRA group were able to walk significantly faster, achieving a mean of 2.08m/sec (range 1.39 -2.50) compared to THA with a mean of 1.89m/sec, (range 1.53-2.22 p=0.01). This 9% difference appears to be due to a longer stride length at higher speeds (173 vs. 163 cm) and higher cadence (141 vs. 136 steps/min). Of the other variables, the peak force asymmetry recorded in the THA group at heel strike did not reach significance. The mean gait cycle at top speed of the two groups is illustrated (Figure 1).

DISCUSSION AND CONCLUSION: This small, blinded, case control study is the first to focus on high end performance following hip arthroplasty, encouraging patients to achieve as high a speed as they comfortably could. The THA group in this study walked 9% faster than the previously published top speed of 1.73m/sec, however the HRA group still walked 9% faster again, matching the normal controls for speed and stride length. At higher speeds, in the THA group, the operated leg was spared peak loads at heel strike, while the HRA and control groups were comfortable. This data suggests that an HRA may enable a more normal gait at higher speeds.

The measurement of systemic levels of metal ions gives an insight into the wear occurring (i.e. state of the bearing couple) and is advocated by regulatory bodies as routine practice in the assessment of resurfaced hips. However, there is still considerable debate regarding the interpretation of measured metal ion values after MoM implantation. A fundamental question is “what are the acceptable upper levels of chromium (Cr) and cobalt (Co) ions concentration beyond which the measurements become clinically significant?” The aim of this study is to address this question in both unilateral and bilateral resurfaced hips.

METHODS: A total of 453 patients with unilaterally MoMHRAs and 139 patients with bilateral MoMHRAs (assessment: >12 months post last surgery) were retrospectively identified from an independent specialist hip center’s database. Routine metal ion levels were measured at last follow up (ICPMS protocol). Radiological assessment included measurement of acetabular component orientation using EBRA, calculation of the contact patch to rim (CPR) distance, and evaluation for any adverse X-ray findings. The cohort was divided into the well functioning group (Group A) and the non-well functioning group (Group B). In order for a resurfacing to be well functioning, all of the following criteria had to be fulfilled: (bilateral patients had to fulfill criteria for both hips): 1. No patient reported hip complaints, 2. No surgeon detected clinical findings, 3. HHS> 95, 4. CPR distance> 10mm, 5. No abnormal radiological findings and 6. No further operation scheduled. Upper levels (acceptable limits of Cr/Co were considered to be represented by the top margin of the box-whisker plot [upper limit = 75th quartile value + (1.5 x interquartile range)] in Group A.

RESULTS: A total of 251 unilateral MoMHRAs patients (55%) and 58 patients with bilateral MoMHRAs (42%) comprised Group A. The majority of males were in Group A compared to the majority of females who belonged in Group B (p<0.001); subsequently Group A patients had bigger size components (p<0.001). Unilateral Group A [Cr: 2.0 µg/l (SD: 1.5)] / Co: 1.8µg/l (SD: 1.2)] patients had significantly lower ions than Group B [Cr: 7.3µg/l (SD: 17.3)/ Co: 6.6µg/l (SD: 18.1)] patients (p <0.001). Similarly, Group A bilateral patients [Cr: 3.8µg/l (SD: 2.7)/ Co: 2.8µg/l (SD: 1.9)] had significantly lower ions that Group B [Cr: 10.7µg/l (SD: 16)/ Co: 8.5µg/l (SD: 15.8)]. The upper levels (safe were: Cr: 4.6µg/l / Co: 4.0µg/l for unilateral MoMHRAs and Cr: 7.4µg/l / Co: 5.0µg/l for bilateral MoMHRAs). Unilateral MoMHRAs had significantly higher ions compared to bilateral patients (p <0.001). Sensitivity and specificity of these upper levels in predicting poor function were respectively 25% and 95% for Cr and 22% and 96% for Co.

DISCUSSION AND CONCLUSION: The findings of this study suggest that both unilaterally and bilaterally resurfaced patients with well functioning implants have low metal ion levels with upper levels of Cr: 4.6µg/l / Co: 4.0µg/l for unilateral MoMHRAs and Cr: 7.4µg/l / Co: 5.0µg/l for bilateral MoMHRAs. These results indicate that the upper acceptable limit of metal ion levels in resurfaced hips is lower than the previously MHRA recommended threshold, 7.4µg/l / Co: 5.0µg/l for bilateral MoMHRAs. These results indicate that there would be no difference between the operated and un-operated hip. The study was powered to detect a 5% difference.

PAPERS, POSTERS & SCIENTIFIC EXHIBITS
Risk Factors for Pseudotumor in Metal-on-Metal Hip Replacements

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INTRODUCTION: Pseudotumors are sterile, inflammatory lesions associated with large-diameter metal-on-metal hip replacements (MOM-HR). They may be diagnosed using cross-sectional imaging during the investigation of an unexplained, painful MOM-HR. Pseudotumors are an important clinical problem due to their association with unexplained hip pain and rare reports of devastating periprosthetic tissue damage. We aimed to investigate risk factors for pseudotumor and to determine which were associated with poor prognosis.

METHODS: We conducted a case-control study in 149 consecutive patients that had metal artifact-reduction sequence MRI performed at our centre. We identified 81 cases with pseudotumor (three solid, 78 fluid-filled) and 68 controls without pseudotumor. We analyzed demographic, prosthesis, positioning and serological data. We performed subset analyses in the pseudotumor group to compare well-functioning to patients with MOM-HR that had MARS MRI performed at our center.

RESULTS: Solid pseudotumors were all painful, but were uncommon when compared to fluid-filled pseudotumors. Distributions of risk factors for pseudotumor are presented in Table 1. No significant differences between groups were found for any risk factor. Risk factors that may be important in prognostication in pseudotumor patients are presented in Table 2. Female sex (p=0.001), raised blood metal ion levels (p=0.003) and small head size (p=0.027) were associated with painful pseudotumor.

DISCUSSION AND CONCLUSION: There are currently no obvious risk factors for pseudotumor in MOM-HR. All common implant types are affected, whether they are well-functioning or painful. Our data agrees with published studies in that female sex, raised blood metal ion levels and small head size were associated with poor clinical status. However, we found the presence of a fluid-filled pseudotumor was not and provide this new information.

Table 1. Comparison of factors that may be linked to pseudotumor in 149 patients with MOM-HR that had MARS MRI performed at our centre.

<table>
<thead>
<tr>
<th></th>
<th>Case group (Pseudotumor)</th>
<th>Control group (No Pseudotumor)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study number</td>
<td>81 patients</td>
<td>68 patients</td>
<td></td>
</tr>
<tr>
<td>Age at primary surgery [median (range)]</td>
<td>54 (28-74) years</td>
<td>52 (21-66) years</td>
<td>p=0.088</td>
</tr>
<tr>
<td>Duration from primary surgery to MRI [median (range)]</td>
<td>32 (5-93) months</td>
<td>27 (3-64) months</td>
<td>p=0.536</td>
</tr>
<tr>
<td>Gender</td>
<td>29M:52F</td>
<td>20M:48F</td>
<td>p=0.485</td>
</tr>
<tr>
<td>Bilateral?</td>
<td>28/81 patients</td>
<td>32/68 patients</td>
<td>p=0.134</td>
</tr>
<tr>
<td>Oxford Hip Score/48</td>
<td>30 (2-48)</td>
<td>29 (4-45)</td>
<td>p=0.186</td>
</tr>
<tr>
<td>Maximum of either cobalt or chromium in whole blood [median (range)]</td>
<td>5.3 (0.6-386.5) ppb</td>
<td>4.6 (0.6-162.3) ppb</td>
<td>p=0.145</td>
</tr>
<tr>
<td>Implant Type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Version [median (range)]</td>
<td>20 (-22-47) deg</td>
<td>25 (-47-51) deg</td>
<td>p=0.399</td>
</tr>
<tr>
<td>Malposition?</td>
<td>35 Malpositioned</td>
<td>29 Malpositioned</td>
<td>p=0.493</td>
</tr>
<tr>
<td>Head size [median (range)]</td>
<td>48 (38-55) mm</td>
<td>46 (40-58) mm</td>
<td>p=0.457</td>
</tr>
<tr>
<td>CRP [median (range)]</td>
<td>5.0 (0.4-236.0) mg/L</td>
<td>2.0 (0.4-159.0) mg/L</td>
<td>p=0.355</td>
</tr>
</tbody>
</table>

Table 2. Comparison of 81 patients with pseudotumor on MARS MRI to determine factors that may be associated with poor prognosis.

<table>
<thead>
<tr>
<th></th>
<th>Painful</th>
<th>Well-functioning</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study number</td>
<td>60</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Age at primary surgery [median (range)]</td>
<td>54 (28-73) years</td>
<td>56 (33-74) years</td>
<td>p=0.302</td>
</tr>
<tr>
<td>Duration from primary surgery to MRI [median (range)]</td>
<td>28 (5-78) months</td>
<td>32 (8-93) months</td>
<td>p=0.072</td>
</tr>
<tr>
<td>Gender</td>
<td>15M:45F</td>
<td>14M:7F</td>
<td>p=0.001</td>
</tr>
<tr>
<td>Bilateral?</td>
<td>22/60 patients</td>
<td>6/21 patients</td>
<td>p=0.599</td>
</tr>
<tr>
<td>Oxford Hip Score/48</td>
<td>25 (2-45)</td>
<td>39 (24-48)</td>
<td>p=0.000</td>
</tr>
<tr>
<td>Maximum of either cobalt or chromium in whole blood [median (range)]</td>
<td>8.7 (0.6-386.5) ppb</td>
<td>3.2 (1.2-41.0) ppb</td>
<td>p=0.003</td>
</tr>
<tr>
<td>Implant Type</td>
<td>45 Resurfacing</td>
<td>18 Resurfacing</td>
<td>p=0.214</td>
</tr>
</tbody>
</table>

The FDA has not cleared the drug and/or medical device for the use described in this presentation (i.e. the drug or medical device is being discussed for an off label use). For full information refer to page 14. An alphabetical faculty financial disclosure list can be found starting on page 19.
amounts released from the bearing appear to sensitize a large and is present only as a contaminant. However the small percentage (<1%) of the cobalt-chrome alloy used in MoMHA are being sensitized to nickel. Nickel constitutes only a small that patients with modern metal-on-metal hip arthroplasty published figures from non-exposed population, it is evident study is the absence of a control group of patients without DISCUSSION AND CONCLUSION: The limitation of this (8.3%) and titanium (3.6%) and high against nickel (52%).

PAPER NO. 659

High Incidence of Nickel Sensitization at 10-Year
Review of Metal-on-Metal Arthroplasty

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Derek McMinn, FRCS, Birmingham, United Kingdom

INTRODUCTION: Metal-on-metal hip arthroplasties (MoMHA) have been shown to fail through a unique macrophage and lymphocytic vasculitis dominated pattern which has been variously described as pseudotumours, adverse reactions to metal debris, etc. The underlying reason for this is often related to excessive metal debris released from the device in most cases. In some patients these reactions are found even in the presence of low metal ion levels, indicating an immune hypersensitivity type of reaction. A histological ALVAL score has been used to differentiate the two types of reactions. Lymphocyte transformation test (LTT) is one means of assessing the sensitivity of a patient to metals although its reliability is clinically unproven.

METHODS: This is a minimum 10-year review of the first 350 consecutive patients (402 hips) who had been treated with MoMHA including all ages and diagnoses. Mean age of the patients is 53 years and mean body mass index (BMI) 26.3. Twenty-five patients (30 hips) had a smaller head size than the MOP THAs. There was no more often diagnosed with aseptic necrosis, and more often were more expensive, had a shorter follow-up period, were more often diagnosed with aseptic necrosis, and more often had a smaller head size than the MOP THAs. There was no significant difference in the CRRs between the COP (3.0%), COC (5.6%), or MOP (3.3%) THAs (p=0.17). There was also no difference in the RR between COP and MOP THAs (hr = 0.97, p=0.503) or between COC and MOP THAs (hr=1.32, p=0.53)

Analysis was performed to compare cumulative revision rates (CRR) and the risk of revision (RR) for the three groups. Analysis was done using Kaplan Meier methods and Cox regression. RESULTS: COC/COP THAs were done in younger patients, had a shorter follow-up period, were more often diagnosed with aseptic necrosis, and more often had a smaller head size than the MOP THAs. There was no significant difference in the CRRs between the COP (3.0%), COC (5.6%), or MOP (3.3%) THAs (p=0.17). There was also no difference in the RR between COP and MOP THAs (hr = 0.97, p=0.503) or between COC and MOP THAs (hr=1.32, p=0.53)

PAPER NO. 660

Do Ceramic on Polyethylene or Ceramic on Ceramic Hip Implants Add Value?

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INTRODUCTION: Surgeon preference for choice of bearing surface in total hip arthroplasty (THA) has changed over time. Traditional metal on polyethylene (MOP) THAs have known shortcomings so alternative bearing surfaces have been developed to solve these problems. Recent failures of metal on metal have made ceramic on poly (COP) and ceramic on ceramic (COC) bearing surfaces more popular. However, recent studies have failed to show significant differences in survival of these THAs. METHODS: All COP (n=609) and COC (n=168) THAs performed in our community registry between 2002 and 2010 were compared to a group of MOP THAs (n=1196) done in the same time frame. Analysis was performed to compare cumulative revision rates (CRR) and the risk of revision (RR) for the three groups. Analysis was done using Kaplan Meier methods and Cox regression. RESULTS: COC/COP THAs were done in younger patients, were more expensive, had a shorter follow-up period, were more often diagnosed with aseptic necrosis, and more often had a smaller head size than the MOP THAs. There was no significant difference in the CRRs between the COP (3.0%), COC (5.6%), or MOP (3.3%) THAs (p=0.17). There was also no difference in the RR between COP and MOP THAs (hr = 0.97, p=0.503) or between COC and MOP THAs (hr=1.32, p=0.53)

After adjusting for age, year of index procedure, and head size.
PAPER NO. 766

THR Compared to IF for Femoral Neck Fractures: A Randomized, Controlled Trial with a Seventeen Year Follow Up

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Andreas Stark, JR, Stockholm, Sweden
Olof Skoldenberg, MD, Stockholm, Sweden

INTRODUCTION: The aim of this trial was to compare total hip replacement (THR) and internal fixation (IF) over a long-term follow up of 17 years with regards to hip function, mortality, re-operation rate and clinical outcome for elderly, healthy patients with a displaced femoral neck fracture (FNF).

METHODS: We enrolled 100 patients; 79 women, 21 men, median 79 (range 65-90) years, with a pre-injury healthy hip, in a single-center, randomized controlled trial. Subjects were randomly assigned to surgery with THR (n=43) or IF (n=57). The primary end point was hip function, evaluated with Harris hip score (HHS). Secondary end points included mortality, re-operation, gait speed and activities of daily life (ADL). Follow-up was done after three months and one, two, four, 11 and 17 years. RESULTS: HHS was significantly higher in the THR group with a mean difference throughout the study period of 14.3 points (95% CI 8.7 to 19.9; p<0.001, ANOVA). There was no difference in mortality between two groups. After 17 years, 10 (23%) patients in the THR group and 27 (53%) in the IF group had been re-operated (relative risk with IF 2.3; 95% confidence interval [CI], 1.3 to 4.1; P=0.003).

DISCUSSION AND CONCLUSION: In healthy, elderly patients with a displaced FNF, THR yields, without increasing mortality, a better hip function and significantly fewer re-operations over a long term period.

PAPER NO. 767

Step Activity Levels after Surface Replacement and Total Hip Arthroplasty in a Young Active Population

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Erin Ruh, MS, Saint Louis, MO
Robert L. Barrack, MD, Saint Louis, MO

INTRODUCTION: There has been recent interest in surface replacement arthroplasty (SRA) as an alternative to total hip arthroplasty (THA), although there is limited objective data to support claims that SRA allows patients to be more active postoperatively. Rating scales for THA were developed in the 1960s, and, consistent with indications at that time, excellent score required only pain relief, normal walking, and successful basic activities of daily living. Despite the application of hip arthroplasty procedures to a younger, more active, more demanding patient population, these same subjective rating scales are still utilized. If no difference in any objective clinical measure can be demonstrated, continued support for SRA will be difficult to justify given the rising concerns over metal on metal articulations. The purpose of this study was to objectively determine the functional outcomes following SRA compared to THA using a step activity monitoring device.

METHODS: We prospectively enrolled 64 young, active patients (35 SRA and 29 THA) to wear an activity monitor (AM), which measures duration and level of activity, total number of steps taken per day, and distinguishes between patterns of activity and inactivity. Inclusion criteria: Males age ≤65 and females age ≤55, pre-symptomatic UCLA score ≥6, BMI ≤35, and a desire to return to high impact activities. The THA group consisted of patients meeting the inclusion criteria but with a contraindication precluding SRA (e.g., large cyst; AVN > 50%; LLD > 1cm). Patients wore the AM on their ankle for one week pre-operatively and at one year postoperatively.

RESULTS: Both groups showed statistically significant improvement in activity after surgery for the average number of steps per day (p=0.003) and percentage of time at high levels of activity (p=0.0066). There was also a decrease in the percentage of inactivity for both groups (p=0.0157). Additionally, the THA group significantly increased the percentage of time at medium (p=0.0018) and low (p=0.0013) levels of activity. The only significant difference between the two groups was change in inactivity after surgery that favored the THA group (p=0.0496).

DISCUSSION AND CONCLUSION: Step activity monitoring data indicates that both SRA and THA patients increase activity levels following surgery, but we found no objective evidence to support the claim that SRA patients are more active than THA patients.

PAPER NO. 768

Labral Tears Seen in MRI: What is the Significance?

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Fiona Carty, MD, Castleknock, Ireland
William Morrison, MD, Philadelphia, PA
Javad Parvizi, MD, Philadelphia, PA

INTRODUCTION: Acetabular labral tear is becoming an increasingly common diagnosis with orthopedic surgeons facing patients who have been given an MRI diagnosis of labral tear. The significance of labral tear seen on the MRI is still not well understood. It has been our experience that a large number of patients presenting with labral tear in a symptomatic hip also have evidence of labral tear in the contralateral and often asymptomatic hip. The intention of this study was to determine the incidence of labral tear in asymptomatic hips.

METHODS: Patients undergoing MR arthrogram for unilateral hip or pain were included in this study. Patients were excluded if they had documented bilateral hip pain, no labral pathology was present on the affected side, or if patients had recent hip or pelvic surgery. A total of 176 studies met the inclusion criteria. Radiologist readings of both the affected and asymptomatic sides were compared. This study is ongoing with a plan to include a total of 777 MR arthrograms of the hip done within the past three years at our institution.

RESULTS: Labral tear was seen in 158 of 176 symptomatic hips. Of the 158 patients with a labral tear on their symptomatic side, 20 patients (12.7%) also had a contralateral labral tear that was asymptomatic.

DISCUSSION AND CONCLUSION: The relatively high presence of labral pathology in contralateral and asymptomatic hip reinforces the notion that presence of a labral tear on cross sectional imaging may not be a clinically significant finding and certainly does not warrant surgical intervention in all. Even in the presence of labral pathology (tear, cyst, detachment, and so on) meticulous clinical evaluation should be performed to determine the exact cause of hip pain. This study is most likely underreporting the incidence of labral pathology in asymptomatic hips, as arthrogram of the asymptomatic hips were not performed.
Does Periacetabular Osteotomy Modulate Hip Cartilage Biochemistry? A Prospective dGEMRIC Study

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Nitya Krishnan, MS, Singapore, Singapore
Jenny Chan, BS, Boston, MA
Michael B. Millis, MD, Boston, MA
Young Jo Kim, MD, Boston, MA

INTRODUCTION: The aim of this study was to prospectively assess proteoglycan content in patients with developmental dysplasia of the hip (DDH) undergoing periacetabular osteotomy (PAO). METHODS: Thirty-six hips of 36 patients (mean age 25.5±8.9 years, range 13-45) undergoing PAO were included in this prospective cohort study. Patients with DDH and a lateral center edge angle < 16 degrees were included. Patients with more severe osteoarthritis (Tönnis grade greater or equal to II) and neuro-muscular disorders were not eligible. To assess cartilage proteoglycan content delayed Gadolinium Enhanced MRI of Cartilage (dGEMRIC), scans were performed pre-operatively and one year post-operatively for each patient. A 1.5T MR system and a fast 3D isotropic T1 mapping sequence (four minutes scan time) were used. The regions of interest (ROIs) were selected on five radial reformats along the acetabulum: anterior, anterior-superior, superior-anterior, superior, and superior-posterior radial slices were generated in 30 degree steps. Anatomic landmarks around the acetabulum were used to register the pre and post-operative scans. On each of the five radial reformats, the acetabular cartilage was evaluated. Pre-operative X-rays were evaluated for Tönnis osteoarthrosis grade. In addition to a global analysis, the data were subdivided into tertiles (thirds) of pre-op dGEMRIC index (12 per group) to assess the dGEMRIC changes in patients with a low, intermediate, and high dGEMRIC index. Paired t-tests were used. RESULTS: The pre-operative Tönnis grade was 0 (normal) in 23 and I (minimal OA changes) in 13 patients. The dGEMRIC index of the total cohort decreased from 575.8±139.8 milliseconds (ms) pre-op to 520.3±130.3 ms one-year post-op; however, these values are within the normal range for healthy subjects (570±90 ms). The tertile cohort of low pre-op dGEMRIC index showed a significant increase in dGEMRIC index: 430.4±74.5 vs. 456.8±118.8 ms (pre-op vs. post-op; p=0.02). On the other hand, the intermediate and high pre-op dGEMRIC cohorts showed a decrease (within the normal range): 576.9±31.4 vs. 515.0±117.8 and 717.7±103.1 vs. 587.9±120.6 ms (p<0.001 for both). DISCUSSION AND CONCLUSION: In vitro and in vivo studies have shown that cartilage proteoglycan content can be modulated by mechanical stress and furthermore, in vivo dGEMRIC studies have shown that physical activity can modulate knee cartilage proteoglycan content (Tiderius et al, Magn Reson Med. 2004). Our results demonstrate an increase in proteoglycan concentration after osteotomy in cartilage areas with low pre-op dGEMRIC index (mild degenerative changes). In areas with normal and higher than normal pre-op dGEMRIC index (intermediate and high dGEMRIC cohorts), the proteoglycan content decreased to normal range after osteotomy. It can be assumed that this decrease in proteoglycan content is related to decreased mechanical loading resultant from increased femoral head coverage after osteotomy. Hence, PAO for hip dysplasia appears to modulate cartilage proteoglycan concentration into a more normal range after surgery. A “healing response” of mildly degenerated acellular cartilage after PAO is suggested by these data.

Medical Complications and Mortality Following Lower Limb Arthroplasty in the English NHS

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Philip James, PhD, Alcester, Warwickshire, United Kingdom
Ignacio Serrano-Pedraza, PhD, Madrid, Spain
Robert Sanders, MBBS, London, United Kingdom
Mike R. Reed, MBBS MD, Northumberland, United Kingdom

INTRODUCTION: Medical complications and death are rare events following elective orthopaedic surgery. Diagnostic and operative codes are routinely collected on every patient admitted to hospital in the English NHS (hospital episode statistics, HES). This is the first study investigating rates of these events following lower limb arthroplasty in the English NHS. METHODS: All patients (559,017 patients) who underwent hip (THR) or knee arthroplasty (TKR) between March 2005 and February 2010 were analyzed. Patients were subdivided based on Charlson co-morbidity score. Ninety-day medical complications - myocardial infarction (MI), cerebrovascular event (CVA), chest infection (LRTI), acute renal failure (ARF), and pulmonary embolus (PE) - and inpatient mortality were extracted. RESULTS: The overall 90-day in-hospital MR after THR was 0.44% (1130 of 256350 patients) and 0.34% (1034 of 302667) after TKR. MI rate was 0.43-0.52%. Of these 14.3% died. LRTI rate was 0.72-0.74%. Of these 12.2% died. RF rate was 0.42-0.48%. Of these 14.1% died. PE rate was 0.65-0.80%. Of these 3.9% died. Patients were more likely to die following LRTI than PE (Odds ratio 3.40 [95% confidence intervals 2.82-4.08]). TKR patients with chronic obstructive pulmonary disease (COPD) were more likely to have a post-operative LRTI than patients without COPD (OR 3.92 [3.36-4.58]). For THR patients, this was higher (OR 4.96 [4.28-5.75]). In patients with no co-morbidities, no personal history of venous thromboembolism, and no post-operative complications (47% of all patients in this study, 261,222 of 559,017), mortality was only 0.1% (257 patients). DISCUSSION AND CONCLUSION: This national data analysis allows a greater understanding of mortality risk following post-operative complications, and provides robust information for the consenting process. Despite the concerns regarding VTE and the high investment in prevention, fatal PE is in fact far less common than mortality after MI, LRTI and RF. This data also shows that the risk of mortality for fit patients without post-operative complications was very low.

Total Hip Arthroplasty for Femoral Neck Fracture: Comparing Outcomes to an Elective Patient Population

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Stephen A. Sems, MD, Rochester, MN
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Tad M. Mabry, MD, Rochester, MN

INTRODUCTION: Medical complications and death are rare events following elective orthopaedic surgery. Diagnostic and operative codes are routinely collected on every patient admitted to hospital in the English NHS (hospital episode statistics, HES). This is the first study investigating rates of these events following lower limb arthroplasty in the English NHS. METHODS: All patients (559,017 patients) who underwent hip (THR) or knee arthroplasty (TKR) between March 2005 and February 2010 were analyzed. Patients were subdivided based on Charlson co-morbidity score. Ninety-day medical complications - myocardial infarction (MI), cerebrovascular event (CVA), chest infection (LRTI), acute renal failure (ARF), and pulmonary embolus (PE) - and inpatient mortality were extracted. RESULTS: The overall 90-day in-hospital MR after THR was 0.44% (1130 of 256350 patients) and 0.34% (1034 of 302667) after TKR. MI rate was 0.43-0.52%. Of these 14.3% died. LRTI rate was 0.72-0.74%. Of these 12.2% died. RF rate was 0.42-0.48%. Of these 14.1% died. PE rate was 0.65-0.80%. Of these 3.9% died. Patients were more likely to die following LRTI than PE (Odds ratio 3.40 [95% confidence intervals 2.82-4.08]). TKR patients with chronic obstructive pulmonary disease (COPD) were more likely to have a post-operative LRTI than patients without COPD (OR 3.92 [3.36-4.58]). For THR patients, this was higher (OR 4.96 [4.28-5.75]). In patients with no co-morbidities, no personal history of venous thromboembolism, and no post-operative complications (47% of all patients in this study, 261,222 of 559,017), mortality was only 0.1% (257 patients). DISCUSSION AND CONCLUSION: This national data analysis allows a greater understanding of mortality risk following post-operative complications, and provides robust information for the consenting process. Despite the concerns regarding VTE and the high investment in prevention, fatal PE is in fact far less common than mortality after MI, LRTI and RF. This data also shows that the risk of mortality for fit patients without post-operative complications was very low.
operative complication rate, post-operative disposition, and mortality rate were examined and compared between groups at six-year intervals (‘90-’95, ‘96-‘01, ‘02-‘07). RESULTS: A total of 2,160,061 primary THA procedures were performed for OA, while 174,641 were performed for FNF. There was a difference in the mean age between the two groups, which was 68 and 79, respectively. The peri-operative mortality rates following elective and post-traumatic THA were 0.2% and 1.7% for the first interval, 0.1% and 2.9% for the second interval, and 0.3% and 0.8% for the third interval (p<0.001). The percentage of patients with diabetes, the length of stay, and the percentage of patients discharging to a rehab facility were higher in the FNF group at each time interval. Acute dislocations were more frequent in the FNF patients during the first and second intervals, but this was not observed during the last time interval.

DISCUSSION AND CONCLUSION: In comparison to primary elective THA for OA, THAs performed in patients with a FNF result in higher peri-operative mortality rates, longer hospital stays, and a greater need for post-operative inpatient rehabilitation. While once greater in the FNF population, dislocations between the elective and FNF groups have recently equilibrated. This may be due to increased use of larger femoral heads.

PAPER NO. 772
Total Hip Arthroplasty in Osteonecrosis: Does Prior Treatment Affect Long Term Outcome?
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Aaron J. Johnson, MD, Baltimore, MD

INTRODUCTION: Osteonecrosis can be a challenging disease for the orthopaedist to treat, especially since these are young patients who present with end stage hip disease. Consequently, many joint preserving procedures, such as core decompression, bone grafting, or bone sparing procedures such as resurfacing arthroplasty are utilized in an attempt to preserve as much femoral bone stock as possible in these patients. Historically, total hip arthroplasty has been considered a last resort for these patients after all other treatment options have been exhausted, mainly due to historically poor reported implant survivorship. The purpose of this study was to assess the clinical and radiographic outcomes of standard total hip arthroplasty in all patients who were treated by a single surgeon for osteonecrosis to determine if prior surgical treatments affected outcomes.

METHODS: Between 2001 and 2010, 213 total hip arthroplasty procedures were performed in 192 patients who had a primary diagnosis of osteonecrosis. There were 125 men and 88 women who had a mean age of 41 years (range, 13 to 81 years) at time of total hip arthroplasty, a mean body mass index of 27 kg/m2, and a mean follow up of 75 months (range, 24 to 125 months). Patients were stratified according to prior surgical intervention for osteonecrosis: there were 42 patients (44 hips) who had a prior resurfacing arthroplasty, 45 patients (48 hips) who had prior core decompressions or bone grafting procedures performed, and 105 patients (121 hips) who had no prior surgical intervention. Additionally, there were nine patients who had failed hemisurfacing arthroplasty procedures. All hips were graded according to the Ficat and Arlet classification system. Outcomes were assessed to determine overall implant survivorship, time to revision surgery, and Harris hip scores.

RESULTS: There were nine revisions for aseptic reasons, for an overall implant survivorship of 96%. The mean Harris hip scores improved from a pre-operative mean of 45 points (range, 30 to 60 points) to a post-operative mean of 86 points (range, 55 to 100 points). Of the 44 hips who had previous resurfacing arthroplasty, there were four revisions for aseptic reasons (91% survivorship); there were two aseptic revisions in 48 hips that had a history of core decompression (96% survivorship); and three aseptic revisions in 121 hips that had no history of prior surgical treatment (98% survivorship). Although the survivorship was higher in the cohort of patients who did not undergo prior surgical procedures, there was no difference when compared to either patients who had prior resurfacing (p=0.08), or prior core decompression (p=0.62).

DISCUSSION AND CONCLUSION: This study reports excellent overall survivorship of 96% in this difficult patient population at mid-term follow up. Although patients who had prior surgical interventions, especially those who had undergone resurfacing arthroplasty, had slightly lower survivorship when compared to those who had not, there was no statistical difference in the results. This indicates that joint preserving procedures, including core decompression and bone grafting procedures, do not adversely affect the outcomes of later total hip arthroplasty. In light of this, it is the opinion of the senior authors that joint preserving procedures should be attempted whenever appropriate, taking into account the level of collapse and stage of disease at time of presentation, prior to total hip arthroplasty. When arthroplasty is ultimately required, it is encouraging that the overall survivorship is high in this difficult to treat young patient population.

PAPER NO. 773
◆Does the Patient Know Best? Sports and Satisfaction after Total Hip Arthroplasty
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INTRODUCTION: Many patients expect to recover normal hip function after total hip arthroplasty (THA), and often return to the sports they enjoyed prior to surgery. Surgeons have recommended against participation in many of these demanding activities because of their risk to the patient and to implant survival. The purpose of the study was to determine if participation in demanding activities after THA causes an increase in pain, symptoms, or dissatisfaction.

METHODS: A total of 143 patients (51% male, avg. age 62.9) were enrolled in the study with IRB approval. All patients underwent primary, unilateral THA and had no co-morbidities. At a minimum of one-year post-op, each patient completed a self-administered Hip Function Questionnaire, consisting of an inventory of 124 activities and a survey of the patients’ symptoms, pain and satisfaction. An activity score was also calculated for each patient, based on their frequency of participation and the level of collapse and stage of disease at time of presentation, prior to total hip arthroplasty.

RESULTS: A total of 31% of patients were classified as high-demand (HD), 31% as medium-demand (MD), and 38% as low-demand (LD). There was no significant difference between groups in terms of: frequency of hip pain (23%; p=0.89), hip stiffness (18%; p=0.95), or use of pain medications (5%; p=0.98). Fewer HD patients reported that their hip feels normal (81%) compared to MD (95%; p=0.02) and LD patients (89%; p=0.03). However, more high-demand patients were extremely satisfied (86%) than medium-
demand (64%; p = .007) or low-demand patients (71%; p = .03).

DISCUSSION AND CONCLUSION: Despite the risk of participation in sports and other high-demand activities, patients do not seem to experience increased incidence of pain or symptoms compared to those who are sedentary. High-demand patients seem to be aware of persistent symptoms yet are satisfied to maintain an active lifestyle.

PAPER NO. 774

Spinal vs. General Anesthesia in THA: An Analysis using Prospectively Collected Clinical Patient Data

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INTRODUCTION: The pros and cons of general anesthesia versus spinal anesthesia in total hip arthroplasty (THA) has been a long debated topic. The purpose of this study was to compare the surgical times, blood loss and transfusion requirements between anesthetic types in patients undergoing primary THA.

METHODS: A consecutive series of 1,600 THA procedures with complete preoperative and postoperative data were evaluated. Twenty-eight percent of procedures were performed with a general anesthetic (GA), 67% with a spinal anesthetic (SP) and 5% with a combination of the two. Outcomes were compared and tested for significance using the Independent Samples Kruskal Wallis or Pearson Chi-Square analysis.

RESULTS: Comparing GA and SP respectively, there was a statistically significant difference in patient age between the groups (age 63.73 ± 14.5 vs. 66.6 ± 12.8, p<.05), but not in ASA scores and distribution, or preoperative hemoglobin levels (131.74 ± 32.5 vs. 133.21 ± 28.9). There was a statistically significant difference in length of time proceeding surgical procedure favoring Generals (SP: 35 mins (10 - 72) vs. GA: 30 mins (8 - 65), p<.05), however overall time in room was longer in Generals (GA: 132.83 ± 29.0 vs. SP: 127.15 ± 22.5). There was a statistically significant difference in discharge hemoglobin favoring Spinals (SP: 97.9 ± 14.2 vs. GA: 94.9 ± 16.4, p<.05), lower transfusion rates (SP: 8.4% vs. GA: 14.0%, p<.05) and shorter length of stay (SP: 4.9 days vs. GA: 5.3 days, p<.05). The patients receiving a combination of anesthetic had a significantly greater length of time until surgical procedure (43 mins (20 - 145)) and overall time in room (142.85 ±27.2) compared to both GA and SP, however were similar in all other outcomes.

DISCUSSION AND CONCLUSION: In this consecutive series of patients undergoing general anesthesia, spinal anesthesia and a combination for total hip arthroplasty, the general anesthesia cohort demonstrated advantages in statistically significantly shorter time proceeding the surgical procedure, however the overall procedure time was significantly longer. The spinal group had less blood loss and lower transfusion rates and the combination group had statistically longer procedure times compared to both GA and SP.

PAPER NO. 775

Real Time Visualization of Femoroacetabular Impingement and Subluxation Using 320-slice Computed Tomography

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INTRODUCTION: Femoroacetabular impingement results from unphysiological femoroacetabular contact and causes hip pain as well as premature hip osteoarthritis. As the symptoms are related to function, it may be difficult to identify a femoroacetabular impingement (FAI) on standard radiographs. The purpose of the present study was to identify anatomical factors predisposing a femoroacetabular impingement and assess the diagnostic accuracy of dynamic four-dimensional volume computed tomography in the preoperative diagnosis of femoroacetabular impingement.

METHODS: On dynamic four-dimensional volume computed tomography (CT) 30 patients with hip pain (> 3 months) and positive clinical and radiological impingement signs were prospectively analyzed. The dynamic investigations were performed in flexion, as well as in abduction and external rotation. The accuracy of the computed tomography measurement was tested by comparison of the preoperatively evaluated impingement with the intraoperative findings during surgical dislocation, which were defined as the gold standard.

RESULTS: The rate of anterior and posterior impingement as noted at the time of surgical dislocation was 90% (27 of 30) and 70% (21 of 30). Compared to the intraoperative findings, the dynamic CT images showed a high agreement. Additionally significant correlations were found between decreased hip flexion and a decreased acetabular anteversion and between a decreased external rotation and an increased beta and combined posterior angle. On four-dimensional computed tomography a posterior-caudal subluxation was observed in 12 patients and an anterior subluxation was found in 21 patients DISCUSSION AND CONCLUSION: Four-dimensional computed tomography is a suitable method to dynamically visualize the functional consequences of anatomical FAI pathologies. The location of the impingement can be accurately determined and, when combined with information about possible chondral damage supplied by magnetic resonance arthrography, allows the surgeon to select the optimal surgical access and plan the required operation for minimal invasiveness.
**DISCUSSION AND CONCLUSION:** The surgical alteration of hip bony impingement was 97.0 ± 5.9 degrees on the right and 95.9 ± 16.2 degrees. Maximum mid-sagittal flexion, measured at the time of femoral impingement upon the acetabular rim.

RESULTS: The mean age of the subjects was 27.9 ± 3.1 years and the mean body mass index (BMI) was 25.2 ± 3.8. All femoral heads were found to be spherical. Thirteen subjects were identified with varying degrees of anterolateral head-neck junction CAM morphology, bilateral in three and unilateral in 10 individuals. The overall incidence of CAM findings in the study was 16/80 hips (20%). Soft tissue impingement occurred prior to bony impingement in all hips. Average impingement-free hip flexion measured from full extension to initial labral deflection was comparable side to side: right 68.3 ± 17.2 degrees and left 68.3 ± 16.2 degrees. Maximum mid-sagittal flexion, measured at the time of bony impingement was 97.0 ± 5.9 degrees on the right and 95.9 ± 6.4 degrees on the left. Subjects with CAM morphology impinged at lower degrees of flexion than morphologically normal hips.

DISCUSSION AND CONCLUSION: The surgical alteration of hip anatomy for the purpose of increasing impingement-free range of motion requires knowledge of normative data. This study demonstrates that labral deflection occurs at less flexion than bony impingement in asymptomatic young adult males. Maximum hip flexion in asymptomatic males is approximately 95 degrees, significantly less flexion than previously considered normal.
unknown. The purpose of this study was to evaluate the concordance between administrative claims and the clinical record for 13 commonly reported comorbidities and complications in TJA patients.

METHODS: Administratively coded diagnosis and procedure codes obtained from hospital billing records from 1,350 consecutive primary and revision TJA procedures performed at three high volume institutions during 2009 were compared with corresponding clinical documentation, including operative notes and discharge summaries. Administratively coded comorbidities and complications derived from hospital billing records were compared with clinical documentation. Concordance between the administrative and clinical records was determined for each revision TJA-related ICD-9 comorbidity and complication code.

RESULTS: Concordance was excellent for diabetes and post-op MI (K=0.80), very good for chronic lung disease, coronary artery disease, and post-operative DVT/PE (K=0.60-0.79), and moderate for congestive heart failure, obesity, prior MI, peripheral arterial disease, bleeding complications, history of DVT/PE, prosthetic-related complications, and post-op renal failure (K=0.40-0.59). All comorbidities and complications had a high degree of specificity (>92%), but lower sensitivity (29-100%), indicating that comorbidities and complications coded in the administrative record were highly accurate, but often incomplete.

DISCUSSION AND CONCLUSION: Administratively coded comorbidities and complications have moderate to excellent correlation with the clinical record. However, the specificity of administrative claims is much higher than the sensitivity. These findings underscore the need for improved, unambiguous clinical documentation related to TJA procedures.

PAPER NO. 779

Multiple Osteonecroses (ON) in Patients with Steroid-induced ON of the Femoral Head - Analysis of 2,400 Joints
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INTRODUCTION: Multiple bone necroses occurring in patients with osteonecrosis (ON) of the femoral head has been reported to be relatively rare by radiographic analysis. However, many cases of multiple bone necroses were revealed by MRI. A detailed investigation into multiple bone necroses was conducted in order to contribute to the understanding of the etiology of bone necrosis. This research was performed in order to investigate the incidence, common sites of occurrence, and clinical symptoms and surgical treatment of the steroid-induced multiple bone necroses.

METHODS: The subjects of this study consisted of 300 patients with steroid-induced ON of the femoral head. There were 57 male and 243 female patients with an average age of 37 years. An analysis was made of the hips, knees, shoulders, and ankles of each patient. MRI and radiography were performed in all 2,400 joints, and RI (99mTc-MDP) in 1,272 joints.

RESULTS: Multiple bone necroses were observed in 203 of 300 patients (67%). Through an analysis of occurrence by site in the 1,800 joints (600 knees, 600 shoulders, 600 ankles), the most common site was the lateral femoral condyle (49%), followed by the distal femoral meta-diaphysis (37%), medial femoral condyle (32%), and humeral head (24%). The occurrence of necrosis was classified into two areas: articular areas in contact with cartilage and meta-diaphyseal areas not in contact with bone endostem. Collapse was revealed in 292 of 600 hips (49%), however it was relatively rare in the knees (14%), in the shoulders (7%), and ankles (4%). Surgical treatment was required in 221 hips (37%), 17 knees (3%), and four ankles (1%).

DISCUSSION AND CONCLUSION: From our investigation, it was evident that steroid-induced multiple necroses occurs in high frequency. We believe that systemic damage of the terminal vessels in bone marrow is the cause of steroid-induced ON.

PAPER NO. 780

Characterization of Patient Expectations and Satisfaction Following Total Hip Arthroplasty (THA)
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Manoshi Bhowmik-Stoker, PhD, Mahwah, NJ

INTRODUCTION: Given the growing focus on patient centered care, research on the individual goals of patients who choose to undergo total hip arthroplasty (THA) and the degree to which their expectations are met, becomes increasingly important. The purpose of this study was to prospectively study individual patient’s activity expectations preoperatively in comparison with their subjective outcome postoperatively. This type of individualized data is an important addition to traditional clinical outcome measures.

METHODS: The Patient Expectation Questionnaire (PEQ) was administered to 236 patients prior to primary THA, prospectively enrolled from multiple centers. Preoperatively, patients were asked to select three of 12 possible types of desired activity that were most important in their decision to undergo THA. At six months, one and two years postoperatively, patients rated the extent of their ability to carry out those same activities and their satisfaction. Traditional clinical outcome measures were also collected.

RESULTS: At one year, 82.6% of all identified pre-operative expectations were achieved ‘most of the time’ (≥75%) with a high level of satisfaction (89.3%). Top two expectations from the preoperative PEQ were ‘recreational activities’ (50.42%) and ‘return to sports’ (39.41%), highlighting the significance of return to “nonessential” activities. Younger, patients were more likely to expect the surgery to benefit ‘return to work’ and ‘sexual function’ (p<0.0001) while older (p<0.0001) and heavier patients (p=0.001), often selected ‘elimination of assistive devices’ and ‘independence in daily activities’ in their preop expectations.

DISCUSSION AND CONCLUSION: Characterization of patient expectations is essential in providing patient centered healthcare with positive clinical outcomes.

POSTERS

POSTER NO. P001

A Comparison of Metal on Metal to Metal on Highly Cross-linked Polyethylene Total Hip Replacements
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Liz Paxton, MA, San Diego, CA
Cunlin Wang, Silver Spring, MD
Art Sedrakyan, PhD, MD, New York, NY

INTRODUCTION: Concern regarding increased revision rates of metal on metal bearings has led to caution in their use. While used for many years now, their current status remains questionable. We aimed to provide clinical data from a large prospectively collected...
total joint registry on the short- and mid-term results of total hip replacements (THR) comparing metal on metal (MOM) to metal on highly cross-linked polyethylene (XLPE) bearing surfaces. METHODS: A contemporary total joint registry was reviewed from 2001 to 2009. A total of 18,050 primary THR were evaluated. Metal on metal accounted for 20.4% of these cases while metal on highly cross-linked polyethylene accounted for the remainder, 79.6%. Failure was defined as aseptic revision for any reason. KM survivorship curves were created. A propensity score analysis was performed to evaluate factors associated with revision surgery including bearing surface. The propensity score model was a logistic regression run as generalized linear mixed model with random effects for surgeon and site. It included BMI, age, gender, diagnosis, diabetes, race (black, Hispanic, Asian, white, other), operative time, surgeon and site annual volumes, surgical approach, femoral head size, fixation (hybrid, cemented, uncemented), antibiotics in cement, and surgeon fellowship as predictors. RESULTS: At five-year follow up, cumulative implant survival was 97.5%. For XLPE it was 97.4% and for MOM it was 98.2%. The stratified Cox regression model yielded a hazard ratio for aseptic revision among MOM vs. XLPE of 1.07 (95% CI 0.84, 1.37) p=0.581. DISCUSSION AND CONCLUSION: A contemporary United States based total joint registry found excellent five-year survivorship for total hip replacements utilizing both metal on metal and metal on highly cross-linked polyethylene bearing surfaces. In a multiple variable model, no difference in survivorship was discovered between the two bearing surfaces examined.

POSTER NO. P002

Five-Year Results of a Prospective, Randomized, Controlled Study of a Composite Femoral Component for THA

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Lawrence R. Housman, MD, Tucson, AZ
Scott V. Slagis, MD, Tucson, AZ
John A. Maltry, MD, Tucson, AZ
Jay A. Katz, MD, Tucson, AZ
Brad Askam, Tucson, AZ
Robert W. Eberle, Pleasanton, CA

INTRODUCTION: The purpose of this prospective, randomized controlled study was to compare the five-year clinical, radiographic, and DEXA results of a Composite Femoral Component for primary THA with other non-cemented femoral components of varying design and surface preparation. METHODS: The Epoch® Hip Prosthesis Components were studied in conjunction with the VerSys® Fiber Metal Taper, Fiber Metal Midcoat, and Beaded Fullcoat components. All 227 patients were randomized into one of five groups and followed prospectively for five years. All patients were assessed using the Harris Hip Score, SF-36 and WOMAC. Radiographic analysis was performed to assess differences using the various components. DEXA was used to determine changes in peri-prosthetic BMD. RESULTS: There were differences between groups for the HHS, SF-36 and WOMAC scores. The Epoch Components showed better results for relief of pain and restoration of function. Radiographs revealed no difference in the incidence of assessment criteria. Serial DEXA results showed better maintenance of BMD for the Epoch Components. DISCUSSION AND CONCLUSION: The results from this trial showed that a Composite Femoral Component for primary THA can achieve clinical and radiographic results equal to standard alloy components of varying design. Additionally, the Composite Femoral Components maintained femoral BMD better than the alloy based components used for comparison. Based on these early results, the Epoch Femoral Components for primary THA are justified for continuation of further prospective study.

POSTER NO. P003

ALTERNATE PAPER: ADULT RECONSTRUCTION HIP II

Inpatient Pulmonary Embolism in Elective Primary Hip and Knee Arthroplasty Patients

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Vincent Pellegrini, MD, Baltimore, MD
Mary Forte, PhD, RN, Baltimore, MD

INTRODUCTION: The incidence of inpatient pulmonary embolism (PE) in elective primary arthroplasty patients in the United States is unknown. Prior studies have included patients with cancer, trauma, revisions or patients under age 60. The goals of this study were to determine the incidence and adjusted odds of inpatient PE by procedure in elective primary hip and knee arthroplasty patients in the U.S. METHODS: The 1998-2007 Nationwide Inpatient Sample (NIS), Healthcare Cost and Utilization Project of the Agency for Healthcare Research and Quality (AHRQ) provided a national stratified probability sample of all-payer hospital discharge data for this retrospective cohort study. Patients age 60 years or older who had an inpatient stay for at least one total hip (THA) or total knee (TKA) arthroplasty were included (ICD-9-CM 81.51, 81.54). Patients with cancer, infection, trauma or revisions were excluded. The outcome was inpatient PE (ICD-9 diagnosis 415.1x). We determined descriptive statistics and 95% confidence limits (CL) on the estimates from SAS® SURVEYFREQ and the adjusted odds of inpatient PE by procedure from SAS® SURVEYLOGISTIC, controlling for patient age, sex, Charlson comorbidity score and surgical indication. RESULTS: The sample included 796,121 discharge abstracts representing 3,893,472 patients with inpatient hospital stays for primary THA or TKA. Women comprised 63.7% of patients. Two-thirds of patients were under age 75. Osteoarthritis was the primary diagnosis in 95.6% of patients. Most patients had few comorbidities (Charlson score=0 in 68.5%). Patients with unilateral TKA comprised 65.36% of admissions; two-joint admissions were 4.59% (95.4% were bilateral TKA). The overall unadjusted PE incidence was 0.362% (95% CI: 0.339%, 0.384%). PE differed by procedure with unilateral THA patients having the lowest PE incidence. Multiple-procedure patients had the highest PE incidence, especially bilateral THA. The adjusted odds of PE showed a similar pattern by procedure. DISCUSSION AND CONCLUSION: Elective TKA is associated with higher incidence of inpatient PE than THA in the U.S. Multiple procedures are associated with a higher incidence of PE than unilateral procedures, especially in bilateral THA. Our results can assist surgeons in patient education and perioperative planning. Further research identifying ways to decrease PE in elective TKA and multi-procedure patients is warranted.
The FDA has not cleared the drug and/or medical device for the use described in this presentation (i.e. the drug or medical device is being discussed for an off label use).

For full information refer to page 14. An alphabetical faculty financial disclosure list can be found starting on page 19.

INTRODUCTION: Pseudotumors are sterile, inflammatory periprosthetic lesions found adjacent to painful metal-on-metal hip replacements (MOM-HR). They are thought to represent an adverse response to implant-derived metal wear particles and may be diagnosed using cross-sectional imaging. Their incidence in well-functioning MOM-HR is not known.

METHODS: We performed a case-control study comparing findings on magnetic resonance imaging (MRI) of patients with unilateral MOM-HR. We defined cases as patients with unexplained, painful MOM-HR (intention to revise due to pain or Oxford Hip Score (OHS) <30 out of 48). We defined controls as patients with well-functioning MOM-HR. Thirty cases and 28 controls were consecutively recruited. Incidence and appearances of pseudotumours were recorded. All patients underwent computerized tomography (CT) for acetabular component position measurement.

RESULTS: We diagnosed 34 pseudotumors in this series. The OHS of cases (mean 20.2, 95% confidence interval (CI) 12.7-45.8) was significantly poorer than controls (mean 41.2, 95% CI 18.5-45.8, p=<0.0001). The prevalence of pseudotumor in cases (17 of 30 patients [61%]) versus controls (17 of 28 patients [57%]) was not significantly different. No objective differences in pseudotumor characteristics were identified between groups. No correlation between the presence of a pseudotumor and component position was identified.

DISCUSSION AND CONCLUSION: Periprosthetic cystic pseudotumours were found commonly in both groups, with no significant difference between case and control groups. Pseudotumor was also commonly found in patients with well positioned acetabular components, measured by CT. While MARS MRI is useful for surgical planning, the presence of a pseudotumor may not necessarily indicate the need for revision surgery.

INTRODUCTION: The National Joint Registry for England and Wales report a five-year clinical failure rate of 12% for the DePuy ASR. This compares to 4.3% for the Smith and Nephew BHR. Subsequently this has led to the recall of the ASR resurfacing and XL hip systems. However, the mechanisms responsible for the high failure rate of the ASR compared to other current generation metal-on-metal (MOM) hip arthroplasties remain unclear. We compared clinical data and wear performance for a large series of retrieved ASR and BHR hips.

METHODS: This was a well-powered study of 130 consecutively retrieved total hip replacements. The retrieved ASR and BHR components were macroscopically examined and then sent to an independent laboratory for wear measurements.
revised large diameter MOM hip arthroplasties, comparing the DePuy ASR (n = 66) with the Smith and Nephew BHR (n = 64). Pre-, intra- and post-operative clinical data was collected prospectively for all patients to establish the clinical cause of failure. This included pre-revision radiographs and blood metal ion analysis. Linear wear rates were measured for all explanted components using a roundness measuring machine according to a published protocol.

RESULTS: The two groups had comparable clinical variables (Table 1), including the clinical cause of failure. The ASR group demonstrated higher levels of whole blood cobalt and chromium, although this trend was not statistically significant. Wear analysis (Table 2) showed that the acetabular components of the ASR, when compared to the BHR, were significantly higher wearing (p = 0.03) and more likely to be edge worn (p < 0.01). However, there was no difference in the femoral head wear rate (p = 0.14). DISCUSSION AND CONCLUSION: We attribute our findings to specific design differences between the two prostheses. The ASR has a lower clearance and reduced cup articular arc angle when compared to the BHR. Both of these factors increase the likelihood of edge contact and are likely to lead to increased wear, particularly of the cup. This may explain why the ASR appears to be more sensitive to sub-optimal position.

Table 1. Summary of patient and clinical data for the ASR and BHR hips in this study.

<table>
<thead>
<tr>
<th></th>
<th>ASR</th>
<th>BHR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of hips</td>
<td>66</td>
<td>64</td>
</tr>
<tr>
<td>Female / Male</td>
<td>42 Females / 24 Males</td>
<td>42 Females / 22 Males</td>
</tr>
<tr>
<td>Age at primary</td>
<td>56 (23 to 78)</td>
<td>56 (23 to 68)</td>
</tr>
<tr>
<td>Time implanted (months)</td>
<td>35 (7 to 59)</td>
<td>49 (10 to 121)</td>
</tr>
<tr>
<td>Femoral diameter (mm)</td>
<td>47 (35 to 55)</td>
<td>46 (38 to 58)</td>
</tr>
<tr>
<td>Cup inclination (°)</td>
<td>51 (15 to 82)</td>
<td>51 (24 to 73)</td>
</tr>
<tr>
<td>Cup version (°)</td>
<td>15 (-8 to 48)</td>
<td>23 (-47 to 50)</td>
</tr>
<tr>
<td>WB Chromium (ppb)</td>
<td>9.8 (0.2 to 119.0)</td>
<td>4.8 (0.4 to 183.0)</td>
</tr>
<tr>
<td>WB Cobalt (ppb)</td>
<td>13.5 (0.5 to 167.0)</td>
<td>10.2 (0.0 to 167.0)</td>
</tr>
</tbody>
</table>

Table 2. Comparison of linear wear rates between the ASR and BHR hips.

<table>
<thead>
<tr>
<th></th>
<th>ASR</th>
<th>BHR</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetabular Cup:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linear wear depth (μm)</td>
<td>21.99 (1.3 to 651.8)</td>
<td>14.9 (2.0 to 740.4)</td>
<td>0.646</td>
</tr>
<tr>
<td>Linear wear rate (μm/yr)</td>
<td>9.2 (0.0 to 245.6)</td>
<td>4.2 (0.0 to 153.8)</td>
<td>0.032</td>
</tr>
<tr>
<td>Femoral Head:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linear wear depth (μm)</td>
<td>13.14 (0.0 to 315.3)</td>
<td>15.07 (1.5 to 234.4)</td>
<td>0.779</td>
</tr>
<tr>
<td>Linear wear rate (μm/yr)</td>
<td>6.0 (0.0 to 84.7)</td>
<td>3.5 (0.7 to 52.4)</td>
<td>0.143</td>
</tr>
<tr>
<td>Edge Loading</td>
<td>85% (n = 56)</td>
<td>63% (n = 40)</td>
<td>0.005</td>
</tr>
</tbody>
</table>
INTRODUCTION: Hepatitis C affects 1-2% of the general population and up to 5% of orthopedic patients. Despite this high prevalence, the effects of Hepatitis C on total joint arthroplasty outcomes have not been studied.

METHODS: Eighty-two patients undergoing 95 surgeries between 2006 and 2011 were identified as Hepatitis C patients by the inclusion of ICD-9 codes 70.51, 70.54, or 70.7 in their charts. The study obtained demographic and surgical data for these patients through a chart review and focused on length of hospital stay, blood loss, and hemoglobin loss as outcomes of the surgery. The study values were compared to control values from PubMed-indexed literature between 2008 and 2011.

RESULTS: There were no statistically significant differences in demographics between the study and control samples. In addition, there were no significant differences in outcomes between the acute and chronic/unspecified Hepatitis C samples. The study found that Hepatitis C patients undergoing joint arthroplasties had a shorter hospital stay (3.18 ± 1.4 days) and a smaller hemoglobin drop (3.67 ± 1.9 g/dL) compared to controls (3.7 days and a drop of 4.75 g/dL). These findings were significant at the p < 0.001 level. In addition, the subsample of Hepatitis C patients undergoing hip arthroplasty had a significantly shorter hospital stay (3.1 ± 1.26d), smaller blood loss (164.7 ± 111.5mL) and hemoglobin loss (4.14 ± 1.82g/dL) than their controls (3.7 ± 0.02d, 368.5 ± 277.8mL, and 5.3 ± 1.8g/dL, respectively).

DISCUSSION AND CONCLUSION: These results indicate that Hepatitis C patients performed just as well as the general population. Surgeons may be especially careful with Hepatitis C patients due to the risk of infection spread with blood contact. This prudence may result in more successful surgeries with attendant smaller blood losses and shorter hospital stays. In addition, it is possible that the patients in this study represent a well-controlled Hepatitis C population with liver function similar to the normal population. In that case, orthopedic outcomes would be predicted to be normal, similar to the results of the study. The study has some limitations - the study and control surgeries were performed by different surgeons at different locations. This disparity may lead in part to the outcome differences noted in the study. Further investigation of the surgery time for Hepatitis C patients, suggesting surgical caution, is warranted. Overall, this study finds that Hepatitis C does not have a negative impact on orthopedic surgeries, as measured by length of stay, blood loss, and hemoglobin loss. As a result, a diagnosis of Hepatitis C should not be a contraindication to elective joint replacement surgery since these patients do not appear to have increased complications compared to normal population. Instead, a thorough assessment of the patient’s disease process may be a better indicator for predicting surgical complications.
lowest ALVAL scores demonstrating lower cytokine levels and the highest ALVAL scores demonstrating the highest cytokine levels. DISCUSSION AND CONCLUSION: In patients experiencing ALTR to MoM implants, there is a severe inflammatory response with the cytokines, IL-8, IP-10 and TNF-α, playing a central role. The expression of these cytokines correlates with the histologic severity of the reaction. Pre-operative synovial fluid analysis of select cytokine levels may provide useful diagnostic and prognostic information in determining the necessity and urgency of revision surgery.

POSTER NO. P010
ALTERNATE PAPER: ADULT RECONSTRUCTION HIP VII
Abnormal VEGF Expression in Mesenchymal Stem Cells from Osteonecrotic Hips
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INTRODUCTION: In osteonecrosis (ON) of the hip, interruption of angiogenesis is a pathological process that may lead to impairment of the nutrient supply, cell death, and the collapse of bone. However, the process of angiogenesis in ON is not well understood. The purpose of this study was to investigate the expression of vascular endothelial growth factor (VEGF) in human mesenchymal stem cells (MSCs) in vitro. METHODS: MSCs from osteonecrosis patients were obtained from 15 milliliter aspirates from the intramedullary canal of donors undergoing total hip arthroplasty for osteoarthritis. Salt-free primers for target genes VEGFA, VEGFB, VEGFC, VEGFD and PGF as well as for housekeeping gene GAPDH were generated. Real time PCR conditions included one cycle of denaturation (95°C for 15 min), 45 cycles of amplification and quantification (95°C for 15 sec, 58°C for 15 sec, and 72°C for 15 sec with a single fluorescence measurement), melting curve (65-95°C with a heating rate of 0.1°C per sec and a continuous fluorescence measurement), and finally a cooling step to 4°C. After real-time PCR, the samples were collected by centrifugation and the gene size was analyzed on 2.0% agarose gel. RESULTS: Cultured MSCs obtained from the hips of normal, ON, and osteoarthritic (OA) patients all expressed VEGF-A. Furthermore, MSCs from normal stem cells also expressed VEGF-B, but its expression had a tendency to increase in stem cells from ON and OA patients while VEGF-C was absent in any of the stem cells. However, VEGF-D expression was consistently decreased in MSCs from ON, but increased in stem cells from OA donors than in controls. In addition, placental growth factor (PGF) which has a similar function as VEGF, was expressed in MSCs and the levels were similar in MSCS from normal, ON, and OA donors. DISCUSSION AND CONCLUSION: The results suggest that ON and OA are associated with aberrant VEGF-D expression. Our data further defines the complex changes and interrelationships in the VEGF family gene expression in stem cells from ON and OA donors that may occur in the course of vascular invasion and cell death. This investigation draws attention to these VEGF molecules and their relationships to the physiological and pathological events that are part of angiogenesis.

POSTER NO. P011
Two-year Follow Up of Pseudotumor Diagnosed in Metal-on-Metal Hip Arthroplasties
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Johann Henckel, BM, London, United Kingdom
Keshthra Satchithananda, FRCS, London, United Kingdom
Adam Mitchell, MD, London, United Kingdom
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Donald McRobbie, PhD, London, United Kingdom
John Skinner, FRCS, London, United Kingdom
Alister Hart, FRCS, London, United Kingdom

INTRODUCTION: Cross-sectional imaging of patients with painful metal-on-metal hip arthroplasties (MOM-HA) frequently identifies a pseudotumor, which is thought to represent a sterile, inflammatory reaction. However, the clinical significance of pseudotumor is uncertain following recent evidence that they are commonly present in well functioning MOM-HA. We aimed to investigate prognosis following diagnosis of pseudotumor on metal-artifact reduction sequence MRI. METHODS: We performed a prospective cohort study to follow 81 patients with MOM-HA diagnosed with pseudotumor. We recorded demographic data, Oxford hip score (OHS), 3D computed tomography assessment of component position (n=58) and blood metal ion levels (n=70) at the time of MARS MRI. We performed longitudinal follow up with clinical scores and recording of revision procedures. RESULTS: Fifty-six patients met follow-up criteria. At a median of 27 months follow up, 42 patients had undergone revision surgery. Of the remaining 14 patients, only two had deterioration in OHS. Follow-up results are presented in Table 1. A Kaplan-Meier curve to demonstrate survival of prostheses following diagnosis of pseudotumor on MARS MRI is presented in Figure 1. Demographic data for our study population are presented in Table 2. DISCUSSION AND CONCLUSION: Early revision surgery was common following diagnosis of pseudotumor. However, a proportion of patients showed a clinical improvement for reasons that were not clear. Follow-up MARS MRI may provide useful information in this population. Further research is needed to determine the natural history of pseudotumor and factors associated with poor prognosis.

Table 1. Follow-up of 81 patients diagnosed with pseudotumor on MARS MRI

<table>
<thead>
<tr>
<th>Study number</th>
<th>81 patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lost to follow-up</td>
<td>25 patients</td>
</tr>
<tr>
<td>died [n=2]</td>
<td>dementia [n=1]</td>
</tr>
<tr>
<td>did not wish to participate [n=1]</td>
<td></td>
</tr>
<tr>
<td>Number surveyed</td>
<td>56 patients</td>
</tr>
<tr>
<td>Duration from MARS MRI to follow-up [median (range)]</td>
<td>27 (6-43) months</td>
</tr>
<tr>
<td>Duration from primary surgery to follow-up [median (range)]</td>
<td>54 (28-127) months</td>
</tr>
<tr>
<td>Number revised</td>
<td>42 patients</td>
</tr>
<tr>
<td>unexplained pain [n=38]</td>
<td>aseptic loosening [n=3]</td>
</tr>
<tr>
<td>size-mismatch [n=1]</td>
<td></td>
</tr>
<tr>
<td>Duration to revision surgery from MARS MRI [median (range)]</td>
<td>4 (0-22) months</td>
</tr>
</tbody>
</table>
Table 2. Demographic data for 81 patients diagnosed with pseudotumor on MARS MRI.

<table>
<thead>
<tr>
<th>Oxford Hip Score at follow-up</th>
<th>14 patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>• unchanged [n=2]</td>
<td></td>
</tr>
<tr>
<td>• improved [n=8]</td>
<td></td>
</tr>
<tr>
<td>• deteriorated [n=2]</td>
<td></td>
</tr>
<tr>
<td>• well-functioning, no initial score [n=1]</td>
<td></td>
</tr>
<tr>
<td>• poor-functioning, no initial score [n=1]</td>
<td></td>
</tr>
</tbody>
</table>

**Oxford Hip Score at MARS MRI [median (range)]**

| Age at primary surgery [median (range)] | 26 (2-48) |
| Gender | 16 male : 40 female |
| Bilateral | 28/81 patients |
| Maximum of either cobalt or chromium in whole blood [median (range)] | 8.8 (1.0-368.5) ppb |

**Implant Type**

| Implant Type | 42 Resurfacing |
|             | 13 Modular |
|             | 1 No data |

**Manufacturer**

| Manufacturer | 5 Adept |
|             | 8 ASR |
|             | 22 BHR |
|             | 4 Biomet |
|             | 6 Cormet |
|             | 4 Durom |
|             | 7 Other/No Data |

**Inclination [median (range)]**

| Inclination | 50 (31-78) deg |

**Version [median (range)]**

| Version | 19 (-22-43) deg |

**Component position?**

| Component position? | 22 Malpositioned |
|                     | 14 Well-positioned |

**Head size [median (range)]**

| Head size | 46 (38-58) mm |

Figure 1. Kaplan-Meier survival curve demonstrating survival of prostheses following diagnosis of pseudotumor on MARS MRI.

**POSTER NO. P012**

**Have Fretting and Corrosion Been Reduced in Contemporary Head/Neck Modular Junctions?**

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INTRODUCTION: Contemporary femoral component head/neck junctions with 12-14, 14-16 or similar taper geometries are now in wide use. These junctions are of larger diameter to increase flexural rigidity and have improved tolerances and enhanced surfaces relative to earlier designs in which mechanically-assisted crevice corrosion was problematic. Although contemporary modular head/neck junctions promise improved resistance to fretting and corrosion, there is a paucity of data on the actual prevalence of fretting and corrosion in retrieved devices. We asked whether fretting and corrosion had in fact been reduced in contemporary head/neck junctions.

METHODS: A total of 246 consecutively retrieved femoral hip stems with 12-14, 14-16 or similar geometry head/neck junctions from 12 different manufacturers were examined using a reflected light stereo microscope. The mean duration of implantation was 36 months. The devices included 141 CoCr/CoCr junctions and 105 CoCr/Ti-alloy junctions. The neck tapers were scored for the degree of fretting and corrosion damage (minimal=1, mild=2, moderate=3 or severe=4). Selected femoral necks were studied using a scanning electron microscope to determine the mechanisms of corrosion. Scores for fretting and corrosion damage were compared between the different head/neck couples using the Mann-Whitney test.

RESULTS: Overall, the mean scores for fretting and corrosion were relatively low and were similar for CoCr/CoCr (1.4±0.8) and CoCr/Ti-alloy (1.5±0.7) couples (p=0.056). Mild to moderate fretting and/or corrosion were observed in 42% of CoCr/Ti-alloy couples and 22% of CoCr/CoCr couples (p=0.042). Severe intergranular corrosion over the majority of the femoral neck taper occurred in 5% of all CoCr/CoCr couples (p=0.000). Intergranular corrosion was limited to the area of the neck within the head/neck junction and occurred exclusively in CoCr stems that had undergone sintering to bond their metallic bead porous coating. The prevalence of intergranular corrosion in the 79 CoCr stems with bead coating from three different manufacturers was 9%. Intergranular corrosion was not present in any of the CoCr stems for cement fixation. Severe corrosion was not observed in any of the Ti-alloy neck tapers, whether they had a sintered porous coating or not.

DISCUSSION AND CONCLUSION: Fretting and corrosion do occur in contemporary femoral tapers, but appear to be reduced both in prevalence and severity compared to previous studies of earlier designs. This was especially so for CoCr/Ti-alloy couples. The prevalence of intergranular corrosion of the neck in CoCr stems with a sintered bead porous coating was greater than anticipated. This suggests that some CoCr stems that have undergone sintering to bond their bead coatings may be more susceptible to corrosion attack at the head/neck junction. Additionally, the presence of intergranular corrosion implies that fretting, while necessary to initiate the corrosion process, is not required to continue corrosion within the grain boundaries. Clearly, the solution conditions within the intergranular regions and the electrochemical status of the interface result in continued attack. Severe intergranular corrosion of the femoral necks of CoCr stems with sintered bead porous coating can increase the particulate and metal ion burdens.
and increase the potential for component failure.

POSTER NO. P013

Ellipsoidal Wear Zones on MoM Heads Show Distinct Damage Patterns
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Douglas Van Citters, PhD, Hanover, NH

INTRODUCTION: Clinical results for current generation metal on metal (MoM) devices are mixed, with adverse local tissue reaction commonly reported. The recall of a widely used MoM system has heightened interest and scrutiny of devices. This study uses high resolution imaging of bearing surfaces to identify and compare wear features across a variety of MoM designs.

METHODS: Ten retrieved current-generation MoM hip devices were studied, representing eight different hip systems: six total hip arthroplasty (THA) designs and two resurfacings. Head diameters were 36 - 54 mm; in vivo duration 13.8 - 56.7 mos. Bearing surfaces were imaged using standard stereo microscopy, 3-D digital imaging at resolution to 1000x, and white light surface profilometry.

RESULTS: All 10 femoral heads (eight designs) display ellipsoidal articulation zones defined by linear boundaries. The boundaries are areas of relatively intense scratching and changes in scratch alignment. Although there is notable lighter scratching (depth 0.01 - 0.05 µm) inside the ellipsoidal areas, the heavier or more intense scratching, (depth 0.1 - 0.2 µm) generally lies outward of the linear boundary the eye perceives, rather than inward of it.

DISCUSSION AND CONCLUSION: The ellipsoidal boundaries appear to have undergone extensive metal-metal contact and resultant scratching, with less severe scratching within the ellipsoid. The alignment of the ellipsoid boundaries along great-circle lines on the head indicates repetitive contact between the head and the rim of the cup. The presence of ellipsoids across the range of sizes and in all device designs studied demonstrates that metal-metal contact at the rim of the cup is routine.

POSTER NO. P014

Disc Degeneration in Lumbar Spine Precedes Osteoarthritic Changes in the Hip: A Postmortem Study of 350 specimens
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INTRODUCTION: The relationship between hip and spine degeneration was first described by MacNab. It was hypothesized that degeneration in one area could lead to compensation in the other; which preceded the other however, was unclear. WA Saunders studied 150 patients and found that lumbar degenerative disc disease (DDD) was three times more common in patients with hip osteoarthritis (OA). However it was not clear whether the spinal degeneration led to hip arthritis or if the hip degeneration led to spinal compensation. The aim of this study is to determine which degenerative process precedes the other.

METHODS: A total of 350 cadaveric human specimens from the Hamann-Todd osteological collection in Cleveland, OH were examined for evidence of endplate arthrosis in lumbar spine and OA changes in the hip. Baseline data of age, sex and race of the specimen were collected. Degeneration of the lumbar endplates was graded on a scale of 0 to 4, on a continuum from no arthritis to ankylosis using the Eubanks modification of the Kettler classification. The hips for each specimen were also graded for degeneration on a scale from 0-3, as per the Abdullian modification of the Cooperman classification for hip degeneration. Linear regression was used to analyze the relationship between hip OA and lumbar endplate degeneration. Fisher exact tests were performed with subjects grouped by decade of age, and to identify differences in each age group.

RESULTS: Hip OA is significantly associated with endplate degeneration at L1, L3 and L5 levels (p < 0.02). In the age group of 20 to 29 years, 35% specimens had evidence DDD in at least one lumbar level as compared to only 17% with hip OA changes. At 70 yrs 100% specimens had evidence of DDD in lumbar vertebrae while hip OA changes were present in only 50%. Fisher exact tests demonstrated significant differences in each age group (p<0.01).

DISCUSSION AND CONCLUSION: Based on our study of a large population of adult skeletal specimens, it appears that there is significant association between degenerative disc disease of lumbar spine and hip osteoarthritis. Lumbar DDD changes precede hip OA with one third of the population in the 20s showing evidence of early DDD of lumbar spine as compared to only 17% with OA changes in hip. Lumbar DDD changes were seen in all subjects over 70 years of age while only 50% population over 70 years shows OA changes in hip. These findings suggest that lumbar degeneration may precede hip degeneration, and that lumbar degenerative disease may lead to the development of hip osteoarthritis.

POSTER NO. P015

Does Native Hip Anatomy Fit Recommendations for Safe Component Orientation in THA?
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Elise Pegg, PhD, Oxford, United Kingdom
Hemant G. Pandit, FRCS, Oxford, United Kingdom
Peter R. Aldinger, MD, Stuttgart, Germany
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Harinderjit Gill, PhD, Oxford/Oxon, United Kingdom

INTRODUCTION: The introduction of hard-on-hard bearings and the possible consequences of edge-loading and impingement have stimulated increasing interest in the importance of component orientation in total hip arthroplasty and hip resurfacing. Recommended “safe zones,” such as Lewinnek’s, have been described for optimum acetabular component orientation in order to prevent impingement, dislocation and excessive wear.

Furthermore, the concept of a “safe” combined anteversion has gained popularity. The aims of this study were (1) to define the native anatomy in a cohort of patients with primary hip osteoarthritis and (2) to determine whether native anatomy corresponds to surgical recommendations of acetabular and femoral component orientation.

METHODS: We retrospectively reviewed a consecutive series of 131 CT scans performed pre-operatively in patients with primary end-stage hip osteoarthritis (131 patients, 57 males, 74 females, mean age 60 (range: 42 - 79) years, mean body-mass-index (BMI) 27 (range: 19-45) kg/m²). Patients were positioned according to a standardized protocol as confirmed by scout views. Acetabular orientation was determined from axial images by selecting points of the acetabular rim included. Using validated programmes, a plane was fitted to the vertices along the rim, and a sphere was fitted to the native acetabulum. The diameter of the sphere represented the size.
of the native acetabulum, while the abduction and anteversion of the acetabulum were defined by the relationship of the acetabular rim relative to the co-ordinate system of the CT scanner, accounting for the amount of pelvic flexion for each individual case. Moreover, femoral anteversion was determined as the angle between the femoral neck axis and the posterior condylar line of the knee. Combined anteversion was calculated as the sum of acetabular and femoral anteversion. Native anatomy was evaluated with reference to the "safe zone" as described by Lewinnek (inclination: 35-35°, anteversion: 5-25°) and to a "safe combined anteversion" of 20-40°.

RESULTS: The mean acetabular rim diameter was 54 mm (SD: 6 mm, range: 41-71 mm). The mean acetabular anteversion was 18° (SD: 6°, range: 1-33°). Females had a greater amount of acetabular anteversion (16°, range: 3-32°) compared to males (12°, range: 2-23°, p<0.001). A total of 90% of native acetabulae classified as being with the 'safe' anteversion zone. The mean acetabular inclination was 62° (SD: 7°, range: 30-76°). There was no difference in acetabular inclination between females (62°, range: 30-75°) and males (62°, range: 37-76°, p=0.57). Twenty-one percent of native acetabulae classified as being withing the safe inclination zone. There was no difference in combined anteversion between females (34°, range: 7-70°) and males (30°, range: 2 - 55°) (p=0.1). Some 60% of patients had a native combined anteversion with the "safe" limits.

DISCUSSION AND CONCLUSION: There is still debate if acetabular and femoral implants should be orientated in such a way to reconstruct individual anatomy or fit within a safe zone. This study highlights the great variability in native hip anatomy. If individual patient anatomy was reconstructed, only 14 cases (11%) of the present cohort with primary osteoarthritis would have component orientation that met the criteria of both "safe zone" definitions. The major difference between native anatomy and "safe" component orientation was observed for acetabular inclination. Reduction of native acetabular inclination by 15° during cup implantation would result in safe component inclination in 84% of cases, however only 47% of cases would meet criteria for both "safe zones."

POSTER NO. P016

Should Draining Wounds Be Cultured Prior to Revision Hip and Knee Arthroplasty?

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INTRODUCTION: Obtaining cultures from draining wounds or a sinus tract is controversial. While some believe that valuable information can be obtained, others think that such cultures lead to confusion and the treatment of non-pathogenic bacteria obtained from the skin. The purpose of this study is to evaluate the value of superficial wound cultures compared to deep cultures obtained from within the joint.

METHODS: Thirty-one patients with a draining wound or sinus tract after 16 total hips and 15 total knees were prospectively studied at three centers. Aerobic, anaerobic and fungal cultures were taken from around the draining sinus or wound and a second set were obtained at the time of revision surgery. Culture results were then compared to determine how frequently and accurately the superficial cultures identified the same organism(s) as those from within the joint and how often the skin cultures identified additional organisms not present within the joint.

RESULTS: Skin cultures correctly identified the same organism(s) as the deep cultures in 15 cases (48.4%). The mean accuracy of skin cultures compared to intraarticular controls was 59.7%. Skin cultures identified additional organisms in 10 cases and did not recognize all infecting organisms in two cases that would have led to an unnecessary change in the choice of antibiotic treatment (38.7%). In one case, the skin cultures were positive, while the joint cultures did not suggest a deep infection. In five cases (16.1%), the skin cultures were negative while the joint cultures suggested infection.

DISCUSSION AND CONCLUSION: Cultures taken from a sinus tract or draining wound often contain contaminants that may potentially impact management. Based on these findings, obtaining skin culture from a draining wound or sinus does not seem to have any value in the management of patients with total joint arthroplasty (TJA), and may further confuse the choice of antibiotic treatment.

POSTER NO. P017

Do We Need Pedometer Data to Differentiate Long-Term Function Following Total Hip Replacement?

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INTRODUCTION: As more and more total hip replacement implant designs and bearing surface options have become available and as the cost associated with the procedure is escalating (because of the increased numbers being performed), it is prudent to differentiate the results between designs long term. The purpose of this study was to evaluate a group of active patients (less than 50 years of age at the time of surgery) who were still actively functioning 10 years following their total hip replacement surgery. These patients were evaluated with activity monitors, self administered rating scales, and six-minute walks.

METHODS: A consecutive series of 50 patients who underwent total hip replacement when they were under 50 years of age and who were followed for at least 10 years were included. In this consecutive group, all patients wore activity monitors (accelerometers worn around the ankle, similar to a pedometer) for up to 14 days, performed a six-minute walk, and completed SF-36, WOMAC, Tegner, and UCLA questionnaires. In addition, every patient had a minimum 10-year radiograph along with sequential radiographs.

RESULTS: Mean age at surgery and BMI were 39.3 years and 29.1, respectively. Mean 6-MW distance was 335 meters and pedometer data equaled 1.59 million steps per year. Average UCLA and Tegner Scores were 6.1 and 3.0 respectively. The mean linear wear rate was 0.263 mm/yr; the mean volumetric wear rate was 82.6 mm3/yr. Scores were 6.1 and 3.0 respectively. Mean 6-MW distance was 335 meters and pedometer data equaled 1.59 million steps per year. Average UCLA and Tegner, and WOMAC, Tegner, and UCLA questionnaires. In addition, every patient had a minimum 10-year radiograph along with sequential radiographs.

DISCUSSION AND CONCLUSION: Using acetabular liner wear as the best surrogate for activity, only pedometer activity correlated with wear. Hence, obtaining pedometer data should be considered when trying to distinguish differences in various hip arthroplasty designs and techniques long term.
Variation in Blood Utilization after Total Hip Arthroplasty (THA) in a Regional Hospital Network

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INTRODUCTION: The practice of red blood cell (RBC) transfusion following total hip arthroplasty (THA) has changed over time. Previously, pre-operative autologous RBC donation (PAD) was pervasive. However, PAD as a blood conservation technique has been on the decline in recent years as pre-operative hemoglobin optimization and intra- and post-operative shed blood recovery techniques have become more widely employed. Although blood conservation has improved, the administration of perioperative blood transfusions may be overutilized. The goal of this study was to examine the current blood utilization patterns among individual surgeons performing THA within our largeregional hospital network.

METHODS: A retrospective cohort study was conducted that investigated blood utilization after primary THA throughout a large hospital system. Using our regional hospital network’s electronic database, transfusion and patient outcome information on all orthopaedic surgeons who performed a minimum of 10 THAs annually in the two years spanning 2009-2010 was extracted. Peri-operative RBC transfusion rates, average hospital length of stay (LOS), and charges for hospital stay were obtained for each surgeon. The t-test was used to analyze differences in continuous variables. Statistical significance was defined as p < 0.05.

RESULTS: There were 33 surgeons who met the inclusion criteria. During the study period, 2,070 patients underwent THA; 1,927 had a primary diagnosis of osteoarthritis, 115 had a diagnosis of avascular necrosis, 16 patients had congenital dysplasia, and 12 had rheumatoid arthritis. Overall, 38.5% (796/2070) of these patients received at least one unit of allogeneic or autologous RBCs in the peri-operative period. The transfusion rates varied widely between the surgeons and ranged from 4.3% of patients transfused for one surgeon to 86.8% for another surgeon. Some 10.4% (83/796) of the transfusions received were with autologous blood. An average of 1.97 units were transfused to these 796 patients during their hospitalization. The average length of stay (LOS) and charges for hospital stay were obtained for each surgeon.

DISCUSSION AND CONCLUSION: There is a large variation in blood utilization among orthopaedic surgeons performing THA, indicating a possible misallocation of resources. This study demonstrates the need to establish systemic criteria to standardize and reduce blood transfusions in this population, to reduce the risk of infection after blood transfusion. Blood conservation protocols may reduce hospital costs and charges.

Lateral Center Edge Angle is Predictive of Acetabular Overcoverage in Femoroacetabular Impingement

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INTRODUCTION: Lateral center edge angle of Wiberg greater than or equal to 40º accurately predicts acetabular overcoverage and the need for rim trimming for the treatment of femoroacetabular impingement. Surgical treatment options for femoroacetabular impingement (FAI) include both arthroscopic and open techniques. Coxa profunda, defined as the medial wall of the acetabulum at or medial to Kohler’s line, is commonly seen in patients with FAI. However, the implications of coxa profunda in management and choice of surgical technique have not been fully elucidated. The objective of this study is to report the prevalence of coxa profunda in patients undergoing surgical hip dislocation (SHD) for FAI and to report the operative findings radiographic results. METHODS: Seventy-five patients (85 hips) who were treated with SHD for FAI with concurrent coxa profunda, as previously defined, were identified from 155 patients (178 hips) treated with SHD between 8/2002 and 2/2011. There were 32 men (35 hips) and 43 women (50 hips) with an average age of 28.3 years (17-50). Pre and post-operative radiographs were reviewed to determine radiographic criteria consistent with the deformity and correction. Operative reports were reviewed to assess intraoperative correction. The results were evaluated using Fisher’s Exact Test.

RESULTS: The prevalence of radiographic coxa profunda was 48% (85/178). Four hips were lost to follow up in the immediate post-operative period. Nineteen patients had failed previous hip arthroscopy (22%). Overall the average pre-op lateral center edge angle was 55º (17-51) and the average post-op LCE was 31º (10-46). Eighty-two hips (96%) required osteochondroplasty of the femoral head/neck junction, and 41 (48%) required acetabular rim trimming. Labral pathology was present in 74% of the hips and of these, 36 hips (42%) underwent labral debridement, 15 (18%) underwent labral repair, and 12 (14%) underwent labral reconstruction. A pre-op LCE angle greater than or equal to 40º was seen in 24 hips, between 30º and 40º in 39 hips, and less than or equal 30º in 21 hips (pre-op radiographs were unavailable in one hip). Of the 24 hips with a pre-op LCE greater than 40º, 20 hips (83%) required acetabular rim trimming compared to only 33% (13/39) in the 30-40º group (p = 0.0011), and to 33% (7/21) in the less than 30º group (p = 0.00079). In the LCE over 40º subgroup, the average pre-op LCE was 43º (40-51) and the average post-op LCE was 36º (23-46).

DISCUSSION AND CONCLUSION: Coxa profunda, defined as the medial wall of the acetabulum at or medial to Kohler’s line, was present in 48% of all hips undergoing SHD for the treatment of FAI. However, only 48% of those patients with traditionally defined coxa profunda required acetabular rim trimming. By contrast 83% of patients with an LCE angle greater than or equal to 40º had significant acetabular overcoverage requiring rim trimming. The traditional radiographic definition of coxa profunda did not provide useful clinical information in the present series. LCE values in patients with FAI may have unique implications for management and choice of surgical technique. Further studies are needed to better identify the patients who will benefit more from SHD than from arthroscopic treatment.
A Clinico-Pathological Study of 60 Revised Metal-on-Metal Hip Arthroplasties

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INTRODUCTION: Adverse reaction to metal debris (ARMD) is a mode of failure for metal-on-metal (MoM) bearings. It has been used as an inclusive term and can imply "pseudotumour," aseptic lymphocytic vasculitis and associated lesions(ALVAL), macroscopic tissue necrosis, large periprosthetic effusions, or metallosis. Such a broad classification does little to clarify the aetiology or to guide clinicians as to potential risk factors that might lead to suboptimal performance in MoM hips. The aim of the present study was to characterize the nature of the histopathological response in patients with failed MoM bearings seeking evidence for ARMD.

METHODS: Patients undergoing revision arthroplasty of MoM bearings were retrospectively identified from our institution's clinical database. This included MoM hip resurfacings and MoM total hip arthroplasties where a reaction to metal was feasible from the clinical picture. Cases referred from other centers were also included. Clear cases of infection or acute fractures were excluded. Clinical data were obtained from patient notes. Two histopathologists, blinded to all clinical data, examined histological sections using light microscopy. A diagnostic category was assigned using a systematic method of recording the features present.

RESULTS: There were 60 MoM hip arthroplasty revisions performed between 1996 and 2010 which met the selection criteria. Of these 80% (n=48) were hip resurfacings and 20% (n=12) total hip arthroplasties. The prospective clinical indications for revision included aseptic component loosening (32%; n=19), component malposition (27%; n=16), and unexplained pain (27%; n=16). Histological analysis demonstrated the features of ALVAL to be present in 8% (n=5) of cases, while a further 12% (n=7) showed marked lymphocytic infiltration without lymphoid follicles or plasma cells. The remaining patients demonstrated features of a low-grade chronic inflammatory reaction (12%; n=7), infection (5%; n=3), or no evidence of an immunological or infectious process (63%; n=38).

DISCUSSION AND CONCLUSION: The present study demonstrates that tissue responses in revised MoM hips are diverse. Where there is clinical suspicion of ARMD only a small proportion showed true features of ALVAL. In light of this, a more robust classification should be devised for adverse reactions to metal debris.
INTRODUCTION: Clinical results for current generation metal on metal (MoM) devices are mixed, with adverse local tissue reaction commonly reported. The recall of a widely used MoM system has heightened interest and scrutiny of the devices. This study uses high resolution imaging of bearing surfaces to identify and compare wear features across a variety of MoM designs.

METHODS: Ten retrieved current-generation MoM hip devices were studied, representing eight different hip systems: six total hip arthroplasty (THA) designs and two resurfacings. Head diameters were 36 - 54 mm; in vivo duration 13.8 - 56.7 mos. Bearing surfaces were imaged using standard stereo microscopy, 3-D digital imaging at resolution to 1000x, and white light surface profilometry. RESULTS: All MoM designs in this study showed extensive scratching (depth 0.01 - 0.05 µm) consistent with third body debris, arrays of parallel scratches that change direction in echelon, and gouging (depth 0.2 - 0.5 µm) with plastic deformation of the alloy evident. DISCUSSION AND CONCLUSION: These results show that the desired lubrication layer between MoM surfaces is often not operative. The ubiquity of scratches on bearing surfaces indicate hard debris particles are widespread. The alignment of scratches throughout a change in direction indicates that dry contact is occurring during low-velocity articulation and reversal. Gouging is consistent with head-to-rim contact upon subluxation. The occurrence of these phenomena on all the designs studied indicate that they impact performance of all contemporary MoM hips.

POSTER NO. P024

Cross-linked Polyethylene in Primary Total Hip Replacement: Analysis of Over 84,000 Procedures

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Philip Ryan, FAFPHM, Adelaide, Australia

INTRODUCTION: Concerns regarding wear and peri-prosthetic lysis with standard polyethylene led to the development of highly cross linked (modified) polyethylene. This has demonstrated less wear both in vitro and in vivo compared to standard polyethylene. This study compares the results of the use of standard or modified polyethylene with either metal or ceramic femoral heads.

METHODS: The data was obtained from a comprehensive national database that prospectively recorded these procedures over a 10-year period. Analyses were undertaken to examine the impact of age, gender, femoral head size and prostheses as well as determining the reasons for revisions. The principal outcome measure was time to first revision using Kaplan-Meier estimates of survivorship.

RESULTS: In the metal femoral head group 72,128 were used with modified polyethylene (MOMP) and 21,841 used standard polyethylene (MOSP). There were 12,143 procedures reported using ceramic on modified polyethylene (COMP) and 4,352 procedures using ceramic on standard polyethylene (COSP).

There was no difference in outcome between modified and standard polyethylene when a ceramic head was used (CPR at 10 years for COMP 6.3% (4.8, 8.1), COSP 8.2% (6.6, 10.3)). There was a significant difference between modified and standard polyethylene when metal heads were used (CPR at 10 years for MOMP 4.7% (4.3, 5.1) and MOSP 7.1% (6.5, 7.8), HR=1.27 (1.13, 1.44) between 3 months and 3.5 years, p<0.001, HR=1.88 (1.62, 2.17) after 3.5 years, p<0.001). In the MOMP group head sizes less than or equal to 28mm had a higher CPR than head sizes greater than 28mm (CPR at 7 years for less than or equal to 28mm head size 3.7 (3.5, 3.9), CPR at 7 years for greater than 28mm head size 3.2 (2.8, 3.7), HR=1.18 (1.03, 1.36) after 3 months, p=0.014).

DISCUSSION AND CONCLUSION: At 10 years metal on modified polyethylene had the lowest cumulative percent revision of the four bearing surfaces. In addition, larger head sizes had a lower rate of revision in this group.
To Bridge or Not to Bridge?

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INTRODUCTION: Anticoagulation bridges are commonly used in orthopaedic procedures as chemoprophylaxis against thromboembolic disease. For some patients, these bridges result in wound healing complications. We compared a cohort of patients that received subcutaneous enoxaparin and oral dosed warfarin as bridged chemoprophylaxis with those that received only warfarin during total hip arthroplasty (THA) procedures.

METHODS: A total of 120 patients were evaluated after primary hip arthroplasty from 2008-2009. Sixty-three patients were given both enoxaparin and warfarin after THA, and 58 patients received only warfarin after THA. The two groups were statistically matched with respect to various comorbidities that might influence outcomes. In particular, BMI, age, gender, hypertension, and history of diabetes were variables that were standardized. The outcomes of interest were the number of days to dry wound and length of hospital stay.

RESULTS: On continuous days of drainage, a greater number of days was required for healing wound endpoint to be observed for patients placed on warfarin enoxaparin anticoagulation bridges when compared to patients only given warfarin (odds ratio=2.39, p<0.05). Additionally, patients placed on anticoagulation bridges had longer hospital stays (odds ratio=1.27, p<0.05) than their warfarin-only counterparts. The mean hemoglobin drops for the two groups did not show any statistically significant difference (2.74 mg/dL, 2.83 mg/dL).

DISCUSSION AND CONCLUSION: Use of warfarin bridged with enoxaparin as chemoprophylaxis for thromboembolic disease places the patient at a greater risk for prolonged healing, and subsequent infection, as compared to warfarin-only treatment. Additionally, the cost to our healthcare system associated with these bridges is an additional $480 per patient as compared to their non-bridged counterpart. Further studies should examine the risks versus benefit of these bridges in reducing thromboembolic disease.

Successful Use of a Fluted and Tapered Modular Distal Fixation Stem in Revision Total Hip Arthroplasty (THA)

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INTRODUCTION: Modular femoral components with grit-blasted fluted and tapered distal fixation stem showed successful mid-term survivorship in revision THA and factors affecting the survival rate using data from a nationwide arthroplasty registry. Method of revision for aseptic loosening was only 3%. The nine-year overall survivorship for aseptic loosening was rare; the nine-year revision rate for aseptic loosening was only 3%. The nine-year overall survivorship for the stem was 75% (95% CI 70 - 80). The most common reason for re-revision was dislocation of the prosthesis with or without malposition of the socket (67%). Indication for revision strongly affected the survival rate. Revisions for both dislocation and infection had an over three-fold relative risk for re-revision compared to revisions for aseptic loosening. Increasing age slightly decreased the risk of re-revision but sex did not affect the survival.

DISCUSSION AND CONCLUSION: We found that a fluted and tapered modular distal fixation stem showed successful mid-term survivorship in femoral revisions at a nationwide level. Aseptic loosening of the stem was rare; the nine-year survivorship was 75% (95% CI 70 - 80). Using revision for aseptic loosening as the end-point. Revision for both dislocation and PI J had an increased risk for re-revision compared to revisions for aseptic loosening. Majority of the re-revisions (67%) were performed due to prosthesis dislocations.

Cerebral Blood Flow Velocity is Preserved during Total Hip Arthroplasty under Hypotensive Epidural Anesthesia

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INTRODUCTION: Hypotensive epidural anesthesia (HEA) reduces blood loss, thromboembolism and is associated with low perioperative mortality.1 Furthermore, studies have demonstrated preservation of postoperative cognitive function and absence of stroke following HEA for total hip arthroplasty (THA).2 However, the technique is not widely used in part because of concern that it may result in a reduction in cerebral blood flow (CBF). Therefore the present study sought to investigate cerebral blood flow velocity (CBFV) with transcranial Doppler under HEA.

METHODS: Fifty-nine patients undergoing THA with HEA were enrolled in this prospective observational study. The study was performed in fifty patients: nine patients could not be included due to difficulty obtaining transcranial Doppler signals. HEA was induced by injection of 25-30 mL of a mixture of 2% lidocaine and 0.75% bupivacaine at the L1-L2 interspace and infusion of epinephrine (3.5 µg/min) to achieve a mean arterial pressure (MAP) of 40 to 50 mmHg. Sedation was maintained.
with intravenous propofol infusion (mean rate 130 µg/kg/min). Continuous arterial blood pressure, heart rate, ECG, central venous pressure and end-tidal pCO₂ (through a nasopharyngeal airway) were monitored. Peak blood flow velocity in the middle cerebral artery were measured by transcranial Doppler ultrasonography with a 2-MHz probe using a transtemporal window. Cerebral hemodynamics were recorded with the patients awake and after propofol-induced sedation in the supine position. Patients were then placed in the lateral decubitus and reMed in this position throughout surgery. CBFV was measured continuously throughout surgery. Data were analyzed at specific time points prior and during HEA and following ephedrine injection at the end of surgery. RESULTS: Clinical characteristics of patients are shown in Table 1. Changes in MAP and peak CBFV are shown in figure 1. MAP declined by 40% after the induction of HEA (from 84 ± 12 to 50 ± 7 mmHg, p<0.0001) whereas peak CBFV increased by a 10% reduction and increased physical activity.

### Table 1: Clinical characteristics of patients (N=50)

<table>
<thead>
<tr>
<th>Sex (F/M)</th>
<th>18/32</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>54 ± 18</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>173 ± 12</td>
</tr>
<tr>
<td>Weight (Kg)</td>
<td>87 ± 24</td>
</tr>
<tr>
<td>Mean arterial pressure prior to anesthesia</td>
<td>105 ± 14</td>
</tr>
<tr>
<td>Cardiovascular Risk Factors (N)</td>
<td>17</td>
</tr>
<tr>
<td>Hypertension</td>
<td>4</td>
</tr>
<tr>
<td>S/P myocardial infarction and stent</td>
<td>4</td>
</tr>
<tr>
<td>Atrial Fibrillation</td>
<td>4</td>
</tr>
<tr>
<td>ASA Classification: I/II/III</td>
<td>7/30/13</td>
</tr>
</tbody>
</table>

**Figure 1**. Mean arterial pressure (MAP) and peak cerebral blood flow velocity (CBFV) during total hip arthroplasty under hypotensive epidural anesthesia (p<0.05).

**RESULTS**: The mice in Group 1, which received adiponectin injections (2µg/g KG) for 12 days. The other seven mice (Group 2) received no adiponectin injections. Further control groups of 14 wild-type mice also underwent surgery, but no particles were implanted. Of these, seven mice received adiponectin injections (Group 3) and seven no adiponectin (Group 4). After 12 days the mice were sacrificed. The murine tissues were then investigated to detect evidence of apoptotic reactions using a TUNEL analysis. Moreover histomorphometry was performed to evaluate the bone destruction. RESULTS: The mice in Group 1, which received adiponectin injections daily, showed less osteolysis and bone destruction after particle implantation than the wild-type mice of Group 2. As far as apoptotic reactions were concerned, there were practically none in the control groups without particle implantation. In contrast, apoptosis in the mice with particle implantation was significantly increased, although the apoptotic reactions in the Group 1 mice, which received adiponectin injections, were clearly smaller. DISCUSSION AND CONCLUSION: These results show that the serum level of adiponectin can be raised by a fiber-rich diet, weight reduction and increased physical activity.
The Surgical Anatomy of the Piriformis Tendon, with Particular Reference to Total Hip Replacement

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INTRODUCTION: The piriformis muscle is an important landmark in the surgical anatomy of the hip, particularly when using the posterior approach for total hip replacement (THR). Standard orthopaedic teaching dictates that the tendon must be cut in order to allow adequate access to the superior part of the acetabulum and the femoral medullary canal for implantation of a THR through this approach. However, in our experience a routine THR can be easily performed through a posterior approach without sacrificing this tendon. Current surgical literature regarding the femoral attachment of piriformis is inconsistent and confused; this seems to have come about through repeated inaccuracies in the nomenclature and the description of landmarks, particularly in the literature relating to the entry point for anterograde nailing of the femur.

METHODS: We dissected a series of 22 cadaveric proximal femora in order to clearly define the morphological anatomy of the piriformis tendon. To illustrate the variation in the attachment site of the piriformis tendon, the method of shape coordinates (Bookstein orange) was used.

RESULTS: We confirmed that the tendon attaches on the crest of the greater trochanter, in a position typically superior to the trochanteric fossa, well away from the entry point for broaching the intramedullary canal during THR. Overall, the tendon attachment site encompassed the summit and medial aspect of the greater trochanter as well as a variable attachment to the fibrous capsule of the hip joint.

DISCUSSION AND CONCLUSION: The piriform fossa is a term used by orthopaedic surgeons to refer to the trochanteric fossa and normally has no relation to the attachment site of the piriformis tendon. We conclude that the anatomy of the piriformis muscle is usually implied imprecisely in the current surgical literature and terms are mis-used and interchanged inappropriately. The insertion of the piriformis muscle is well away from the entry point for femoral broaching in total hip replacement.

The Morbidity and Mortality Acute Predictor for Hip and Knee Arthroplasty (arthro-MAP)

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INTRODUCTION: We aimed to develop a comprehensive predictive tool for immediate postoperative complications after hip and knee arthroplasty based on pre- and intraoperative variables.

METHODS: Data on procedures, comorbidities and immediate outcomes during hospitalization were collected from all patients undergoing primary and revision hip and knee arthroplasty from March 2003 to March 2006 (N=3511). Logistic multivariable regression analysis was performed to serve as basis for a nomogram. The following eight variables were used in the model: lowest heart rate, estimated blood loss, blood urea nitrogen, primary versus revision procedure, race, American Society of Anesthesiologists (ASA) score, comorbidities, and the presence/absence of fracture. Bootstrapping was used to correct for overfitting bias for both discrimination and calibration. Net reclassification improvement (NRI) was used to compare model performance to the Surgical Apgar Score.

RESULTS: All variables included in the multivariable logistic regression model were found to be statistically significant predictors.
of post-operative complications except race and lowest heart rate. The nomogram based on this model had a concordance index (bootstrap-corrected) of 0.757, which compared favorably to that of the Surgical Apgar Score (0.612), and also was well calibrated. Compared to the Surgical Apgar Score, the NRI was 71.5%, 18.4% and 53% among patients with or without complication respectively.

DISCUSSION AND CONCLUSION: We developed an easy to use novel clinical prediction tool, the morbidity and mortality acute predictor for arthroplasty (arthro-MAP), that might be useful for immediate postoperative risk stratification for major complications in hip and knee arthroplasty, or for longitudinally assessing quality and safety improvement interventions in this population. Future testing in heterogeneous populations and settings is needed.

POSTER NO. P032
Accuracy of Acetabular Component Positioning in Hip Arthroplasty
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INTRODUCTION: Acetabular component malposition is linked to higher bearing surface wear and instability. This study examines the frequency in which acetabular components are placed within a predetermined target range. Surgeon and patient factors were analyzed for risk associated with placing the acetabular component outside the target range.

METHODS: We evaluated postoperative anteroposterior (AP) pelvis radiographs for every consecutive primary total hip arthroplasty (THA), complex THA, and surface replacement arthroplasty (SRA) completed from 2004 to 2009 from a single institution. Cross table radiographs confirmed anteversion vs. retroversion of the components. Hips without adequate radiographs were excluded. Acetabular component abduction and anteverision angles were determined. We defined acceptable ranges for abduction and anteversion for both THA (30°-55° and 5°-35°, respectively) and for SRA (30°-50° and 5°-25°, respectively). The results were compared to a previously published range of abduction (30°-45°) and anteversion (5°-25°) ranges.

RESULTS: From 1753 THA, 1628 (93%) components met our abduction target, 1666 (95%) components met our anteversion target, and 1547 (88%) simultaneously met both targets. From 299 SRA, 265 (87%) components met our abduction target, 277 (93%) components met our anteversion target, and 246 (83%) simultaneously met both targets. When using a previously published range of abduction and anteversion angles, lower percentages fell within the target ranges. From 1,753 THA, 1,776 (44%) components met the abduction target, 1,494 (85%) components met the anteversion target, and 650 (37%) simultaneously met both targets. From 299 SRA, 208 (70%) components met the abduction target, 277 (93%) components met the anteversion target, and 194 (65%) simultaneously met both targets.

Through multivariate logistic regression, we examined if component head size, surgical approach, surgeon experience (>5 yrs in practice), surgeon volume (>100 cases/year), BMI, gender, or age had an impact on component placement. The odds ratio for high-volume surgeons was 1.99 (p<0.002) compared to that of the low-volume surgeons for accurately implanting the component. The odds of successful implantation decreased by 0.2 (p<0.001) for every 5kg/m² increase in BMI. Low-volume surgeons were consistent with placement using all surgical approaches. High-volume surgeons were significantly better with all approaches other than anterolateral (88% vs. 63%, p=0.002). All other variables had no significant effect on component placement.

DISCUSSION AND CONCLUSION: Increased odds of correct implant position were found with higher surgeon volume and lower BMI. High-volume surgeons had higher risk of malposition using an anterolateral approach. All other variables had no significant effect on component placement.

POSTER NO. P033
A Biomechanical Model of Acetabular Cup Deformation in Metal-on-Metal Designs
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INTRODUCTION: Press-fit acetabular components are susceptible to deformation following implantation in an under-reamed socket. Clinical and cadaveric investigations have described this deformation mechanism as component pinching between the ischial and ilial columns following press-fit implantation. Excessive deformation, particularly in metal-on-metal (MOM) components, may potentially lead to increased torsional friction, component micromotion, degradation of fluid-film lubrication, and implant loosening. The purpose of this study was to evaluate the effect of design and material considerations on induced deformation in metal-on-metal as well as conventional metal-backed acetabular components. Understanding of the overall effect of implant design on acetabular cup deformation is critical to the prevention of deformation-related clinical complications.

METHODS: Utilizing an automated reaming and implantation process, metal-on-metal and metal-backed modular acetabular cups were press-fit into a worst-case pinching model in polyurethane foam with a 1 mm under-reamed interference fit. The experimental setup closely follows a previously validated model from separate investigators which generated acetabular component deformation closely matching those observed in cadaveric pelvic specimens. Digital image correlation was used to quantify diametral cup deformations caused by press-fit implantation in cups and polyethylene liners from 0 to 120 hours following implantation with an accuracy of +/- 2 microns. Experimental groups (n=6 per group) consisted of 48, 54, 60 and 66 mm MOM cups with a 6 mm wall thickness, 58 mm cups with a 20 mm wall thickness, and both CoCrMo and Ti6Al4V metal-backed modular cups. RESULTS: Full results are shown in Table 1. Increased deformation was correlated with increased cup diameter, thinner wall construction, and Ti6Al4V metal-backed designs (p<0.0001).

The greatest diametral deformation within the MOM subset of cups tested was 104 +/- 8 microns, measured in 66 mm diameter thin-walled MOM cups. Significantly higher, yet potentially less clinically significant, deformations were measured up to 267 +/- 14 microns in titanium metal-backed modular cup designs.

DISCUSSION AND CONCLUSION: The role of clearance in THA lies in the establishment of elastohydrodynamic lubrication between the femoral head and acetabular bearing surface in metal-on-metal device designs. However, too tight of clearance paired with a large component deformation from press-fit implantation and gait loading could potentially increase early component loosening or wear. While the specific designs tested deformed to a magnitude less than the manufacturer-specified diametral clearance, the results of this study reiterate the need for careful design planning encompassing deformation in thin walled and conventional metal-backed acetabular component designs.
Factors Influencing Acetabular Component Orientation in Total Hip Arthroplasty and the Effect on Outcome

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Sion Glyn-Jones, MA MBBS, Oxford, United Kingdom
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INTRODUCTION: The introduction of hard-on-hard bearings and the consequences of increased wear due to edge-loading renewed interest in the importance of cup orientation for implant/outcome following hip arthroplasty. Studies have shown increased dislocation risk when the cup is mal-oriented which has led to identification of safe-zones. The aims of this study of primary total hip arthroplasty (THA) were to identify factors that influence cup orientation and describe the effect of cup orientation on clinical outcome.

METHODS: In a prospective study involving seven centers, patients undergoing primary THA between 1999 and 2002 were recruited. All patients underwent detailed assessment pre-operatively and at regular post-operative intervals. A total of 1,077 had adequate follow-up data and were included in the study.

RESULTS: There were 22 dislocations (2%) and 11 revisions (1%) at a mean follow-up of seven years. None of factors tested (Gender/ BMI/ Patient Position/ Surgical-experience) had an effect on cup placement within any of the zones tested ($\chi^2>0.47$). Zonal testing as possibly ‘safe’/‘optimum’ included Lewinnek’s (inclination: 35 - 55°, anteversion: 0 - 20°), Callanan’s (inclination: 30 - 45°, anteversion: 5 - 25°) and a zone ± 10° about the study’s mean orientation (inclination: 35 - 55°, anteversion: 0 - 20°).

RESULTS: There were 22 dislocations (2%) and 11 revisions (1%) at a mean follow-up of seven years. None of factors tested (Gender/ BMI/ Patient Position/ Surgical-experience) had an effect on cup placement within any of the zones tested ($\chi^2>0.47$). There was no difference in dislocation rate between the posterior and anterio-lateral approaches ($\chi^2=0.9$). Cups implanted via the posterior approach had greater anteversion (p=0.56), than THAs of either approach ($\chi^2=0.39$). $\Delta$OHS was not different for patients with cups within or outside any of the zones tested (p=0.32).

DISCUSSION AND CONCLUSION: Despite the wide scatter in cup orientation, no safe zone could be identified that would reduce dislocation/ revision rates, nor improve patient reported outcome (OHS). Cup orientation alone, should not be considered predictive of patients’ early/mid-term outcome following THA.

Figure 1. Scatter graph of acetabular component orientations of all THA in study.


POSTER NO. P035

Autogenous Femoral Head for Uncemented Acetabular THA Reconstruction in DDH: 20 Year Results

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INTRODUCTION: Anterolateral bone deficiency in total hip arthroplasties (THA) completed for developmental dysplasia of the hip (DDH) oftentimes compromises acetabular component coverage and stability. Earlier reports on the fate of autogenous femoral head bone grafts have varied. Few studies have investigated the mid-term results of uncemented acetabular components with autogenous femoral heads for acetabular reconstruction in DDH. However, there is minimal literature on long-term outcomes. As such, the purpose of the current study was to determine the 20-year survivorship of THAs with an uncemented socket used in conjunction with a bulk femoral head autograft in patients with anterolateral bone deficiency secondary to DDH.

METHODS: We prospectively followed 33 patients (38 hips) at a single, tertiary care academic institution who underwent THA for degenerative joint disease secondary to DDH with bulk femoral head autograft and an uncemented acetabular component. Five patients had bilateral involvement. The average age at the time of index surgical intervention was 42 years (range, 12 - 67 years), with 85% of the patients being female. Average operative and anesthesia times were 216 and 280 minutes, respectively. The operative approach was anterolateral in 24 hips, transtrochanteric in 10, and posterior in four. Mean follow-up was 19.1 years.

RESULTS: The survivorship free of acetabular revision was 79% at 15 years. At 20 years, the survivorship free from acetabular revision was 66%. Only one autogenous femoral head had not united at the time of revision surgery. An additional two patients underwent liner and head exchanges, while two patients underwent femoral revisions, resulting in a survivorship free from any revision of 55% at 20 years. Two additional patients experienced Vancouver B1 periprosthetic femoral fractures due to osteolysis.

For full information refer to page 14. An alphabetical faculty financial disclosure list can be found starting on page 19.
after trauma at an average of 11 years post-operatively. Both were treated with retention of components and plating. DISCUSSION AND CONCLUSION: Anterolateral acetabular bone deficiency is present in most patients with acetabular dysplasia. Managing this deficiency is one of the technical problems that must be overcome when total hip arthroplasty is used to treat DDH. This study demonstrated acceptable long-term results after use of an uncemented porous-coated socket fixed with screws in conjunction with a bulk femoral head autograft. This method of reconstruction provided reliable acetabular fixation. More importantly, it appeared to restore acetabular bone stock in patients with DDH since many patients with hip dysplasia are young and require additional hip operations. We continue to consider this technique for young patients with moderate anterolateral acetabular bone deficiency requiring total hip arthroplasty.

POSTER NO. P036

Significance of Preoperative 3D-CT Angiography for Localization of the Femoral Artery in Complicated THA
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INTRODUCTION: Major vascular injury is one of the most devastating intraoperative complications in total hip arthroplasty (THA). Although the risk of this complication is low, the risk is increased when the normal anatomy is distorted by previous surgery or original morbidities. We have performed 3D-CT angiography in patients with potential risk for this complication. In this study, we review our clinical experiences and examine the significance and the need for the preoperative vascular survey.

METHODS: Preoperative 3D-CT angiography was performed for 20 hips undergoing THAs. These include five primary THAs (three hips with Crowe type IV and two hips with ankylosis) and 15 revision THAs. Prior to the index THA, the patients had undergone zero to nine previous surgical procedures (average: 3.5). In each of the patients, we evaluated the preoperative angiographic images and assessed the amount of migration of the femoral head.

RESULTS: Altered anatomic location and route of the deep femoral artery was identified in all patients. Especially, in revision cases with proximal migration of the femoral head of 5 cm or more, the deep femoral artery was shown to be shifted to upper, posterior and lateral direction and adjacent to lower part of the original acetabulum. In addition to the distorted location, it was shown that numerous twisted co-lateral circulatory vessels developed and grew into the original acetabulum.

DISCUSSION AND CONCLUSION: The preoperative 3D-CT angiography revealed altered anatomy of the femoral artery as well as the presence of unusually developed co-lateral vessels in and around the original acetabulum. Preoperative identification of this anatomical variation is thought to be of great help to reduce the risk of inadvertent vascular injury during the complicated THA.

POSTER NO. P037

The Use of Performance-Based Tests for the Preoperative Evaluation of Total Hip Arthroplasty
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INTRODUCTION: Preoperative functional evaluation of patients undergoing total hip arthroplasty (THA) is commonly assessed by using self-reported questionnaires such as the Western ON McMasters Universities Osteoarthritis Index (WOMAC) and the Short Form-36 (SF-36). Performance-based tests such as the two-minute walk test and the timed get-up-and-go test are simple maneuvers to evaluate actual physical function and have been advocated as an essential part of preoperative THA evaluation. To the best of our knowledge, this is the first study to demonstrate the relationship between the shorter and more clinically practical two-minute walk test and self-reported questionnaires in preoperative THA patients. The objectives of this study were to assess the relationship between self-reported questionnaires (WOMAC and SF-36) and performance-based tests (two-minute walk test and timed get-up-and-go test) in patients scheduled for THA, and to identify clinical variables associated with the two-minute walk test and the timed get-up-and-go test.

METHODS: We prospectively collected data from a cohort of patients scheduled for primary THA from April 2010 to January 2011. Each patient was asked to complete the WOMAC and SF-36 and to perform the two tests (two-minute walk test, timed get-up-and-go test) at the time of a preoperative evaluation. For the two-minute walk test, patients were asked to walk up and down a designated corridor and the distance walked in two minutes was recorded. For the timed get-up-and-go test, patients were asked to get up from a chair, walk for three meters, and return to the original position. Pearson’s correlation coefficients and Spearman’s rho were used to determine the association between the self-reported questionnaires and performance-based tests. Multivariable linear regression models were created to evaluate independent associations between clinical variable and preoperative two-minute walk test and timed get-up-and-go test results.

RESULTS: A total of 162 patients completed the WOMAC and SF-36 and performed two-minute walk test and timed get-up-and-go test. The correlation between preoperative self-reported questionnaires and two-minute walk test and timed get-up-and-go test was only mild to moderate, ranging from 0.16 to 0.58, thus indicating these measures are not equivalent or interchangeable. The highest correlation was found between performance-based tests and the SF-36 physical function subscale (r=0.58, p<0.001 and r=0.52, p<0.001 respectively). The use of a walking aid, female sex and the presence of other painful lower extremity joints were significantly associated with two-minute walk test (r=0.51, p<0.001) while age and additional painful lower extremity joints were significantly associated with timed get-up-and-go test (r=0.10, p<0.001).

DISCUSSION AND CONCLUSION: Our study demonstrates that there are mild to moderate correlations between preoperative self-reported questionnaires and performance-based tests. This indicates that performance-based tests and self-reported questionnaires are not interchangeable and provide distinct information about different aspects of physical function. Thus, a comprehensive preoperative evaluation for THA patients should include a combination of self-reported and performance-based tests in order to better assess the level of disability prior to surgery.

The FDA has not cleared the drug and/or medical device for the use described in this presentation (i.e. the drug or medical device is being discussed for an off label use). For full information refer to page 14. An alphabetical faculty financial disclosure list can be found starting on page 19.
Given that performance-based tests are simple to efficiently perform in clinical practice, they should be integrated into routine preoperative evaluation and, in addition to self-reported questionnaires, might be important patient-centered outcomes during post-operative evaluation.

POSTER NO. P038
Results in the Midterm of Arthroscopic Assisted Mini-open Technique for Femoroacetabular Impingement
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INTRODUCTION: Surgical treatment of femoroacetabular impingement (FAI) is becoming accepted worldwide, mainly because of improvement in clinical results and quality of life in preliminary studies. In addition, the arthroscopy assisted direct anterior mini-open approach has provided an excellent way to treat this condition in different FAI presentations. The aim of the study is to verify if satisfactory short-term clinical-functional results prevail at the midterm and if they differ according to preoperative degenerative stage.

METHODS: A cohort of 296 hips in 278 patients operated between 2003 and 2008 (mean follow up 5.2 years, range 2 - 8 years) have been included in the study. Data of Merle D’Aubigné and WOMAC scores and UCLA activity level preoperative and at the latest follow up (FU) have been obtained from clinical records. A Kaplan-Meier survivorship curve has been established considering endpoint those patients who either were lost from FU or who underwent hip replacement. Chi-Squared and Wilcoxon tests have been used for comparisons between groups according to Tönnis radiological preoperative stage.

RESULTS: Overall results show mean improvement in MDA, WOMAC and UCLA activity level from preoperative values of 15.7, 59.7 and 7.3 to 17.4, 93.3 and 8.7, respectively at the latest FU (p<0.01). Global survivorship was at eight years 88.8% (CI 95%, 82.8 - 94.8%), for Tönnis 0 and 96.7% (CI 95%, 92.0 - 100.0%) for Tönnis 1. According to our experience it should be recommended to this population to undergo surgical procedure with onset of clinical symptoms.

POSTER NO. P039
Achieving Clinically Adequate Stem Fixation Despite Severe Proximal Femoral Bone Loss
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INTRODUCTION: Revision hip arthroplasty often presents with severe proximal femoral bone loss. A non-cemented, grit-blasted dual tapered stem designed to achieve diaphyseal fixation was evaluated under aggressive physiological loads, simulating extreme activity, in a cadaver model for potential use in revision cases. We then measured the effect of simulated sequential proximal femoral bone loss on interfacial micromotion.

METHODS: Ten cadaveric femurs were implanted with non-cemented tapered titanium femoral stems by an orthopaedic surgeon, familiar with the instrumentation. Dynamic axial compression increasing from 300N-1000N, and biaxial torque (±1Nm to ±15Nm) were applied using an MTS 858 servohydraulic load frame. Sequential, transverse cuts were performed in 1-cm increments from proximal to distal. Motion detector transducers measured AP and ML interface micromotion at the stem tip and 1cm below the level of the last cut, with an accuracy of one micron. Following intact testing, sequential transverse cuts in 1-cm increments were made, with loading repeated after each cut until failure, or the sixth cut. An additional specimen was loaded intact seven times, without any sequential cuts, as a control.

RESULTS: Three specimens reMEd stable throughout testing, with initial and peak per-cycle motions of less than 50 µm. Six specimens destabilized under loading with higher per-cycle motions, specifically at the distal stem tip during peak loading in the anterior-posterior direction, with motions of 78±69 µm, compared to 12±9 µm in the stable specimens (P<0.05). Total migration of the destabilized specimen was also significantly higher, specifically at the proximal stem tip in the medial-lateral direction, with migrations of 101±34 µm (P<0.05) and at the distal stem tip in the anterior-posterior direction, with migrations of 155±179 µm (P<0.05), compared to 33±12 µm and 13±11 µm for the stable specimens.

DISCUSSION AND CONCLUSION: For implants with good bone quality, interfacial micromotion measured using an extreme biomechanical model reMEd below the previously reported initial stability ingrowth threshold of 50µm, even after severe bone loss. With severe proximal bone loss, a non-cemented tapered stem
that achieves sufficient meta-diaphyseal fixation may be a more desirable option than a larger, distal diaphyseal-fit revision stem. Therefore, the results indicate that when a strong initial fixation is achieved, long term success is possible in the face of substantial proximal femoral bone loss.

POSTER NO. P040
Achieving Expectations Predicts Satisfaction After Hip and Knee Arthroplasty
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INTRODUCTION: Patient satisfaction after total hip and knee replacement has been linked to pre-operative expectations and whether or not those expectations were met. This study aims to determine which expectations best predict patient satisfaction after elective total knee and total hip replacement, using a validated 19-item expectation tool.
METHODS: All patients undergoing elective hip and knee arthroplasty in four metropolitan hospitals (two public and two private) were approached to participate. Patients were recruited pre-operatively and followed at six and 12 months post-operatively. Data collected were: demographic data, pre-operative expectations, pre and post operative SF-36 general health survey, pre and post operative Oxford hip or knee scores, patient satisfaction, and a post-operative expectation survey to determine which expectations were met. Multivariate analysis was performed to determine significant predictors of satisfaction.
RESULTS: A total of 331 patients were recruited, and follow up was 89% at 12 months. Satisfaction was strongly correlated with SF-36 scores and Oxford outcome scores. Unmet expectations was the strongest predictor of dissatisfaction at six and 12 months post-operatively. Of the 19 expectation items measured, the strongest predictors of dissatisfaction were unmet expectations of: “improvement in walking”; “relief of pain during the day” and “using public transport.” Meeting expectations of sexual function was not associated with satisfaction at six or 12 months. Patient age and gender, surgeon and hospital were not associated with satisfaction.
DISCUSSION AND CONCLUSION: Patient satisfaction after hip and knee arthroplasty is strongly associated with meeting pre-operative expectations. Expectations of pain relief and walking are the strongest predictors.

POSTER NO. P041
Primary Cementless Acetabular Fixation at Minimum 20-year Follow-up: Are We Improving Versus to Cemented Fixation?
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INTRODUCTION: Loosening of the acetabular component has been the long term problem associated with cemented total hip replacement. The authors evaluated the results of a consecutive, non-selected series of cementless acetabular components at minimum 20-year follow up and compared these results to the same surgeon's consecutive non-selective series of cemented acetabular components at a comparable minimum 20-year follow-up to determine whether cementless acetabular fixation was more durable than cemented fixation.
METHODS: A total of 120 consecutive non-selected total hip replacements were performed by a single surgeon using a single cementless acetabular component and a cemented femoral component, and followed for a minimum of 20 years. They were compared to a similar series performed by the same surgeon using a cemented acetabular and cemented femoral component that had also been followed for a minimum of 20 years. Hips were evaluated for revision for loosening and wear, and radiographic loosening.
RESULTS: At minimum 20-year follow up, the prevalence of revision of the acetabular component for aseptic loosening was 0.8% in the cementless group and 6% in the cemented group (p = 0.008). In the cementless group, 4.2% of cases required reoperation for wear of the liner (linear wear rate revised group 0.241 mm/yr). Radiographic acetabular component loosening occurred in 2% in the cementless group and 21% in the cemented group (p = 0.0009).
DISCUSSION AND CONCLUSION: This study demonstrates a marked improvement with cementless fixation compared to cemented fixation in primary total hip arthroplasty at minimum 20-year follow up. Bearing surface wear was the major cause of failure (gamma in air polyethylene) and is currently being addressed by better polyethylene and better acetabular component locking mechanisms.
imaging and microCT scanning at periodic intervals and immunohistological staining of retrieved specimens at sacrifice. RESULTS: Local injection of MCP-1 into the distal femoral canal induced systemic recruitment of intravenously injected reporter macrophages. When RS102895, the CCR2B antagonist was injected, we observed a significant decrease of systemic migration of macrophages using bioluminescence and immunohistology. The same trend was observed using macrophages deficient in the CCR2 receptor. MicroCT analysis confirmed the protective effect of the MCP-1 receptor antagonist on particle-induced bone loss. Total bone mineral density was significantly decreased for Group 2 (receiving particles but no antagonist) compared to Group 1 (receiving particles plus the antagonist). DISCUSSION AND CONCLUSION: Previously, it was assumed that the reaction to wear particles for joint replacements was a localized event. The current study provides strong experimental evidence of a direct relationship between the chemokine MCP-1 and systemic macrophage recruitment in the presence of UHMWPE particles. When the MCP-1 ligand-CCR2 receptor axis was interrupted by two interventions, macrophage trafficking was mitigated. Furthermore, disruption of the chemokine-receptor axis was associated with a decrease in the particle-associated adverse effects on bone mineral density. Thus, modulation of this chemokine-receptor axis may provide a therapeutic strategy to diminish particle-associated periprosthetic osteolysis.

POSTER NO. P043

Femoroacetabular Impingement: Predictors of Surgical Failure

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INTRODUCTION: It is not infrequent to encounter patients presenting with femoroacetabular impingement (FAI) and labral tear. Currently, various surgical procedures are available to treat these patients with arthroscopy of the hip being most popular in North America. The challenges that surgeons face relate to appropriate patient selection, as not every patient with this condition requires surgical intervention. Further, it is not known what factors influence the outcome of surgery for these patients. The objective of this study is to determine the prognostic factors for surgical treatment of patients with FAI.

METHODS: All patients undergoing mini-open femoroacetabular osteoplasty (FAO) are followed prospectively at our institution. Among 320 patients undergoing this procedure between 2006 and 2010, 109 hips (101 patients) have reached the minimum follow-up of two years (average: 2.6 years (range 2.0 to 4.2 years). The outcome of surgery was evaluated in these patients using WOMAC, modified Harris Hip Score, and UCLA activity scores. The influence of numerous patient-related, clinical, and radiographic variables on the functional outcome of FAO was evaluated. Failure was defined as Modified HHS <80, UCLA activity score 20. Univariate regression analysis was performed to detect statistically significant variables. Multivariate analysis was then performed to identify independent risk factors for failure.

RESULTS: Among 30 variables examined, advanced age (p<0.001), higher Tonnis stage (p=0.042), and increased neck shaft angle (p<0.03) were found to be main determinants of failure at surgical intervention. DISCUSSION AND CONCLUSION: Although surgical intervention for patients with FAI is reasonable option, one needs to recognize that not all of these patients do well following surgery. Based on the findings of this study patients who are older and those with more advanced arthritis are less likely to do well with surgical intervention. In addition patients with increased shaft-neck angle, which we believe is a proxy for developmental dysplasia of the hip (DDH), are also at increased risk of failure. Recognition of prognostic factors may allow surgeons to better identify appropriate candidates for surgery and/or counsel these patients better with regard to their expectations for outcome.

POSTER NO. P044

Results of a Two-Year, Prospective, Randomized, Controlled Study of Metal-Ion Release following MoM THA

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INTRODUCTION: Metal ion levels have been measured to estimate their release after primary total hip arthroplasty (THA). Metallic ion release may be related to bearing surface wear and thus serve as an indicator of the in vivo performance of metal-on-metal (MoM) articulations. The purpose of this prospective, randomized, controlled study was to compare a new MoM hip component with established MoM and metal-on-polyethylene (MoP) components.

METHODS: We designed and implemented a multi-surgeon, prospective, randomized controlled trial to compare clinical, radiographic and ion concentration in serum (cobalt and chrome) results across multiple devices including the Large Head ASR™ XL System (MoM-1) the Ultamet™ Advanced Modularity System (MoM-2), and, as the control, the Pinnacle™ Acetabular Cup System with Marathon cross-linked polyethylene liner (MoP) (DePuy, Warsaw, IN, USA). One-hundred and fifty-one consecutive patients undergoing THA were included for study: MoM-1 n=97; MoM-2 n=22; MoP n=32. Clinical, radiographic, and venous whole blood assessments were performed pre-operatively, and post-operatively at six months, one year, and two years, with further assessments planned yearly thereafter through five years. All serum ion concentrations are reported in nmol/L. Complications were recorded both intra-operatively and post-operatively. Five patients from the ASR group had six revisions performed (one bilateral) we collected blood samples at one, three and six months after revision for ion levels.

RESULTS: MoM-1 patients had significantly increased average Co and Cr levels at all post-operative periods (Table 1). Clinical scores improved after surgery in all groups and continued to improve in MoM-2 and MoP patients after two years but, decreased slightly in MoM-1 patients at two years. Acetabular abduction angle for MoM-1 was 50.2°, MoM-2 was 47.8°, and MoP was 51.7°. In the MoM-1 group, 12 (13%) hips (11 patients) had significantly elevated ion levels at all post-operative time periods (MoM-1 Outliers). Six hips (6%) in five MoM-1 outliers patient required revision THA.

DISCUSSION AND CONCLUSION: We report two-year follow-up results of a prospective, randomized, controlled trial comparing clinical radiographic and serum metal ion levels for ASR MoM, Ultimet MoM and Pinnacle MoP articulations. Clinical and radiographic outcomes through two years were similar for all groups, with a slight drop in clinical outcome in the ASR (MoM-1) group at two years. High metal ion levels (greater than 1000) are an indicator of failure of large head metal on metal implants. Average serum CO and Cr ion levels were elevated at all post-
operative follow-ups for the ASR (MoM-1) group only. Alarmingly high serum metal ion levels were observed in the ASR (MoM-1) group in 12 hips (11 patients) with six hips (five patients) requiring revision THA. All revisions were in the ASR group and may have caused the dip in clinical outcome scores at two years. However, in the ASR (MoM-1) outlier patients, there was no radiographic evidence of component malposition or aseptic loosening. The Ultamet (MoM-2) articulations performed comparatively across all variables to the Pinnacle (MoP) articulation. Because of the alarmingly high serum ion levels in the ASR (MoM-1) group, continuation of this study through five years is warranted.

Table 1: Average Co and Cr Serum Ion Levels for All Components in nM/mL

<table>
<thead>
<tr>
<th></th>
<th>MoM-1</th>
<th>MoM-2</th>
<th>MoP</th>
<th>MoM-1 Outliers</th>
</tr>
</thead>
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<tr>
<td>Co</td>
<td>3.91</td>
<td>8.00</td>
<td>3.58</td>
<td>4.81</td>
</tr>
<tr>
<td>Cr</td>
<td>5.31</td>
<td>6.32</td>
<td>5.00</td>
<td>6.13</td>
</tr>
<tr>
<td>Baseline</td>
<td>81.60</td>
<td>60.29</td>
<td>16.88</td>
<td>17.03</td>
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<tr>
<td>6 months</td>
<td>103.50</td>
<td>45.31</td>
<td>16.98</td>
<td>17.03</td>
</tr>
<tr>
<td>1 year</td>
<td>257.50</td>
<td>144.39</td>
<td>52.18</td>
<td>31.31</td>
</tr>
<tr>
<td>2 years</td>
<td>158.84</td>
<td>168.15</td>
<td>32.80</td>
<td>18.32</td>
</tr>
</tbody>
</table>

DISCUSSION AND CONCLUSION: There is a high incidence of complications during the early learning curve of the anterior supine intermuscular approach in the fracture table and cementless implants. Displaced trochanteric fractures and two calcaneal fractures, four of which required cable fixation during the original operation. One non-displaced trochanteric fracture was treated conservatively. One patient sustained an injury of the lateral femoral cutaneous nerve. There were no other ipsilateral fractures. Postoperative complications included one anterior dislocation during irrigation and debridement of a wound hematoma; one infected superficial hematoma that was treated with irrigation, retention of the implants and antibiotics; one stem subsidence presenting as increasing pain three months after surgery, requiring stem revision. The overall complication rate was 16.39%. Overall, three patients (three hips; 4.92%) required reoperation. All the intraoperative complications were performed by four arthroplasty surgeons in a single urban academic center. Three surgeons adopted a dual prophylactic antibiotic regimen of Cefazolin and Vancomycin (unless allergy) administered one hour prior to incision, while one surgeon used Cefazolin (unless allergy) as the sole prophylactic antibiotic. During this period, there were 34 surgical site infections identified based on institutional guidelines and reported to CMS. There were 16 men and 18 women with an average age of 59. The average ASA classification for these patients was 2.32 (range 2-4) in the group with dual prophylaxis compared to 2.87 (range 2-4) for patients receiving single antibiotic prophylaxis. The data was blinded and independently reviewed by the chief of infection control.

RESULTS: The overall rate of SSI during this period at our institution was 1.2%. Comparing surgeons who elected dual antibiotic prophylaxis compared to a single antibiotic regimen, the infection rate was 1.1% vs. 1.3% (p=0.56). Of the 25 patients with SSI treated with dual antibiotic prophylaxis, three (12%) were culture positive for MRSA while six out of nine patients (67%) with Cefazolin only prophylaxis had culture positive MRSA infection at the time of reoperation (p<0.01). Use of Cefazolin as the sole agent for antibiotic prophylaxis was associated with a 12 times increased likelihood of developing a MRSA SSI (Odds Ratio=12, CI 2.5-60, p=0.0004). There were no known complications associated with the use of dual antibiotic prophylaxis during this period.

DISCUSSION AND CONCLUSION: The addition of Vancomycin as a prophylactic antibiotic agent does not significantly reduce the rate of SSI compared to Cefazolin alone. However, use of Vancomycin does appear to change the microbiology of SSI and reduce the prevalence of MRSA infections.

POSTER NO. P044

Early Complications of Total Hip Arthroplasty Using the Anterior Supine Approach on the Orthopaedic Table
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INTRODUCTION: Anterior supine intermuscular (ASI) total hip arthroplasty performed on a fracture table has been increasingly used for primary total hip arthroplasty (THA). Accurate placement of the cup, low incidence of dislocation, a shorter hospital stay and faster return of function and unassisted gait are potential benefits. However, a high complication rate, particularly during a surgeon’s learning curve, has been reported. In the present study, we reviewed the complications and short-term results of the ASI THA using an orthopaedic table in an academic center.

METHODS: Sixty-one consecutive primary total hip replacements in 54 patients with at least three-month follow-up were included in the present analysis. All procedures were performed using the anterior supine intermuscular approach in the fracture table and cementless implants under fluoroscopic guidance. A retrospective review was performed to evaluate the early complication rate and radiographic accuracy of implant placement. Additional analyses were performed to establish the learning curve for the ASI approach for primary THA in an academic setting.

RESULTS: Intraoperative complications included three trochanteric fractures and two calcaneal fractures, four of which required cable fixation during the original operation. One non-displaced trochanteric fracture was treated conservatively. One patient sustained an injury of the lateral femoral cutaneous nerve. There were no other ipsilateral fractures. Postoperative complications included one anterior dislocation during irrigation and debridement of a wound hematoma; one infected superficial hematoma that was treated with irrigation, retention of the implants and antibiotics; one stem subsidence presenting as increasing pain three months after surgery, requiring stem revision. The overall complication rate was 16.39%. Overall, three patients (three hips; 4.92%) required reoperation. All the intraoperative fractures occurred during the first 32 cases performed.

DISCUSSION AND CONCLUSION: There is a high incidence of complications during the early learning curve of the anterior supine THA using the fracture table in an academic setting.

POSTER NO. P046

Rate of Surgical Site Infections in Joint Replacement Surgery: One Versus Two Prophylactic Antibiotics
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INTRODUCTION: A surgical site infection (SSI) is an infection that develops before 30 days after an operation or within one year if an implant was placed and the infection appears related to surgery. It is estimated that 2.6% of 30 million surgical procedures annually are complicated by SSI and these complications can cause significant morbidity and increased healthcare costs. While timely and appropriate administration of preoperative antibiotics can significantly reduce the risk of infection, due to the increasing prevalence of MRSA in the community, it is unclear which antibiotic(s) provides optimum prophylaxis for patients undergoing hip and knee procedures. Therefore the purpose of this study is to evaluate the effect of dual antibiotic prophylaxis compared to single antibiotic prophylaxis in patients undergoing elective hip and knee procedures.

METHODS: We reviewed the institutional records of prospective outcomes data from 7/31/2008 to 1/31/2011. During this period, a total of 2,890 hip and knee replacement procedures including revisions were performed by four arthroplasty surgeons in a single urban academic center. Three surgeons adopted a dual prophylactic antibiotic regimen of Cefazolin and Vancomycin (unless allergy) administered one hour prior to incision, while one surgeon used Cefazolin (unless allergy) as the sole prophylactic antibiotic. During this period, there were 34 surgical site infections identified based on institutional guidelines and reported to CMS. There were 16 men and 18 women with an average age of 59. The average ASA classification for these patients was 2.32 (range 2-4) in the group with dual prophylaxis compared to 2.87 (range 2-4) for patients receiving single antibiotic prophylaxis. The data was blinded and independently reviewed by the chief of infection control.

RESULTS: The overall rate of SSI during this period at our institution was 1.2%. Comparing surgeons who elected dual antibiotic prophylaxis compared to a single antibiotic regimen, the infection rate was 1.1% vs. 1.3% (p=0.56). Of the 25 patients with SSI treated with dual antibiotic prophylaxis, three (12%) were culture positive for MRSA while six out of nine patients (67%) with Cefazolin only prophylaxis had culture positive MRSA infection at the time of reoperation (p<0.01). Use of Cefazolin as the sole agent for antibiotic prophylaxis was associated with a 12 times increased likelihood of developing a MRSA SSI (Odds Ratio=12, CI 2.5-60, p=0.0004). There were no known complications associated with the use of dual antibiotic prophylaxis during this period.

DISCUSSION AND CONCLUSION: The addition of Vancomycin as a prophylactic antibiotic agent does not significantly reduce the rate of SSI compared to Cefazolin alone. However, use of Vancomycin does appear to change the microbiology of SSI and reduce the prevalence of MRSA infections.

POSTER NO. P047

Treatment of Corticosteroid Hip Osteonecrosis with Stem Cells
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INTRODUCTION: This study reports the results of percutaneous autologous bone marrow grafting in 62 patients with...
corticosteroids treatment who had bilateral osteonecroses. One hip osteonecrosis was treated with bone marrow (BM) injection and the other contralateral hip osteonecrosis with core decompression (CD) alone. Only patients with bilateral symptomatic osteonecrosis and patients with hips at stage I or II (as defined by Steinberg) were included in this study. METHODS: Between 1990 and 1995, 62 consecutive patients (28 males and 34 females) were included in this study. These patients had a mean age of 31 years (range 18 to 34 years) at the time of the onset of symptoms. The average follow up was 17 years (range, 15 to 20 years). An average of 152 ± 16 milliliters of marrow was aspirated from the iliac crest. The number of stroma progenitor that was transplanted was estimated by counting the Fibroblast Colony Forming Units which express type I and type III collagen. The bone marrow graft obtained after concentration contained average 4889 ± 716 progenitors per cubic centimeter (range 3515 to 6293 per cubic centimeter). Each hip received a mean number of thirty cubic centimeters of bone marrow graft (range 27 to 35 cubic centimeters). The average total number of CFU-F injected in each hip was therefore 147 x 10^3 cells (range 119 x 10^3 to 195 x 10^3 cells).

RESULTS: Clinical results were determined by the change in Harris hip scores from preoperative evaluation to the last follow-up visit, by the change in the radiographic progression and by the number of hips that progressed to collapse, and delayed the need for total hip replacement. Ten hips had collapsed and needed arthroplasty at the most recent follow-up after bone marrow grafting, compared to 45 after core decompression. Bone marrow grafting afforded better reduction in pain, affected a reduction with time in the number of hips that progressed to collapse, and delayed the need for total hip replacement. Ten hips had collapsed and needed arthroplasty at the most recent follow-up after bone marrow grafting, compared to 45 after core decompression. For hips with collapse, the mean survival time before collapse was 71.2 months (43.35-60.96; 95% CI) for the bone marrow graft and 38.5 months for the control group (13.2-39.74; 95% CI). With the number available, there was a positive correlation (Spearman’s test) between the duration of clinical survival before collapse and the number or concentration of CFU-F in the graft group. These results are explained by the fact that bone marrow injection improved the repair process on MRI. Overall, 10 hips with bone marrow injection showed a total regression of the signal, 59 hips showed a partial reduction (42 with BM and 17 with CD) and 55 hips did not show a significant reduction (10 with BM and 45 with CD).

DISCUSSION AND CONCLUSION: Bone marrow grafting afforded better reduction in pain, delay in the number of collapses, delayed the need for total hip replacement, and improved the repair process on MRI.

POSTER NO. P048

How Do Frozen and Permanent Histopathological Diagnoses Compare for Periprosthetic Hip Infections?

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INTRODUCTION: Periprosthetic joint infections can be challenging to accurately diagnose and treat. One diagnostic method has been intra-operative pathology using freshly frozen tissue samples. A major concern is the intra- and inter-observer variability among pathologists, and the impact this has on the accurate diagnosis of continued infection. Some patients may present with continued infection following what should have been a definitive re-implantation procedure. The purpose of this study was to determine the discrepancy between diagnoses made from frozen sections compared to the final permanent frozen section diagnosis and how this may have affected surgical treatment and patient outcomes.

METHODS: Between 2005 and 2008, there were 162 individual procedures performed at the senior author’s institution on patients who were undergoing staged revision for deep periprosthetic infection as confirmed by previously-published criteria. During each procedure, between two and five tissue samples were sent for intra-operative histopathologic analysis, with unused tissue fixed in formalin for a later final histopathological reading. Frozen sections were evaluated from multiple slices from each sample with greater than 40 high powered fields scanned per slice. A positive section was considered to have greater than five polymorphonucleocytes per high-powered field. Indeterminate sections contained between one and five cells per high-powered field. Negative sections averaged less than one cell per high-powered field, with no sections containing five PMNs. A frozen section diagnosis was considered a false negative or positive if there was a discrepancy with the final histopathological diagnosis made upon review of the permanent section. Evaluations were performed on individual samples as well as individual surgical episodes.

RESULTS: There were a total of eight discrepancies between frozen and permanent sections out of 237 samples. For the tissue samples, concordance with permanent sections occurred 229 times (97%). Analysis by procedure found that four of these had one frozen section read as indeterminate, with positive permanent sections; in all of these cases a prosthetic re-implantation arthroplasty was not performed until a later date. In two cases, permanent sections were positive after negative frozen sections, however these patients did not have re-implantation because other frozen sections during the case were positive. In one case, the frozen section was positive, but the permanent section was negative (had positive intra-operative culture); this patient underwent a successful staged revision. In one case, there was a false negative (negative frozen, positive permanent), and the patient was subsequently reimplanted. Upon notification of permanent section diagnosis, they underwent 42 days of intravenous antibiotics, but eventually became re-infected. Therefore, only one out of 162 procedures appeared to have been adversely affected by frozen/permanent section diagnosis discrepancies.

DISCUSSION AND CONCLUSION: A false negative diagnosis can be a source of significant morbidity for re-implantation procedures. Therefore, it is critical that these be minimized. The results of this study indicate that even with an experienced pathologist, discrepancies can occur between frozen and permanent section samples. Fortunately, in only one instance out of 162 procedures did this appear to untowardly influence final outcome. To minimize the risk of a false negative interpretation, the senior authors emphasize the necessity of attaining multiple tissue sections intra-operatively if there is a high suspicion of infection.
reported on clinical outcome measures, digital radiographic evaluations, and whole blood metal ions. The purpose of the current study was to report the nine to 14-year clinical, radiographic, and metal ion trends in patients following MoMTHA.

METHODS: We prospectively followed 105 patients (115 hips) after second-generation metal-on-metal total hip arthroplasty between July 1997 and November 2001. Functional outcome was measured using the Harris Hip Score (HHS) and the University of CA Los Angeles (UCLA) Activity Score. Radiographic analysis was performed using Einzel-Bild-Roentgen-Analyse (EBRA) by two of the authors blinded to the study. Cobalt and chromium metal ions were measured annually from whole blood and analyzed using inductively coupled plasma-mass spectrometry.

RESULTS: Twenty hips were lost to follow up, two died for causes unrelated to their surgery, and 11 failed between 0.4 and 2.8 years (mean, 1.1 years) due to manufacturer’s recall. Of our cohort, 105 patients (115 hips) had complete radiographic, clinical and metal ion data to be included in the final analysis. The mean age at surgery was 50.8 years (17 to 66). There were 41 females and 64 males. The mean follow up was 11.2 years (range, 9 to 14 years). Six hips (5%) were revised: two for infection at 0.2 and seven years; one for a loose stem at 1.3 years; and one for a loose cup at nine years. Two patients were revised for aseptic loosening at nine and 11.4 years. One patient received wound debridement for a superficial infection and did not have any components revised. There were no cases of adverse local soft tissue reactions, including pseudotumours. The mean HHS and UCLA scores at the last follow up were 91 and 6.8, respectively, from pre-operative values of 38 and 4.2. During the follow up, the mean HHS varied from 90 to 94 while the mean UCLA score varied from 6.7 to 6.9. The mean acetabular inclination and anteversion was 40 degrees (range, 24 to 57), and 19 degrees (range, 3 to 39), respectively. Median cobalt levels peaked at a value of 2.87 µg/L at 4 years (p=0.0001 vs. pre-operative) and subsequently decreased to 2.0 µg/L after nine years (p=0.002 vs. four years). Median chromium levels maximally increased up to 0.75 µg/L after five years (p<0.0001 vs. pre-operative) and tended to decrease thereafter to values of 0.56 µg/L after seven years. The Kaplan-Meier survivorship was 87.7% for revision at five years. and 95.5% when excluding the hips revised for a manufacturer’s defect at a mean of 11.2 years (range, 9 to 14 years) (Figure 1).

DISCUSSION AND CONCLUSION: The Kaplan-Meier survivorship in our study is comparable to other studies with similar follow ups. Metal-on-metal implants are durable. Metal ions peaked at four years and decreased thereafter. Clinical scores have demonstrated that patients maintain their excellent outcomes.

High Failure Rates with a Large Diameter Hybrid Total Hip Replacement

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INTRODUCTION: This study reports the mid-term results of a large bearing hybrid metal on metal total hip replacement (MOMHTHR) using the cemented collarless polished tapered (CPT) stem in combination with a specific manufacturer’s modular head and cup. Further aims were to identify potential sites of failure from retrieval wear analysis and factors predictive of revision.

METHODS: Between 2002 and 2007, 199 MOMTHRs (185 patients, 110 females and 57 males) were implanted with a mean age at surgery of 58.1 years (median 60yrs; range 29-77yrs) and a mean follow up of 62 months (median 63; range 32-83mths). Thirteen patients were lost to follow up. Clinical outcome was measured using the Oxford Hip Score (OHS). Patients were also questioned for new onset symptoms, particularly lateral based pain, clunking or fatigue. Those describing new onset symptoms were categorized as “painful hips.” Radiographs were assessed for component migration, progressive radiolucencies and peri-implant osteolysis. EBRA software was used to measure cup inclination and version. Metal ion levels were measured at latest review. In revision cases explants were analyzed for wear at the articular and trunnion/head interfaces.

RESULTS: Seventeen patients (8.6%) had undergone revision, and a further fourteen are awaiting surgery. The cumulative survival rate, with revision for any reason was 92.4% (95%CI: 87.4-95.4) at five years. Including those undergoing surgery, the revision rate would be 15.1% with a cumulative survival at five years of 89.6% (95% CI: 83.9-93.4). Clinical: all revision cases and nine of the 14 (64%) awaiting revision presented with symptoms. In those not revised or awaiting revision, 17 patients (9%) had painful hips. The mean OHS for all patients was 21 (3-39) pre-operatively and 45 (11-48) post-operatively compared to 17 (6-31) pre-revision in the revision / awaiting revision cohort. Radiological: progressive radiological changes were observed in 10 of the 14 patients diagnosed with adverse reaction to metal debris (ARMD) and in all those awaiting revision. There was no significant difference in cup size (p=0.77), inclination (p=0.38) or cup version (p=0.12) when comparing the revision / awaiting revision to the non revision cohorts. Metal ion analysis: there was a significant increase in Co levels in the revision / awaiting revision group (p=0.001) compared to the non revision cohort, but this was not observed for Cr or Mo metal ions (p=0.14; p=0.22 respectively). Retrieval analysis: the stem had obvious pitting and evidence of corrosion along the surface. The mean bearing surface wear between head and cup was 1.86mm/yr +/-1.55mm (+/-2SD). These values along with geometric information gathered from redlux images did not demonstrate abnormal wear volume, depth or position for the length of time the implants had been implanted. The mean maximum out of roundness of the taper was 34.5 microns +/-13.3 (+/-2SD; normal range 8-10 microns). A characteristic pattern was observed with two discrete regions of wear at polar opposites to each other on the trunnion circumference margin. Multifactorial analysis: the presence of an isolated raised Co level in the absence of either symptoms or XR changes was not predictive of failure (p=0.675). However both the presence of pain (p=0.001) and XR changes (p<0.001) in isolation were both significant predictors of failure.
Predicting Difficulty of Femoral Preparation in the Direct Anterior Approach for Total Hip Arthroplasty

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INTRODUCTION: The advantages of the direct anterior approach (DAA) for total hip arthroplasty (THA) include the preservation of external rotators and hip abductors thus leading to quicker recovery times. To our knowledge, there is no objective method in the literature to predict the level of difficulty for femoral exposure through the DAA. It would be beneficial to the surgeon learning the DAA to assess difficulty pre-operatively to avoid prolonged operative times. The purpose of this study was to develop a predictive model of femoral exposure difficulty in the DAA using a combination of demographic data and radiographic measurements.

METHODS: A total of 305 post-operative radiographs of consecutive THAs in patients (184 female, 120 male) with primary or secondary osteoarthritis, mean age 64.6 (range 26-91, SD=11.43) performed through the DAA by one of the co-investigators from 12/2005 to 12/2009 were retrospectively reviewed by two separate observers. The observers were blinded to the difficulty level of femoral exposure. Standard post-operative AP pelvis films were assessed for with CAD software to make radiographic measurements as shown in Figure 1. Each radiograph was calibrated using the size of the femoral head implant. Exclusion criteria included films that had inadequate coverage of the entire pelvis, mal-rotation, or poor exposure. Statistical analysis was performed. A two-sided Kruskal-Wallis test was utilized for non-parametric data. Chi-squared tests and Fisher’s Exact Test were used to compare proportions. Statistically significant associations were then added to a multivariate model predicting an outcome of difficult exposure.

RESULTS: The difficult exposures were equally distributed throughout the study period. The side of the THA was not predictive of difficulty (χ²=0.5516, p<.01) whereas 66% of difficult cases were male (χ²=38.5323, p<.01). Height, weight, BMI, and age were all independent predictors of a difficult exposure, with taller (>175cm) more difficult than shorter (p<.01), heavier (>100kg) more difficult than lighter (p<.01), higher BMI (>32) being more difficult than lower BMI (p<.01), and younger age (<60) being more difficult than older age (p<.01). Increased cup size (p<.01) and femoral head size (p<.01) were utilized in cases having difficult exposure. Radiographic criteria that were predictive of difficult femoral preparation were decreased distance (<110mm) between teardrop signs (p<.01), increased distance (>211mm) between the superior lateral acetabulum (p<.01), and increased distance (>306mm) between the lateral edge of the greater trochanter’s (p<.01). From this, we determined a pre-operative rating scale to predict difficult exposure consisting of sex, BMI, cup size, head size, and radiographic parameters.

DISCUSSION AND CONCLUSION: The DAA approach has proven difficult to learn for many surgeons. Careful patient selection can facilitate the learning curve and improve patient outcomes. We describe a simple to implement preoperative rating scale, which gives the surgeon learning DAA an algorithm for appropriate patient selection. Selecting the appropriate patient can reduce the risks to the patient and minimize the cost to society of integrating new surgical techniques.
INTRODUCTION: Infection in total joint replacement has been a major complication since its inception. Many arthroplasty surgeons routinely mix powdered vancomycin with bone cement in an attempt to decrease infection rates. Despite this common practice, the impact of preparation technique on antibiotic elution and the role antibiotic elution has on cement strength have been neglected. The goal of this study was to investigate the role mixing technique has on antibiotic elution rates and the properties of the cement.

METHODS: Five cement samples in four groups (plain cement hand-mixed, plain cement vacuum-mixed, plain cement + 5g vancomycin hand-mixed, and plain cement + 5g vancomycin vacuum-mixed) were prepared. Each sample underwent a CT scan before and after elution of vancomycin. Each sample was incubated in a solution of sterile phosphate-buffered saline (PBS) for a total of six weeks and aspirates obtained every 24 hours for one week and at three and six weeks. High Performance Liquid Chromatography (HPLC) was used to quantify antibiotic concentration. Each aspirate was inoculated with a human strain of Staphylococcus aureus to demonstrate clinical efficacy. All samples underwent Ultimate Compression Strength (UCS) testing before and after elution. RESULTS: Hand-mixing vancomycin with plain bone cement resulted in greater elution of vancomycin (p<0.05). Over the first day the hand-mixed cement eluted 38% more vancomycin than the vacuum-mixed cement. Elution of vancomycin from hand-mixed and vacuum-mixed cement decreased its compression strength by 22% and 12% after six weeks (p<0.05).

DISCUSSION AND CONCLUSION: Hand-mixing technique increased concentrations of vancomycin eluted from bone cement when compared to vacuum-mixing. The UCS of bone cement is significantly decreased after elution of vancomycin.

POSTER NO. P054

The Course of the Femoral Artery in Congenital High Hip Dislocation
Jin Yamaguchi, MD, Nagoya, Japan

INTRODUCTION: In the adult hip, the femoral artery or profunda femoris artery usually runs apart from the acetabular anterior roof. In a few cases the profunda femoris artery is injured at the time of total hip arthroplasty (THA). We have experienced injury to the profunda femoris artery during operation of the primary acetabulum in cases of congenital high hip dislocation. Retrospectively investigated, the femoral artery of the affected side ran more closely to the acetabular anterior roof than that of the unaffected side. We analyzed anatomically the course of the femoral artery. We focused on (1) whether the femoral artery on the affected side would run more closely to the acetabular anterior roof than that on the unaffected side, (2) whether the iliopsoas muscle could not be seen between the femoral artery and acetabular anterior roof and (3) whether the profunda femoris artery on the affected side would branch off the femoral artery, at a more proximal level than on the artery on the unaffected side. METHODS: We retrospectively reviewed 48 patients / 56 hips of congenital high hip dislocation. We excluded 15 patients / 17 hips without CT scan and one patient / one hip with a neuromuscular disorder. This left 33 patients / 39 hips (four males / 29 females). The overall mean age was 64.9 ± 8.1 years. There were 14 Crowe Type III hips / 25 Type IV hips. There were no Crowe Type I or II hips. In the unilateral patients, the hip on the unaffected side was defined as the normal hip and the hip on the affected side was defined as high hip dislocation. In this way, we evaluated 39 high hip dislocations and 27 normal hips. Radiographical examination was performed using plain CT. We classified the course of the femoral artery as the far group if the distance between the femoral artery and acetabular anterior roof exceeded 1cm and as the near group if it was less than 1cm. We evaluated the presence of iliopsoas muscle between the femoral artery and acetabular anterior roof on the same image. We examined the location of the femoral artery branching to the profunda femoris. RESULTS: The distance between the femoral artery and acetabular anterior roof was 6.69±3.26 mm in the high hip dislocation and 11.76±3.11 mm in the normal hip group (p<0.0001). Near groups were 29 hips of the 39 hips of high hip dislocation (74.4%) and six hips of the 27 normal hips (22.2%) (p<0.0001). Only five iliopsoas muscles could be seen in the 39 cases of high hip dislocation (12.8%) and all iliopsoas muscles could be seen in the 27 normal hips (100%) between the femoral artery and acetabular anterior roof (p<0.0001). Seventeen femoral arteries branched to the profunda artery at the level of the primary acetabulum in the 39 cases of high hip dislocation (43.6%). Six femoral arteries branched at the level of the primary acetabulum in the 27 normal hips (22.2%) (p<0.05). DISCUSSION AND CONCLUSION: In this study, the femoral artery in high hip dislocation ran more closely to the acetabular anterior roof than that of normal hip joint. The iliopsoas muscles, which protect a femoral artery and profunda femoris artery by interleaving between these arteries and acetabular anterior roof, could not be seen in most of the cases of congenital high hip dislocation. The femoral artery of the high hip dislocation group branched more proximally than that of the normal hip group significantly. A profunda femoris artery usually runs behind a femoral artery. When a femoral artery branches proximally, a

POSTER NO. P053

Mixing Technique Impacts Antibiotic Elution from Bone Cement and Its Elution Compromises Cement Strength
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INTRODUCTION: Infection in total joint replacement has been a major complication since its inception. Many arthroplasty surgeons routinely mix powdered vancomycin with bone cement in an attempt to decrease infection rates. Despite this common practice, the impact of preparation technique on antibiotic elution and the role antibiotic elution has on cement strength have been neglected. The goal of this study was to investigate the role mixing technique has on antibiotic elution rates and the properties of the cement.

METHODS: Five cement samples in four groups (plain cement hand-mixed, plain cement vacuum-mixed, plain cement + 5g vancomycin hand-mixed, and plain cement + 5g vancomycin vacuum-mixed) were prepared. Each sample underwent a CT scan before and after elution of vancomycin. Each sample was incubated in a solution of sterile phosphate-buffered saline (PBS) for a total of six weeks and aspirates obtained every 24 hours for one week and at three and six weeks. High Performance Liquid Chromatography (HPLC) was used to quantify antibiotic concentration. Each aspirate was inoculated with a human strain of Staphylococcus aureus to demonstrate clinical efficacy. All samples underwent Ultimate Compression Strength (UCS) testing before and after elution. RESULTS: Hand-mixing vancomycin with plain bone cement resulted in greater elution of vancomycin (p<0.05). Over the first day the hand-mixed cement eluted 38% more vancomycin than the vacuum-mixed cement. Elution of vancomycin from hand-mixed and vacuum-mixed cement decreased its compression strength by 22% and 12% after six weeks (p<0.05).

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Jin Yamaguchi, MD, Nagoya, Japan

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profunda femoris artery runs closely to the acetabulum. It is unlikely that the artery came close to the acetabular roof during surgery. Preoperative evaluation of the artery is important to avoid injury. Attention should be paid to the course of arteries surrounding the hip.

POSTER NO. P055
Have Large Femoral Heads Solved the Problem of Dislocation After Revision Total Hip Arthroplasty?
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INTRODUCTION: Dislocation after revision total hip arthroplasty (THA) is a devastating complication that has been reported to occur in roughly 7-15% of cases. Newer bearings with larger femoral head diameters are now being utilized in the hope of decreasing the rate of dislocation. We wished to determine what effect these modern implants have on dislocation rates following revision THA, and hypothesized that larger heads would lead to lower dislocation rates. We compared revision THAs with femoral head sizes 32 mm and less to revision THAs with femoral head sizes 36 mm and greater to determine if larger femoral heads have reduced the incidence of dislocation after revision THA.

METHODS: Data were reviewed for 100 consecutive revision THAs performed via the posterior approach by six joint surgeons at one hospital. All revisions occurring at our hospital during the time of the study, regardless of etiology, were included in the analysis. All cases had at least one year of follow up. Information was collected through mailed inquiries about dislocation status and telephone contact for those patients not responding via mail.

RESULTS: Of the 100 revision THA, 50 had femoral head sizes 32 mm or less, and 50 had head sizes 36 mm or greater. Sixteen patients were lost to follow up. Of the remaining 84, there were nine dislocations; five dislocations occurred in the group with head sizes of 32 mm or less, and four dislocations occurred in the group with head sizes of 36 mm or larger. The dislocation rate for the cohort as a whole was 10.7%. The two groups had nearly identical dislocation rates, thus failing to show that larger head sizes have significantly reduced the risk of dislocation after revision THA.

DISCUSSION AND CONCLUSION: Dislocation continues to be a significant problem following revision THA, despite availability of heads with diameters of 36 mm and greater. Larger head sizes did not solve the problem of dislocation in this cohort of patients. This study highlights the persistently increased risk of dislocation following revision THA, as well as the need to continue the search for solutions to this clinical problem. Because head sizes of greater than 40 mm were rarely used in this cohort, we cannot determine whether so-called jumbo heads will fare better than the 36 and 40 mm heads that we utilized. Further studies are needed to determine if larger head sizes are beneficial in certain subgroups of patients as well as to identify pre-operatively (or intra-operatively) which patients may need a more constrained bearing.

POSTER NO. P056
Long Term Follow-Up of Cementless THR for Osteonecrosis: Have We Improved on Cemented THR?
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INTRODUCTION: The results of cemented total hip replacement (THR) for osteonecrosis of the hip are reported to be inferior to the results for other diagnoses. The authors evaluated the results of cementless THR performed for osteonecrosis (consecutive non-selected series) at minimum 10-year follow up and compared them to the author’s previously performed cemented consecutive non-selected series (forthcoming diagnosis reported at comparable followup).

METHODS: Eighty consecutive cementless THRs were performed in 66 patients with osteonecrosis of the hip and were followed for a minimum of 10 years. The average age at the time of surgery was 54 years. The cohort was compared to a consecutive series cohort of 48 cemented THRs performed in 38 patients for the same diagnosis and that had been followed by the same authors at a similar minimum 10-year interval follow up. In addition to obtaining Harris Hip scores, hips were evaluated for revision of the components related to loosening and wear, and for radiographic loosening.

RESULTS: At minimum 10-year follow up, the comparative prevalence for the cementless versus the cemented series for femoral revision for loosening, acetabular revision for loosening, overall femoral loosening and overall acetabular loosening (radiographic) were 1.2% vs. 6.5% (p = 0.01), 0% vs. 13% (p = 0.0001), 1.2% vs. 13% (p = 0.0001) and 0% vs. 15.2% (p = 0.0001). In the cementless group, 7.5% of hips required a liner exchange for wear (most hips had non-contemporary polyethylene).

DISCUSSION AND CONCLUSION: This study demonstrates a marked improvement in cementless THR fixation compared to cemented fixation in patients with osteonecrosis of the femoral head. Bearing surface wear was the major cause of failure. Addressing this problem should provide even more durable results in this active population.

POSTER NO. P057
Ceramic-Ceramic Bearing Decreases the Cumulative Long-term Risk of Dislocation: A 20-Year Study versus Ceramic-PE
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INTRODUCTION: After total hip arthroplasty (THA) a widely variable prevalence of dislocation has been reported, partly because of varying durations of follow up for this specific endpoint. The purpose of the present study was to determine if the risk of first-time dislocation as a function of time as well as the cumulative long-term risk of dislocation following total hip arthroplasty in patients with two different bearing surfaces, ceramic on ceramic and ceramic on polyethylene (PE).

METHODS: We reviewed 126 patients (252 hips) with bilateral THA (one ceramic-ceramic, AL/AL and the contralateral ceramic-polyethylene, AL/PE) who had THA performed between from 1978 to 1985, and who had survived at least 20 years after surgery. Surgery was performed in both sides within a two years delay with a posterolateral approach under general anesthesia in patients who were average 50 years (range 31-61) old at the time of surgery. All patients received the same implants except for the cup. The stem
was made of anodized titanium alloy (TiAl6V4) and was smooth and always cemented. The alumina head was 32 mm in diameter on each side and anchored through a Morse taper. The acetabular component was a polyethylene cup or an alumina cup and was always cemented. The patients were followed at routine intervals and were specifically queried about dislocation. The cumulative risk of dislocation was calculated with use of the Kaplan-Meier method.

RESULTS: For hips with PE liners, the cumulative risk of a first-time dislocation was 1% (95% confidence interval, 0.9% to 1.1%) at one month and 2% (95% confidence interval, 1.7% to 2.3%) at one year and rose with an increasing rate of 1.2% for the first two five year periods to 4.5% at 10 years, rose with an increasing rate of 1.8% for the next two five year periods to reach 8% at 20 years, and then rose with an increasing rate of 2.5% for the last two five years periods to elevate to 13% (95% confidence interval, 9% to 17%) at 30 years for patients who were alive and had not had a revision by that time. Multivariate analysis revealed that the relative cumulative risk of dislocation (with PE liners) for female patients (as compared with male patients) was 1.8 and that the relative risk for patients who were 80 years old or more (as compared with those who were less than 80 years old) was 1.5. Two underlying diagnoses, cognitively impaired patients or neurologic disease, were also associated with a significantly greater risk of dislocation. For hips with alumina liners, the cumulative risk of a first-time dislocation was 1% at one month, 2% at one year (95% confidence interval, 1.8% to 2.1%) and then did not change at 20 years and at 30 years for patients who were alive and had not had a revision by that time.

DISCUSSION AND CONCLUSION: The cumulative long-term risk of dislocation was greater for patients with PE cup than for patients with ceramic cups. The reasons are probably the absence of wear with alumina cups, the difference between the histology of the capsule of the hips with the two bearing surfaces (fibrous with ceramic; less fibrous and more elastic with PE cups), and a better adhesion between the two components in ceramic on ceramic hips. The different histological aspects observed on revisions are probably the most important factors to explain the absence of dislocation at the most recent follow up in the ceramic group, even in women older than 80 years, in cognitively impaired patients, or in patients with occurrence of a neurologic disease.

POSTER NO. P058
Significance of Asymptomatic Bacteriuria in Knee and Hip Arthroplasty
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INTRODUCTION: Infection is one of the most devastating and dreaded complications of total joint arthroplasty. The incidence and significance of asymptomatic bacteriuria in patients for hip and knee arthroplasty is unknown. The purpose of the study was to report the incidence of bacteriuria and results of arthroplasty in respect to periprosthetic infection.
METHODS: This was a retrospective review of 400 consecutive patients (155 male, 245 female) with mean age of 65.6 years (43-89) undergoing knee and hip arthroplasty. Patients were evaluated for immediate preoperative urine microscopy results for bacteria, nitrite and leucocytes, morbidities, perioperative treatment for urinary tract infection, postponement of surgery and periprosthetic infection. The mean follow up was 17 months (6-24).
All patients had perioperative urinary catheterization for 24 hours.
RESULTS: The incidence of bacteriuria was 43% with nitrite positive 20% and leucocyte positive 24.7%. Female to male incidence ratio was 1:9. There was 23% incidence of bacteriuria under 65 years of age. Diabetes was the most common (9.2%) co-morbidity, followed by renal disease (4.5%). Surgery was postponed in three patients (0.07%) with 3+ bacteriuria and large leucocytes until urine culture result was negative following oral antibiotic treatment. Of three periprosthetic infections, two underwent debridement and polyethylene exchange and one had a staged revision knee arthroplasty. Two of the infections had negative urine microscopy, but positive for diabetes and HIV. The other one periprosthetic infection had positive urine microscopy, but negative urine culture.
DISCUSSION AND CONCLUSION: Asymptomatic bacteriuria is common even in younger patients and especially female. Postponement of surgery should be considered only if significant other co-morbidities and other signs of cystitis/pyelonephritis are present.

POSTER NO. P059
Multicenter RSA Evaluation of In Vivo Wear of Vitamin E Stabilized Highly Cross-linked Polyethylene
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INTRODUCTION: Vitamin E doping of highly cross-linked polyethylene is a method for enhancing long-term oxidative stability of highly cross-linked ultra-high molecular weight polyethylene for use in total joint arthroplasty. In vitro research and development studies have shown that this material has improved wear performance, better retention of mechanical properties, and high resistance to oxidation due to the anti-oxidative properties of vitamin E. The purpose of this study was to evaluate in vivo properties of vitamin-E doped highly cross-linked polyethylene (VEPE), evaluate the stability of two acetabular cup surface coatings and femoral stem stability using radiostereometric analysis (RSA).
METHODS: One-hundred-and-three hips in 99 patients were recruited into an IRB approved, prospective five year RSA study at two centers. Tantalum beads placed in the VEPE liner, the pelvic bone and the femur at the time of surgery, allow the measurement of femoral head displacement into the polyethylene as well as acetabular and femoral component stability. Fifty-one hips received porous-titanium coated cups while 52 hips received plasma-sprayed cups. Either 32 or 36mm femoral heads were used. RSA radiographs were scheduled immediately post-operatively, at three or six months, one, two, three and five years post-operatively.
RESULTS: Ninety-one hips were followed for three or six months, 64 for one year, 21 for two years, and four for three years. Data for patients with the plasma-sprayed cup were available only at one year follow up. No significant difference was found in femoral head penetration into the VEPE liner between the head sizes. The median head penetration was 0.03±0.01 mm at one year, 0.04±0.01 mm at two years, and 0.3±0.02 mm at three years. The median proximal migration of plasma-sprayed cups was 0.2±0.05 mm at one year while the median proximal migration of porous-titanium coated cups was 0.09±0.03 mm at one year, 0.11±0.04 mm at two years, and 0.17±0.13 mm at three years. Both cup types were stable by one year, and the total penetration was not significantly different between the different coating types. The median femoral stem subsidence was 0.13±0.23 mm at six months, 0.16±0.27 mm at one month.
year. 0.06±0.14mm at two years, and 0.02±2.39mm at three years.

DISCUSSION AND CONCLUSION: This study provides the first in vivo wear measurement of VEPE liners using RSA. The amount of penetration into the liner observed during the early period (creep) is low (0.04mm). Creep in other highly cross-linked polyethylene liners without vitamin E was reported as 0.1mm. There was no significant change in femoral head penetration in vivo over time, indicating that little true wear occurred at the articulation. While not statistically significant, the plasma-sprayed cups tended to migrate more than the porous-titanium coated cups in the early months of follow up. Cups with both types of surface coatings were stable by one year. Prior work has demonstrated that movement of the acetabular cup greater than 1.2mm in the first two years has a greater than 50% probability of revision. The relatively low amount of early movement seen in both groups is encouraging, indicating that the components were stable at one year follow up. While most stems were stable throughout, the high standard error at three years results from one stem that migrated substantially by six months (9.4mm). At one year, the stem was stable and at three years remains stable. The 9.4mm of distal migration was visible in plain radiographs. The patient is doing clinically well with no symptoms. The early results of this multicenter RSA study indicate that the VEPE has excellent wear performance; that the plasma-sprayed and porous-titanium coated components both stabilize during the first year in vivo; and that the femoral components were stable.

POSTER NO. P060
ALTERNATE PAPER: ADULT RECONSTRUCTION HIP IV
Cup Positioning in Total Hip Arthroplasty Improves with Clinical Feedback
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Michael Doerner, BA
Mark C. Callanan, MA, Grand Rapids, MI
David Zurakowski, PhD, Boston, MA
Harry E. Rubash, MD, Boston, MA
Henrik Malchau, MD, Boston, MA

INTRODUCTION: Acetabular cup positioning has been linked to dislocation and increased bearing surface wear. While studies have shown various optimal orientation ranges, a common range of acceptable angles is the Lewinnek safe zone (5-25° of anteversion and 30-50° of abduction). Cup angles that are outside the optimal ranges are linked to a variety of unsuccessful outcomes, including dislocation of the hip. Another previous study found correlations between patient and surgical factors and acetabular component position. The purpose of this study was to determine if the accuracy of acetabular cup positioning improves when surgeons receive feedback on their performance. METHODS: Post-op anteroposterior (AP) pelvis and cross-table lateral radiographs were previously obtained for 2,061 patients who received a total hip arthroplasty (THA) or hip resurfacing from 2004 -2008. The surgeries were performed by seven surgeons. AP radiographs were measured using Hip Analysis Suite to calculate the cup inclination and version angles. Acceptable ranges were defined for abduction (30-45°) and version (5-25°). The same surgeons performed a THA or hip resurfacing on 385 patients from January 2009 through June 2010. Cup inclination and version angles for this set of surgeries were compared to surgeries from 2004-2008 to determine if cup inclination and version angles improved as a result of knowledge of the previous acetabular cup positioning study. Improvement in accuracy was assessed by the chi-square test.

RESULTS: Time 1, from 2004 through 2008, had 1,952 qualifying hips with 1,845 having both version and abduction, and Time 2, from 2009 through June 2010, had 385 qualifying hips, all of which had both version and abduction angles. For Time 1, 1,192 (62%) acetabular cups were within the abduction range, 1,422 (79%) were within the version range, and 908 (49%) were within the range for both. For Time 2, 276 (72%) acetabular cups were within the abduction range, 250 (65%) were within the version range, and 217 (56%) were within the ranges for both. Accuracy of abduction angle improved (p<0.01) while accuracy of version angle decreased (p<0.01). Accuracy of acetabular cup positioning being within range for both abduction angle and version angle improved significantly (p<0.01), by 7%.

DISCUSSION AND CONCLUSION: Malpositioning of the acetabular cup has been correlated with numerous adverse clinical outcomes including increased rate of dislocation, liner fracture, and increased wear. The increased dislocation risk has been well established, and implant wear has been shown to be significantly greater for malpositioned cups. Specifically, it has been shown that surgical technique factors such as abduction angle of the cup were the most predictive of polyethylene wear. This study demonstrates that increased awareness and feedback on the resulting abduction and version measurements from THA surgery over time improves the positioning of the acetabular component. A system where objective measurements are presented to the surgeon can significantly improve cup placement which could improve the clinical outcome of THR patients.

POSTER NO. P061
Three-dimensional Computed Tomography (3DCT) Evaluation of Acetabulum After Periacetabular Osteotomy
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Tomohiro Kobayashi, MD, Fukuoka, Japan
Masatoshi Naito, MD, Fukuoka, Japan

INTRODUCTION: This three-dimensional computed tomography (3DCT) analysis shows that anterior rotation of the acetabular fragment contributes to medialization of the femoral head in 30 patients following periacetabular osteotomy for hip dysplasia. Curved periacetabular osteotomy (CPO) is a modified Ganz procedure that we have performed in our facility since 1995 to treat acetabular dysplasia from the prearthrosis stage to the advanced stage in young patients. During the surgery, we use an image intensifier while performing rotation of the acetabulum, with the main indices being femoral head coverage, acetabular roof obliquity and medialization of the femoral head. However, the key parameter for medialization of the femoral head remains unclear. The purpose of this study was to investigate effective procedures for medialization of the femoral head during CPO using 3DCT. METHODS: Thirty hips in 30 patients with hip dysplasia underwent 3DCT scans with a slice thickness of 0.5 mm before and after surgery. A full search method that varied and superimposed a total of six directional and angular variables in three dimensions was used to investigate the relationships between 3D movements of the acetabulum and medialization of the center of the femoral head. Multiple regression analysis

*The FDA has not cleared the drug and/or medical device for the use described in this presentation (i.e. the drug or medical device is being discussed for an off label use). For full information refer to page 14. An alphabetical faculty financial disclosure list can be found starting on page 19.
was used to clarify the relationships in the resulting data.

RESULTS: Medialization of the femoral head was observed in 24 of the 30 patients. Among these 24 patients, 20 showed anterior rotation of the acetabular fragment in both the sagittal and axial planes. The remaining six cases with lateralization of the femoral head had acetabular retroversion preoperatively. Among the different variables, anterior rotation of the acetabular fragment and presence of acetabular retroversion contributed significantly to medialization of the femoral head.

DISCUSSION AND CONCLUSION: This retrospective study using 3DCT showed that increased coverage of the femoral head and absence of acetabular retroversion contribute to medialization of the femoral head.

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POSTER NO. P062

Measuring Leg Length Using Pelvic Radiographs

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Edward T. Davis, FRCS, Hagley, United Kingdom

INTRODUCTION: Leg length discrepancy (LLD) following total hip arthroplasty (THA) remains common and can be a source of patient dissatisfaction and distress. In an effort to reduce this occurrence, surgeons undertake pre-operative templating and use various forms of intra-operative measurements, including computer navigation. With the advent of better technologies to measure intra-operative leg length the “gold standard” with which to compare them is vital. This study aims to delineate how best to measure LLD form a pelvic radiograph and quantifies the errors.

METHODS: Three observers took a total of 9,600 measurements from 100 pelvic radiographs. Four lines were constructed on each of the radiographs, bisecting the acetabular teardrops (Line A- Methods 1/2), ischial spines (Line B- Method 3/4), inferior sacroiliac joint (Line C- Method 5/6) and inferior obturator foramen (Line D-Method 7/8). Measurements were taken from these lines to the midpoint on the lesser trochanters and to the tip of the greater trochanter. The effect of pelvic positioning was also assessed using radiographs of a synthetic pelvis and femur using the same eight methods by a single observer. Inter-observer variability was analysed using within subject standard deviation. Inter-observer variability was analysed using the coefficient of inter-observer variability (CIV).

RESULTS:

<table>
<thead>
<tr>
<th>METHOD</th>
<th>Reproducibility of LLD Measurements</th>
<th>Effect of Pelvic Positioning</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Intraobserver Variability (SD)</td>
<td>Intraobserver Variability (CIV)</td>
</tr>
<tr>
<td>Teardrop-LT</td>
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</tr>
<tr>
<td>Teardrop-GT</td>
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<td>0.063</td>
</tr>
<tr>
<td>Obturator-GT</td>
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<td>0.001</td>
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</tbody>
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* Significantly worse than other methods (Levene’s test)

DISCUSSION AND CONCLUSION: Measuring from the inferior aspect of the ischial tuberosities and to the midpoint of the lesser trochanters is the most reproducible method for measuring LLD from a pelvic radiograph. This method is also the least affected by pelvic positioning. The errors in measurements from pelvic radiographs can be high especially when there is patient mal-positioning. This information should be considered when using this method as the “gold standard” with which to compare intra-operative measurement techniques.

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POSTER NO. P063

Swanson Implant Arthroplasty for Hallux Valgus in Elder Patients

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INTRODUCTION: Various surgical methods have been reported for hallux valgus with sufficient results; however, several weeks are necessary for patients to walk by full weight bearing after any osteotomy due to the risk of fracture and dislocation. Contrarily, it is possible for the patients to walk immediately after Swanson implant arthroplasty, although there are a few reports which describe its results in detail. The purpose of this study is to investigate the results of Swanson implant arthroplasty for hallux valgus in elder patients, by analyzing the clinical symptoms and X-ray findings including hallux valgus angle and intermetatarsal angle.

METHODS: Analysis of 118 cases of Swanson implant arthroplasty in 75 patients was performed. There were eight male and 67 female, and all the patients were older than 60 years and average age was 73 years old. Swanson implant arthroplasty were performed by one surgeon (K.S.) with additional soft tissue release and tightening of medial capsule. All the patients were followed clinically more than five years postoperatively with mean follow up period of 103 months. Radiographically, hallux valgus angle and metatarsal valgus angle were measured, and bone absorption and position of the implant were checked in detail at 0, 1, 3, 6, 12, 36, 60 months postoperatively and at most recent examination.

RESULTS: 1. Pain decreased significantly after surgery and good condition continued until the most recent examination in all the cases but one. 2. Average hallux valgus angle, which was 52° preoperatively, changed to 3° immediately after operation, 9° at three months postoperatively, and 12° at most recent examination. 3. Average intermetatarsal angle, which was 29° preoperatively, changed to 6° immediately after operation, 8° at three months postoperatively, and 9° at most recent examination. 4. There were no cases with infection, skin necrosis, or sensory disturbance, although bone absorption around the implant was revealed in one case.

DISCUSSION AND CONCLUSION: These results indicate that...
Swanson implant arthroplasty was very effective to reduce pain and correct deformity in most patients with hallux valgus. The best indication of this surgery is believed to be relatively elderly patients who hope for a quick return to normal daily activity, although their activity is not as high as younger ones, considering permanence of the implant.

POSTER NO. P064
Poor Short-Term Outcomes with a Contemporary Metal on Metal Total Hip Arthroplasty System
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INTRODUCTION: Metal on metal (MoM) bearings have been adopted for total hip arthroplasty (THA) in an effort to reduce wear, improve longevity, and reduce dislocation rates compared to polyethylene bearings. Concerns have been raised regarding high metal ion levels, adverse soft tissue reactions, and high rates of clinical failure with some of these bearings. At least two such bearings have now been withdrawn from the U.S. marketplace. It is unknown whether these problems are design specific or whether they apply to MoM bearing technology in general. We report our unfavorable results with a modern MoM THA system that is still commercially available in the U.S.A., but for which there is little published outcome data to date.

METHODS: Utilizing prospectively acquired data from our clinic’s joint registry, we identified 72 consecutive THAs in 62 patients utilizing a MoM bearing from a single manufacturer. Sixty-nine THAs utilized a Cobalt-Chrome (CoCr) monoblock resurfacing acetabular component, and three had a modular titanium acetabular component with an internal CoCr liner. All femoral components were non-cemented titanium prostheses with a modular titanium neck and modular cobalt-chrome head. Follow-up ranged from three to 48 months. Mean age was 62 years. Mean acetabular component size was 51mm and mean femoral head size was 45 mm. There were 31 THAs in males and 41 in females. In addition to revision as an endpoint, we also evaluated clinical failure, defined as aseptic hip pain in conjunction with at least one of the following: radiographic loosening, a demonstrable peri-articular fluid collection or high metal ion levels in the blood. Clinical failure was also designated when clinically significant hip pain was reported and no source of referred pain could be identified.

RESULTS: Seven hips (9.7%) have been revised for acetabular loosening and/or painful ALVAL reaction (Aseptic Lymphocytic Vascular Associated Lesion). One additional (non-revised) hip has failed with revision recommended due to severe pain with probable acetabular loosening and blood cobalt level over 100 micrograms per liter (mcg/l). Average time from THA to revision was 21 months. Six clinically failed hips are under investigation for significant pain with high suspicion of ALVAL reaction. Three hips were moderately painful but these patients declined further work up. Total clinical failure rate (including revisions) was 24% (17/72). Six failed hips underwent metal ion testing with mean serum Chromium level 8.8mcg/l and mean blood Cobalt level 27 mcg/l. Revision rate was 6% in men and 12% in women. Clinical failure rate was 19% in men (6/31) and 27% in women (11/41). Femoral head size was not an independent risk factor for revision or clinical failure. Histologic analysis of all revisions demonstrated strong ALVAL reaction, extensive tissue necrosis, or both. Mean acetabular inclination angle of THAs revised or recommended for revision was 46 degrees (range 39 to 51). Clinical failure rate of monoblock cups was 20% (14/69). All three modular cups had clinical failure or revision.

DISCUSSION AND CONCLUSION: Survivorship for this metal on metal bearing was poor at short term follow up. Results were worrisome both for monoblock and modular acetabular components from this system. Results were suboptimal in both men and women, although women seemed to fare more poorly than men. Failures did not appear to be due to vertical component positioning. We cannot endorse this bearing and have stopped using it. The authors believe that all MoM bearings need to be individually evaluated by independent research teams to document safety and efficacy.

POSTER NO. P065
The Utility of Erythrocyte Sedimentation Rate and C-Reactive Protein in Determining Periprosthetic Hip Infections
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Ronald E. Delanoin, MD, Baltimore, MD
Michael A. Mont, MD, Baltimore, MD

INTRODUCTION: The diagnosis of periprosthetic hip infections is often challenging. Erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) blood laboratory tests have commonly been used to aid in the diagnosis. Controversy exists regarding the efficacy and accuracy of serologic markers alone for diagnosing periprosthetic infection of the hip. The senior author noted a high number of false-negative ESR and CRP values in patients undergoing revision that were later confirmed for infection. The purpose of this study was to determine the efficacy of ESR and CRP in the diagnosis of known periprosthetic hip infections. We examined the sensitivity and specificity of these tests for predicting infection. Additionally, we examined the false-negative rates of each test and compared these to other variables including gender, body mass index, infection type, and immune status.

METHODS: Seventy-seven patients were identified with periprosthetic hip infections and ESR and CRP data. A preset cutoff of greater than 30 mm/hr for ESR was used to determine the test to be positive for infection or negative if it was less. CRP values were also found to be either positive for infection if the value was greater than 10 mg/L or negative for lesser values. Sensitivity and specificity were calculated for ESR and CRP alone, then for a positive result in ESR and CRP in both tests, and lastly for a positive result in either ESR or CRP. Chi-square analysis was performed to determine significance of false negatives compared to gender, body mass index, primary diagnosis, type of infection, and immune status. The validity of the cut-offs for ESR and CRP were evaluated with use of receiver operating characteristic (ROC) curves.

RESULTS: ESR had a sensitivity of 89% and specificity of 69%. CRP had a sensitivity of 93% and a specificity of 40%. The false-negative rate was 10.8% for ESR and 7% for CRP. For ESR and CRP combined (with either result positive), the false-negative rate was 3%. All false-negatives in the combined group were immunocompromised. Chi-square analysis did not find a significant correlation between false-negatives and any other variables. Receiver operating characteristic curves showed similar cutoff values to those previously reported in the literature. An ESR value of 32.5 mm/hr and a CRP value of 9.79 mg/L was determined to maximize the sensitivity and specificity of the tests.

DISCUSSION AND CONCLUSION: In summary, when ESR and CRP serologic tests are used in combination, they are excellent adjunct tests to diagnose periprosthetic hip infection. We found similar sensitivity of ESR and CRP of 89 and 93%, respectively. Although the specificity in this study was lower than what has been reported elsewhere for ESR and CRP of 60 and 40%, respectively.
Physicians should be suspicious of patients who present with hip pain and have normal serologic tests and an underlying immunocompromising disorder. The surgeon should have a higher degree of suspicion for infection intraoperatively in these patients.

POSTER NO. P066

Blood Management Affects Functional Outcome After Hip and Knee Arthroplasty

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INTRODUCTION: The risks and costs associated with blood transfusion has led to a reticence to prescribe blood products after hip and knee arthroplasty. The medical evidence against transfusion is based in part upon non-orthopaedic conditions treated in the ICU setting. The specific aim of this study is to evaluate the relationship between hemoglobin (Hb) levels and short term functional outcomes following primary total hip and knee arthroplasty.

METHODS: We retrospectively reviewed the records of 542 consecutive primary total hip and knee arthroplasty patients performed at a single institution over a two year period. The primary outcome was postoperative walking tolerance of 10, 50, and 100 feet with physical therapy (PT). Hb levels were recorded for each patient preoperatively and on each postoperative day. Logistic and Poisson regression analysis were used to assess the association between Hb levels and our primary and secondary outcome measures.

RESULTS: Pre and postoperative Hb levels were significantly associated with the ability to walk 10, 50, and 100 feet postoperatively. Hb levels were also significantly associated with ability to stand with PT postop day 1, weakness or fatigue limiting participation with PT, need for a transfusion, length of hospital stay, and disposition to home versus skilled nursing or acute rehab facility.

DISCUSSION AND CONCLUSION: Our findings have important clinical implications for rapid mobilization protocols after surgery, hospital length of stay, and disposition to home rather than postacute care. Further prospective studies are needed to confirm these conclusions and to help define a possible patient specific transfusion trigger intended to maximize functional recovery after THA and TKA. Pre and postoperative Hb levels are significantly correlated with short term functional outcomes following primary hip and knee arthroplasty.

POSTER NO. P067

Acetabular Component in Total Hip Arthroplasty: Is There Evidence that Uncemented is Better?

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Fares S. Haddad, FRCS, London, United Kingdom
Javad Parvizi, MD, Philadelphia, PA

INTRODUCTION: At this writing, almost all total hip arthroplasties (THA) being performed in North America use cementless acetabular components. The impetus behind this trend is not well understood. The objective of this systematic review and meta-analysis was to compare the survivorships and revision rates of cemented and cementless acetabular components utilized in THA.

METHODS: Primary literature search in PubMed identified 3,488 articles of which 3,374 were excluded because of not meeting the inclusion criteria or meeting the exclusion criteria. Only English articles on primary THA, with average follow up of 10 years or longer, with either survivorship or revision rate as outcomes were included. This study consisted of 64 articles (14,505 arthroplasties) evaluating long-term outcome of cementless acetabular components, 43 papers (16,634 arthroplasties) reporting the outcome of cemented acetabular component, and seven studies (2,312 arthroplasties) comparing cemented and cementless acetabular components. Meta-analysis and logistic regression on pooled data were performed to compare these studies. Because of the heterogeneity of these studies, the meta-analysis used a random effects model, while the logistic regression included an overdispersion parameter to model high variance.

RESULTS: Meta-analysis did not find any significant difference between survivorship and revision rate of cemented and cementless acetabular component. Logistic regression detected significant differences (p <0.02) for both: estimated odds ratio (OR) of surviving a cemented implant versus a cementless one was 1.54 (95% confidence interval: 1.08-1.95), while that of revising a cemented cup versus revising a cementless one was found to be 0.54 (95% confidence interval: 0.33-0.89). The difference between the two analyses may be that meta-analysis was confined to a smaller set of studies (7 versus 107).

DISCUSSION AND CONCLUSION: Regarding our results, cemented acetabular components seem to have a better survival and lower rate of revision compared to cementless cups. The use of cementless acetabular components for better survival is not supported by evidence. Perhaps the ease of insertion of cementless components, the ability to utilize alternative bearing surfaces and aggressive marketing are the main reasons for the popularity of cementless THA in North America.

POSTER NO. P068

Metal on Metal Local Tissue Reaction is Associated with Corrosion of Head Taper Junction

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William J. Peace, MD, Denver, CO

INTRODUCTION: Corrosion at the head/neck taper interface has been associated with elevated ion levels and revision total hip arthroplasty (THA). Elevated ion levels, tissue masses, and osteolysis have been reported in failed metal-on-metal (MOM) hips. These failures are not completely understood at this time. It is possible that taper junction corrosion could be a contributor to MOM THA failure. We evaluated the extent of taper corrosion in large diameter MOM femoral heads retrieved for various reasons. Our hypothesis was that corrosion would be associated with the occurrence of MOM adverse local tissue reaction (ALTR).

METHODS: Twenty-nine retrieved MOM bearing CoCr heads from a single manufacturer were analyzed. There were 19 (65%) 36mm and 10 (35%) 40mm diameter heads in this study. All retrieved heads had a 12/14 taper and were mated with a CoCr stem. Mean age at revision was 56.7 years (range 36-79). Mean implantation time was 2.5 years (range 0.04 to 8.03). Eleven of the heads came from patients who were diagnosed with ALTR. Taper corrosion was visually graded with a 5 point scale by three reviewers who were blinded to the revision diagnosis. The grading scale is a modification of a previously published scale. In addition corrosion products seen outside of the taper zone were recorded. Grading score of taper corrosion: 1 (NONE) - No visual corrosion observed; 2 (MILD) <30% of engaged taper surface discolored/dull; 3 (MODERATE) >30% of engaged taper surface discolored/dull OR <10% of engaged taper surface has black/dull gray debris, pits or etch mAk; 4 (SEVERE) >10% but <50% of engaged taper surface...
has black/dull gray debris, pits or etch mAK; 5 (EXTREME)- >50% of engaged taper surface has black/dull gray debris, pits or etch mAK.

RESULTS: Of the 29 retrieved heads, 14% had no visible corrosion, 41% had mild, 3% moderate, 21% severe and 21% had an extreme degree of corrosion. The length of implantation time was correlated with corrosion score (p=0.012 spearman’s rho correlation test). Nine heads had corrosion that extended beyond the taper junction. Eight of those nine had a MOM adverse tissue reaction. Corrosion extending beyond the taper junction area correlated with ALTR (p<0.01 spearman’s rho correlation test). The mean corrosion score was 4.36 for cases with ALTR and 2.06 for other cases (p<0.01, Kruskal wallis test).

DISCUSSION AND CONCLUSION: A total of 42% of our retrieved MOM heads had severe to extreme taper corrosion. Patients that had an adverse local tissue reaction to a MOM bearing had more corrosion and were more likely to have corrosion products outside of the taper junction. Since we found that corrosion worsens with time we are concerned that MOM ALTR failures will also increase with longer follow up.

Image 1: Example of taper corrosion score 1

Image 2: Example of taper corrosion score 5 with corrosion extended outside of taper

POSTER NO. P069

Risk Factors Affecting the Accuracy of the Image-free THA Navigation in Determination of Acetabular Cup Orientation

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Shoji Nishio, Nishinomiya, Japan
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Shinichi Yoshiya, MD, Nishinomiya, Hyogo, Japan

INTRODUCTION: Although the use of the image-free total hip arthroplasty (THA) navigation system is thought to improve the consistency of the prosthetic alignment, there are some cases with discrepancy in the results between the intraoperative navigation and the postoperative radiological assessment. We have used the OrthoPilot navigation system (B/BRAUN-Aesculap). In this study, we reviewed our clinical experience and attempted to identify factors affecting the assessment accuracy of this system.

METHODS: A retrospective analysis was performed for 192 hips (185 patients) undergoing THA with the use of the image-free navigation system. All THAs were performed using a cementless cup (Plasma cup; B/BRAUN-Aesculap) with screw fixation. After the surgery, CT evaluation was performed, and three-dimensional cup alignment was calculated. Regarding the potential factors affecting the accuracy of the navigation assessment, we examined the effects of learning experience of the surgeon, initial gap between the acetabular host bone and cup, thickness of soft tissue (STT) underlying the pubic symphysis and Crowe classification in developmental dysplasia of the hip (145 cases) on the assessment error. Statistical assessment was undertaken using univariate and multivariate analyses. Discrepancy of more than 5° between the intra- and postoperative results was defined as indicating an assessment error.

RESULTS: The mean difference between the intra- and postoperative values was 3.5°±2.9° and 5.1°±3.3° in inclination and anteverision angles respectively. The incidences of discrepancy of more than 5° were 21.8% (42 cases) and 39.0% (75 cases) respectively. Crowe classification did not influence the intraoperative assessment error.

In the logistic regression for anteversion, we found that immature surgical experience (during the first and 64th case) (odds ratio, OR=3.4; p=0.006), existence of the initial gap of more than 2 mm between the acetabular host bone and the cup (OR=2.3; p=0.04), obesity (STT of more than 65mm) (OR=47; p=0.0002) were deemed as factors affecting the accuracy of the intraoperative estimation by the navigation system. By contrast, assessment of the inclination value was not influenced by any of these factors.

DISCUSSION AND CONCLUSION: In this study, we evaluated the effects of the potential factors on the accuracy of the intraoperative assessment of cup orientation in navigated THA. Among the factors analyzed, surgical experience, the gap between the acetabular host bone and cup, obesity were identified as factors affecting the intraoperative assessment accuracy regarding the anteversion.

Among those, obesity as assessed by the soft tissue thickness was shown to be highly correlated with the assessment error.

POSTER NO. P070

Primary Total Hip Arthroplasty using a Direct Anterior vs. Posterolateral Approach: A Comparative Study

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INTRODUCTION: Direct anterior approach was described as muscle preserving procedure to improve results and reduce dislocation rate following total hip arthroplasty (THA). Purpose of this study was to compare results of direct anterior versus posterolateral approach following THA.

METHODS: This was a retrospective review of 90 consecutive patients undergoing THA by a single surgeon divided into posterolateral (PL) 50 (29 F, 21M) and direct anterior (DA) 40 (21 F, 19 M) groups. Respective mean age 60.7± 11.8 and 60.2± 11.7 years were comparable. The minimum follow up was two years (2-3.2 years). Early function along with clinical and radiographic analysis was performed.

RESULTS: The difference in mean value in PL and DA groups with respect to blood loss, operative time, hospital stay, BMI, preoperative and postoperative Harris hip scores were not significant. Average cup inclination and anteverision angle in PL and DA was 46.4± 6.7 vs. 41.4± 5.8 degrees and, 27± 5.4 vs. 24± 4.6 degrees. DA group had better postoperative day 2 walking distance 294.8 vs. 194.5 feet (p=0.002) and better VAS pain 1.9 vs. 3.5 (p=0.003). No dislocation, no revision surgery in either group. DA group had complications in 11 patients (27.5%) - thigh lateral femoral cutaneous nerve pain seven

PAPERS, POSTERS & SCIENTIFIC EXHIBITS AR HIP

*The FDA has not cleared the drug and/or medical device for the use described in this presentation (i.e. the drug or medical device is being discussed for an off label use). For full information refer to page 14. An alphabetical faculty financial disclosure list can be found starting on page 19.*
The Outcome of Metal on Metal Bearing Surfaces in Hip Arthroplasty

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INTRODUCTION: The use of metal on metal (MoM) bearing surfaces for primary conventional total hip replacement has become more frequent in recent years. There has been increasing concern however regarding the use of this bearing surface. This study compared the outcome of over 18,000 MoM to over 93,000 metal on polyethylene (MoP) procedures.

METHODS: The data was obtained from a comprehensive national database that prospectively recorded these procedures over a 10-year period. Analyses were undertaken to examine the impact of age, gender, femoral head size and prostheses as well as determining the reasons for revisions. The principal outcome measure was time to first revision using Kaplan-Meier estimates of survivorship.

RESULTS: MoM has a significantly higher rate of revision compared to MoP. At 10 years, the cumulative percent revision for all MoM articulations was 8.8% (7.7, 10.1). This compared to 5.6% (5.3, 6.0) for all MoP (HR>1 up to 6.5 years, p<0.001). When MoM articulations are used, females had a significantly higher rate of revision. There was no age related difference in revision rate with older patients having the same rate of revision as younger patients. There was an important relationship with head size. For head sizes <=32mm there was no difference between MoM and MoP. The difference in the revision rate between these two bearing surfaces was only evident for head sizes >32mm. The outcome of different MoM prostheses varies, but when the head size is >32mm most have a high rate of revision. When comparing the same prostheses with different bearing surfaces MoM has a higher rate of revision. This higher rate of revision for MoM is due to an increased rate of loosening and metal sensitivity.

DISCUSSION AND CONCLUSION: The use of MoM increases the rate of revision in conventional total hip arthroplasty when head sizes >32mm are used.

Detection of Intraoperative Purulence is not Reliable for Diagnosis of Periprosthetic Joint Infection

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INTRODUCTION: Diagnosis of periprosthetic joint infection (PJI) presents a major challenge to orthopedic surgeons. Currently a variety of diagnostic tests are available with varying degrees of sensitivity and specificity. Intraoperative purulence has long been considered a definite sign of PJI. This study aims to evaluate whether its presence is reliable in the diagnosis of PJI.

METHODS: Our prospective institutional database was used to identify PJI patients treated at our institution between January 2000 and March 2010. All patients were diagnosed using our institutional criteria which involve results from intraoperative purulence, serology tests, microbiological cultures, or presence of purulence using our institutional criteria which involve results from intraoperative purulence. The principal outcome measure was time to first revision using Kaplan-Meier estimates of survivorship.

RESULTS: The modified preoperative and postoperative Harris Hip Score (HHS) for the groups was as follows: Group 1 (intact labrum) 68 to 94.6 (p < 0.01); Group 2 (labral damage/refixation) 71 to 95.3 (p < 0.01); Group 3 (OB1-2) 68 to 95 (p < 0.01); Group 4 (OB3-4) 69 to 94 (p < 0.01). Group A (no treatment of cartilage lesions) 64 (55-67; STD 5) to 85 (53-99; STD 21) (p=0.13); Group B (microfracture) 67 (53-85; STD 13) to 80 (68-89; STD 9) (p<0.04); Group C (resection and labral advancement) 66 (43-87; STD 9) to 90 (48-100; STD 10) (p<0.001). In a subset of 27 hips with no labrum present either due to previous surgery or calcification, the preoperative HHS improved less dramatically from 69 to 91 postoperatively (p < 0.01). There was no significant difference in postoperative HHS between groups A and B and A and C, though group C (resection and advancement) was significantly better than B (microfracture) (p<0.02).

DISCUSSION AND CONCLUSION: Previous work has documented inferior clinical outcomes with labral resection and acetabular hyaline cartilage damage. In our study, more aggressive management of FAI with labral takedown and resection of damaged acetabular hyaline cartilage was associated with similar clinical improvement to hips with an intact labrum and less severe hyaline cartilage damage (OB 0-2) supporting the idea that these techniques are safe, clinically effective and preferable to labral resection and neglect of the hyaline cartilage injury.
markers and synovial cell count/differential for diagnosis of PJI. RESULTS: Of 978 patients with PJI, 470 had evidence of intraoperative purulence while 508 patients did not. Presence of purulence was shown to have a sensitivity of 60% and specificity of 90% for diagnosis of PJI when positive culture was used to indicate PJI. The PPV was found to be 94% and the NPV was 49% in these cases. When using positive serology from our diagnostic criteria to indicate PJI, presence of purulence was shown to have a sensitivity of 51% and a specificity of 57%. The PPV for intraoperative purulence was found to be 61% and the NPV was 47%.

DISCUSSION AND CONCLUSION: According to the low sensitivity and NPV, presence of purulence cannot be used as an absolute sign of PJI and should not be a single diagnostic criterion, as it is absent in 52% of PJI cases. In patients with florid purulence, Staphylococcal species were most commonly isolated in monomicrobial and polymicrobial cultures.

POSTER NO. P074
ALTERNATE PAPER: ADULT RECONSTRUCTION HIP VI
Assessing Safety and Clinical Efficacy of Revision Total Hip Arthroplasty in Geriatric Patients
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INTRODUCTION: The number of revision total hip arthroplasties (THAs) is growing, particularly for older patients. Revisions are associated with higher complications. The purpose of this study was to determine if there were greater complications and poorer short-term outcome in the geriatric (>75 years) patients than in younger patients following revision THAs.

METHODS: All patients undergoing revision or conversion THA under a single surgeon were entered prospectively into a database from 2004 to 2010 (total 439 cases). There were 40 patients older than 75 yrs (mean 80 yrs). These patients were matched to a cohort of 40 younger patients (mean age 58 yrs) based upon: type of surgery, year of surgery, and peri-operative anesthesia and rehab protocols. Outcome was assessed using the Harris hip score, peri-operative data, length of hospital stay, and complications.

RESULTS: There were two mortalities in the geriatric group and one in the younger group during the 12-month follow-up period. There was no significant difference with numbers available in the operative time (171 min. vs. 201 min., p=0.07), blood loss (900 ml vs. 1512 ml, p=0.63), nor length of hospital stay (7.4 days vs. 5.6 days, p=0.08). There was no difference in the Harris hip score either pre-operatively (52 vs. 56, p=0.33) or at the one-year follow-up (89 vs. 93, p=0.33). There were six complications in the geriatric group requiring two reoperations and three repeat revisions. There were eight complications in the younger group requiring one re-operation and two repeat revisions.

DISCUSSION AND CONCLUSION: Our data did not demonstrate any significant differences between the two groups. Instead, our data showed that revision THAs were equally safe and clinically efficacious in the geriatric population as in the younger patients.

POSTER NO. P075
The Transverse Acetabular Ligament as a Guide for Acetabular Component: A Clinical Study of 300 Crowe 1-4 Cases
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INTRODUCTION: Recent studies have supported usefulness of the transverse acetabular ligament (TAL) as a guide for the anatomical acetabular cup implantation in idiopathic osteoarthritis with excellent clinical results. However, no clinical study has been reported efficacy of the TAL in secondary osteoarthritis (OA) cases such as dysplastic hips or hips with congenital dislocation. Some reports difficulties of intra-op visualization of the TAL in these secondary OA hips. The purpose of this study was to investigate effectiveness of the TAL as a guide of acetavelar cup anteversion in secondary osteoarthritis.

METHODS: A total of 305 secondary osteoarthritis cases (309 hips) were included in this study; 248 hips with dysplasia (Crowe 1-3), 10 hips with congenital dislocation (Crowe 4) and 51 others. We performed intraoperative visual assessment of the TAL according to the reported grading system (Grade 1: Normal-quality TAL visible on exposure of the acetabulum, Grade 2: TAL covered by soft tissue, which needed to be cleared to expose the ligent , Grade 3: TAL covered by osteophytes, which have to be remover to expose the ligament, Grade 4: No ligament identified). We also assessed intra-operative cup placement according to reported classification (component aligned to TAL, averted, retroverted, too high, and too deep). All hips were followed up for short term clinical results.

RESULTS: All 309 hips were classified as TAL Grade 1 (35 hips), Grade 2 (124 hips), Grade 3 (136 hips) and Grade 4 (14 hips). In 295 hips (95.5%), intra-operative TAL identification was possible with or without removal of peri-acetabular soft tissue or osteophytes (TAL 1-3). We were able to align acetabular cup correctly to the TAL in 234 hips. At final follow up, four hips (1.4%) had posterior dislocations (two hips in Crowe 1-3 and two hips in Crowe 4). DISCUSSION AND CONCLUSION: Intra-operative identification of the TAL in 295 hips (95.5%) was possible. The cases included severe dysplastic hips that we experienced difficulty in identifying bony landmarks. Dislocation rate was low with the TAL implantation technique. The TAL can provide reliable intra-operative guide for acetabular cup placement in secondary osteoarthritis hips.
INTRODUCTION: The technique of injection and polymethylmethacrylate (PMMA) composition has undergone ‘three generational changes’ with the aim of increasing the overall strength of the bone-PMMA-stem composite. Little emphasis, change or research of the bone-PMMA interface has occurred. Clinically, most aseptic loosening of a prosthesis occurs between the bone-cement interface and not between the stem-PMMA interface. This is a biomechanical study to determine if the strength (push out and torsional) of the bone-PMMA interface can be increased by changing the internal architecture of the cortical wall by ‘rifling’ i.e., creating circumferential undercuts into the cortical bone in contrast to a ‘smooth’ cortical wall which normally results after ‘routine’ reaming.

METHODS: We utilized 12 fresh frozen human allografts; all diaphyseal femoral cortical segments. All segments were precision machined to 18mm diameter; Gp.1 controls (8); smooth cortical canals to simulate standard reaming techniques and Gp.2 were eight grooved (undercuts) with 2, 3mm grooves at equal intervals. Fluted intramedullary stems 80 mm in length (diameter= 18mm) were machined with four flutes with a sand blasted finish. All were 16 mm in diameter thus leaving a 1 mm cement mantle. The test specimens consisted of the intramedullary tubes cemented into the cortical segments under pressurization. All specimens were ‘potted’ in square aluminum tubing using resin for specimen fixation. These tubes were held in place in the MTS® by specially designed fixtures. A standard MTS® machine was utilized for push-out and torsional testing measured in Kilo Newtons (KN) to failure. Failure was defined as a drop off of the Force curve as well as visual inspection of the bone-PMMA-stem construct. Analysis: a paired analysis of Gp.1 (controls) vs. Gp.2 (grooved) was performed looking at force to failure; push-out and torsional force and mode of failure defined as the point of initiation of the crack in the cement mantle. Failures at the stem-PMMA or Bone-PMMA interface were recorded.

RESULTS: All of the grooved specimens (Gp.2) had a significantly higher force to failure in both push-out and in torsional testing than the non-grooved (Gp.1) specimens. The average increase in strength (force required to fail) of Gp.2 (grooved) to non-grooved (Gp.1) was 6.2 KN vs 2.6 KN i.e., 278% increase in (push-out) and 283% (torsional) strength. None of the non-grooved specimens (Gp.1) approached the lower limits of failure of the grooved specimens (Gp.2). All specimens failed at the bone-PMMA interface and NOT at the stem-PMMA interface.

On inspection, the point of failure appeared to initiate at the grooves.
from excessive subclinical wear. From this review, we believe that surgeon technique is critical in providing optimum wear in large diameter metal-metal bearings. To reduce RSS, hip bearings (built of any material design) should be carefully positioned. Furthermore, appropriate femoral offset should be utilized to reduced pelvic abutment which can also cause RSS.

POSTER NO. 0078

Acute Kidney Injury Following Lower Limb Arthroplasty
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Trevor Lawrence, West Midlands, United Kingdom

INTRODUCTION: Acute kidney injury (AKI) formerly known as “acute renal failure” results in rapid reduction in kidney function associated with a failure to maintain fluid, electrolyte and acid-base homeostasis. The UK NCEPOD published a report in 2010 on AKI that revealed many deficiencies in the care of patients with AKI. The UK Renal Association has published the final draft of Clinical Practice Guidelines for Acute Kidney Injury on the 08/01/2011. In our study we determined retrospectively the occurrence of this problem in a District General Hospital and its impact on the recovery after lower limb arthroplasty.

METHODS: Data was collected retrospective study over three months between October to December 2010 from theater registers and the hospital database system. A total of 359 patients were identified. Preoperative (baseline) and postoperative blood investigations included Creatinine, Urea, K+, Na+, GFR, Haemoglobin were analyzed. Data collection also included type of anesthesia, timing of operation, duration of procedure and estimated blood loss. From the hospital database system and clinical letters we collected length of stay and time required for blood results to come back to baseline. A diagnosis of AKI was based on the International Kidney Disease Improving Global Outcomes (KDIGO) staging classification as recently recommended by UK Renal Association. Stage I Creatinine increased by ≥ 26 µmol/L from baseline, Stage II Creatinine increased by 200-300% and Stage III Creatinine increased ≥ 300%.

RESULTS: In our study, 11.97% (43/359) of patients developed acute kidney injury following lower limb arthroplasty. Eighteen patients (42%) developed Stage I (Cre increase ≥ 26 µmol/L), 17 (39%) developed Stage II (Cre increase 200-300%) and eight patients (19%) developed Stage III (Cre increase ≥ 300%) acute kidney injury. Most of these patients were operated during the afternoon session. Patients with acute kidney injury stayed longer in hospital (12.58 days) compared to similar age group of patients (5.95 days) admitted during the same period. Some 25% of patients took more than a month for renal parameters to come down to preoperative baseline.

DISCUSSION AND CONCLUSION: AKI is a new definition and the incidence in our hospital is higher than the 1% expected nationally. Patients with AKI are often complex to treat and timely referral and transfer to renal services if appropriate should be considered. The aetiology of acute renal injury is very complex and includes gentamicin antibiotic prophylactic, rapid blood loss in elderly frail patients, nonsteroidal painkillers and preexisting cardiac and renal pathology. The need for careful postoperative observation cannot be overemphasized together with judicious blood replacement as required. Acute kidney injury following lower limb arthroplasty is a sensitive marker of postoperative care. A successful surgical outcome may not mean a successful renal outcome. Patients with AKI are often complex to treat, and the new AKI definition and staging system allows an earlier detection and management of this condition. Further prospective studies with a large number of patients are required.

POSTER NO. P079

Do Pulmonary Emboli Arise from Lower Extremity Deep Venous Thrombosis?
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INTRODUCTION: Venousthromboembolism(VTE)isanimportant complication that may occur following total joint arthroplasty (TJA). It is a commonly held belief that pulmonary embolii (PE) arise from propagation of a deep venous thrombosis (DVT) and that prevention of DVT will lead to a reduction in PE. Our study was designed to examine the association between symptomatic DVT and PE in a consecutive group of patients undergoing TJA.

METHODS: This prospective study was initiated in April of 2010. A total of 1,710 TJA were performed at our institution between April of 2010 and December of 2010. Patients who had signs/symptoms of VTE postoperatively, were evaluated for both DVT and PE. A total of 129 patients were evaluated for DVT and/or PE by lower extremity ultrasound (US), chest CT, or V/Q scan within 90 days of arthroplasty. Of the 129 patients who were evaluated for VTE, 78 had symptoms of DVT and 51 had symptoms of PE. A test of association was performed in order to determine if the odds of developing positive symptomatic PE was significantly increased following positive symptomatic DVT and vice versa.

RESULTS: Of the 79 patients with symptoms of DVT, 14 had evidence of DVT of the lower extremities. Of 52 patients with suspected PE, 16 had PE based on imaging. Of 37 scanned for both DVT and PE, only seven patients (19% of those scanned for DVT and PE, 5.4% of the total cohort) had both DVT and PE. Thus, guidelines that use DVT as a proxy for PE may result in over anticoagulation of patients with all its associated risks. This study was designed to examine the association between symptomatic DVT and PE in a consecutive group of patients undergoing TJA. No significant association between developing PE and DVT was found within 90 days of undergoing TJA.

POSTER NO. P080

Fracture of Modular Revision Femoral Stems at the Mid-Stem Junction
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Ofer Levi, MSc, Rehovot, Israel
Yona Kosashvili, MD, Rishon Le Zion, Israel
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INTRODUCTION: Mechanical failure of femoral stems at the modular junction of revision hip arthroplasty systems has been reported only infrequently. In the current study, the causes of six stem fractures, which occurred in vivo, were analyzed with use of clinical data and failure analysis.

METHODS: Six patients with a fracture at the mid-stem junction of a modular revision hip implant were identified in our database
of patients who had undergone revision arthroplasty. The characteristics of the patients with a fractured stem were compared with those of 165 patients from the same prospective database who had a modular stem implanted, had at least two years of follow-up, and had not had a fracture of the stem. Failure analysis of three implants (six fracture surfaces) was carried out, with use of microscopic, chemical, and microhardness characterization techniques.

RESULTS: Patients with a fractured stem had significantly higher body mass indices than patients without a stem fracture. Radiographs demonstrated that these femoral implants lacked adequate osseous support of the junction area of the stem. All stems failed approximately 1 to 2 mm proximal to the body-stem junction, thus indicating the presence of a bending moment. The chemical composition and microhardness matched those of Ti-6Al-4V. Evidence of wear and fatigue were found on the fracture surface. A wear strip was also observed along the circumference of the stem near the junction.

DISCUSSION AND CONCLUSION: We concluded that the stem failure was initiated by a fretting fatigue mechanism and was propagated by a pure bending fatigue mechanism. Risk factors for fractures of the modular junction include excessive body weight and inadequate proximal osseous support because of trochanteric osteotomy, reduced reoperative bone stock, osteolysis, loosening and/or implant undersizing. Surgeons should consider the use of implants with strengthened junctions when using modular stems in such patients.

POSTER NO. P081

Is Second Generation Metal-on-Metal Primary Total Hip Arthroplasty with 28mm Head a Worthy Option?

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INTRODUCTION: Recently many authors have reported early osteolysis, pseudotumor and cancer probably due to adverse reactions of metal ion, even in second generation metal-on-metal total hip arthroplasty (MoM THA). To identify whether second generation MoM THA with 28mm head is still worthy enough to continue using, we investigated long-term survivorship and influencing factors associated with failure in these implants.

METHODS: We retrospectively reviewed 149 consecutive patients (195 hips) who underwent second generation MoM THA with 28mm head. Among them, 180 hips in 141 patients with a mean age of 43 (19-55) years were available for clinical and radiographic review at a mean of 13.4 (11-17) years postoperatively. Survivorship analysis with the end points of acetabular cup revision or periacetabular osteolysis as a failure was performed, and factors associated with failure and adverse reactions were also investigated.

RESULTS: Survival rate with acetabular cup revision for any cause and that with the development of periacetabular osteolysis were 97.8%, and 96.7% respectively at 17 years. Four hips were revised due to cup loosening. Periacetabular osteolysis appeared in six hips. But pseudotumor and cancer were not found. Mean Harris hip score improved to 91.9 points at final follow up. No significant factors associated with failure were evident according to cup orientation, stem alignment, and patient-related factors.

DISCUSSION AND CONCLUSION: These encouraging long-term results indicate that second generation MoM THA with 28mm head may be worth using.

POSTER NO. P082

Low Prevalence of Unexpected Pathological Diagnoses After Primary Total Hip Replacement

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INTRODUCTION: The cost and effectiveness of routine pathologic review after total hip arthroplasty (THA) have been previously reported on in a relative small cohort of patients. As the costs associated with this process are not inconsequential, the purpose of this study was to establish a prevalence of unexpected pathological diagnoses after THA at one institution.

METHODS: A retrospective review of an institutional joint replacement registry was done searching for all patients having had THA. A total of 2,833 patients were identified. Femoral head pathology reports from each case were obtained from the hospital systems Research Patient Data Registry. The reports were scanned for a list of pertinent abnormal diagnoses provided by the institutions pathology service which included amyloid, enchondroma, gout, leukemia, lymphoma, metastatic, osteomyelitis, Paget’s, avascular, calcium pyrophosphate, necrotic bone and osteonecrosis.

RESULTS: Of the entire cohort there were 419 positive findings (14.13%). Osteonecrosis was the most frequent diagnosis with 220 cases, followed by avascular necrosis with 99 cases. Calcium pyrophosphate was seen in 57 cases and there were 12...
cases of necrotic bone. There were 25 cases of the remaining diagnosis of which, fourteen were pre-existing. Of these 11 new diagnoses seven were enchondromas, one was gout, two were lymphoma, and one was Paget’s. There were no unexpected cases of amyloid, leukemia, metastatic disease, or osteomyelitis.

DISCUSSION AND CONCLUSION: The single largest review of unexpected pathology identified during routine femoral head examination after THA. This confirms the low prevalence of unexpected diagnoses indicating limited yield associated with this process. In light of the current crisis in healthcare economy, and the projected increase in the number of THAs over the next decade, further studies are required to examine the utility of routine pathological examination during THA in providing cost-efficient quality medical care.

POSTER NO. P083

Hip Resurfacing Arthroplasty - Short Term Survivorship of 4,401 Hips from the Finnish Arthroplasty Register

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INTRODUCTION: Population-based register data from the Nordic Arthroplasty Register Association (NARA) and from the National Joint Register of England and Wales have revealed that the outcome after hip resurfacing arthroplasty (HRA) is inferior to that of conventional total hip arthroplasty (THA). METHODS: Based on data extracted from the Finnish Arthroplasty Register, the risk of revision of 4,401 HRAs performed during 2001-2009 was analyzed using Cox regression model. The revision risk of the HRAs was compared to that for 48,409 THAs performed during the same time period. RESULTS: In the Cox regression analysis, there was no difference in revision risk between HRAs and THAs (RR 0.93, CI 0.78-1.10; p = 0.4). Female patients had two times increased revision risk compared to male patients (RR 1.98, CI 1.44-2.71, p < 0.001). Hospitals that had performed 100 or more HRA procedures had a reduced revision risk compared to those with less than 100 HRAs (RR 0.61, CI 0.41-0.88, p = 0.009).

DISCUSSION AND CONCLUSION: We found that HRA had comparable short-term survivorship with THA at a nationwide level. Implant design had an influence on revision rates, as did hospital procedure volume. Female patients had two times increased revision risk compared to male patients.

Survival of HRA and THA, the reference group. End-point is defined as increased revision risk compared to male patients.

## Table

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POSTER NO. P084

Radiographic Evidence of Cam Type Femoroacetabular Impingement in Young Patients with Hip Osteoarthritis

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INTRODUCTION: Femoroacetabular impingement (FAI) may contribute to the development of early onset hip osteoarthritis (OA). A cam lesion (or pistol grip deformity) of the proximal femur reduces head-neck offset resulting in cam type FAI. The alpha angle is a radiographic measurement recommended for diagnosis of cam type FAI. The purpose of this study was to determine if patients that develop end stage hip OA prior to 55 years of age have radiographic evidence of cam type FAI.

METHODS: The anteroposterior (AP) pelvis and lateral hip radiographs of 244 patients (261 hips) who presented to our institution for hip arthroplasty or hip fracture fixation between 2006 and 2008 were retrospectively reviewed. Three cohorts were compared: 1) patients with end stage hip OA < 55 years old (N=76); 2) patients with end stage hip OA ≥ 55 years old (N=84); 3) hip fracture patients ≥ 65 years old without radiographic evidence of hip arthrits were used as controls (N=101). Patients with inflammatory arthritis, avascular necrosis and post-traumatic hip OA were excluded. Alpha angles were measured on the AP pelvis and lateral radiographs by three coauthors using ImageJ 1.43 software (National Institutes of Health, USA). For patients with end stage hip OA, AP alpha angles were measured on both the hip with OA and the contralateral hip. Lateral alpha angles were measured on the contralateral hip. A one-way ANOVA with post hoc Tukey’s HSD test was used to compare the AP and lateral alpha angles for the three cohorts.

RESULTS: The intraclass correlation coefficient (ICC) for the three coauthors measuring AP and lateral alpha angles was 0.85 and 0.86 respectively, indicating excellent inter-rater agreement. Patients < 55 years old with end stage hip OA had the largest AP and lateral alpha angles (82.7±11.6 degrees AP and 63.9±18.5 degrees lateral). These angles were significantly larger (p<0.01 for both comparisons) than patients ≥ 55 years old with end stage hip OA (71.2±17.8 degrees AP and 55.5±18.0 degrees lateral) and hip fracture patients without hip OA (52.7±10.9 degrees AP and 44.4±11.4 degrees lateral). Comparing AP alpha angles of the contralateral hips, the mean AP alpha angle for patients < 55 years old with hip OA (70.8±13.2a) was significantly larger (p=0.04) than patients ≥ 55 years old with hip OA (64.5±16.2 degrees) which in turn was significantly larger (p=0.01) than the hip fracture patients (52.7±10.9 degrees).

DISCUSSION AND CONCLUSION: Patients < 55 years old with hip OA had the largest mean AP and lateral alpha angles,
Which Factors Predict the Clinical Outcome after Femoroacetabular Impingement Surgery?

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INTRODUCTION: The aim of this study was to compare pre-operative and intra-operative factors such as delayed gadolinium enhanced MRI of cartilage (dGEMRIC) index, minimal joint space width (JSW), radiographic grade of osteoarthritis, the patient reported pain level and the amount of surgical bone resection to the one-year clinical outcome after femoroacetabular impingement (FAI) surgery.

METHODS: Thirty patients (13/17 m/f, age 27.8±8.2 years) with cam or mixed FAI were included in this retrospective study. Inclusion criteria were an age between 14 and 60 years, FAI surgery, a preoperative dGEMRIC scan, and a pre-op WOMAC pain score greater than 4. DGMRIC was performed at 1.5T in 27 patients and at 3T in three patients using a fast 3D isotropic T1 mapping sequence. The dGEMRIC index at 3 Tesla was corrected for the higher T1 values seen at higher field strength. On sagittal 3mm-reformats, a region of interest (ROI) evaluation was performed on the most central sagittal slice. One ROI was selected for the acetabular cartilage from the anterior acetabular rim to the superior-most point in the joint. Pre- and post-operative x-rays were evaluated for Tönnis osteoarthritis grade, JSW (both assessed on AP supine view), and alpha angles (on frog or Dunn view). Improvement in WOMAC pain and alpha angle was tested using Student’s t-test. The clinical improvement in the WOMAC pain score was calculated as:

ΔWOMACp = WOMAC pain pre-OP - WOMAC pain post-OP

which follows:

ΔWOMACp = WOMAC pain pre-OP - WOMAC pain post-OP

α angle post-op, the pre-op JSW and the pre-op WOMAC pain score was performed. An independent sample t-test was performed to compare ΔWOMACp between pre-op Tönnis grade 0 and I.

RESULTS: Twenty-nine out of 47 hips (62%) had a pseudotumour. The mean preoperative dGEMRIC value of our cohort was 533.2±111.6 msec (standard deviation). The surgical resection improved the mean femoral neck alpha angle from 58.1±16.0 degrees pre-op to 42.5±6.1 post-op (p<0.001). The WOMAC pain score decreased from 9.8±3.3 pre-op to 4.4±3.4 post-op (p<0.001). The Tönnis grade was 0 (normal) in 14 and I (mild osteoarthritis) in 16 patients pre-op and was 0 in 10 and I in 20 patients post-op. WOMACp was not different in patients with pre-op Tönnis grade 0 and I (6.1±1.8 vs. -5.1±5.2; p=0.48). There was no correlation of dGEMRIC index with WOMACp (r=-0.05; p=0.82). WOMACp also did not correlate with the amount of femoral bone resection (r=-0.01; p=0.97) and the JSW (r=0.32; p=0.09). The only factor associated with WOMACp was the pre-operative WOMAC pain score (r=0.56; p=0.001).

DISCUSSION AND CONCLUSION: The amount of pain improvement after impingement surgery is positively associated with the severity of pre-operative level of pain. The pre-op dGEMRIC index, the amount of femoral bone resection, the pre-op JSW, and the pre-op Tönnis grade were not associated with one-year pain improvement (WOMACp) in our study. All of our patients had minimal to no radiographic evidence of osteoarthritis and femoral resection was sufficient. Therefore, careful selection of symptomatic patients with FAI for surgical treatment can lead to predictable improvement in symptoms.

Sterile Pseudotumour can Explain a High C-reactive Protein

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INTRODUCTION: Surgeons use blood C-reactive protein (CRP) to help diagnose infection in a painful hip arthroplasty and decide between one or two stage revision. However, there are some case examples of a high CRP resulting from a sterile inflammatory pseudotumour seen around metal on metal (MOM) hips. Our aim was to determine the relationship between CRP and infection / non-infection in patients with a pseudotumour adjacent to a painful MOM hip.

METHODS: Ninety-seven patients were seen in our painful MOM hip replacement (MOMHR) clinic. Forty-six patients (11 males and 35 females) with 47 MOM hips fulfilled our inclusion criteria: 1) a painful MOM hip sufficient to require revision, or with an Oxford hip score less than 30; 2) a known serum CRP; 3) a metal artefact reduction sequence (MARS) MRI; 4) and a means of determining infection from non-infection (hip aspiration or cultures from revision surgery). A CRP of >10 mg/L was regarded as elevated. All MRIs were evaluated by two senior musculoskeletal radiologists.

RESULTS: Twenty-nine out of 47 hips (62%) had a pseudotumour on MARS MRI, of which 12 (41%) had an elevated CRP. Nine out of the 12 (75%) hips with a pseudotumour and an elevated CRP were not infected. The sensitivity and specificity for the presence of a pseudotumour based on an elevated CRP was 0.47 and 0.61 respectively. The sensitivity and specificity of infection in pseudotumour positive patients based on the CRP are 0.50 and 0.54 respectively. This is lower than the accepted values for non-MOMHRs.

DISCUSSION AND CONCLUSION: Two-thirds of patients with a painful MOMHR had a pseudotumour on MARS MRI. There was poor correlation between an elevated CRP and a pseudotumour. The sensitivity and specificity were low for diagnosing infection based on CRP in patients with pseudotumours on MRI.
Do Health Related Quality of Life Scores Improve in Overweight Patients Following Total Hip Arthroplasty?

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INTRODUCTION: There were few reports concerning long-term results of various pelvic osteotomy for developmental dysplasia of the hip. Dome pelvic osteotomy (Figure) has been introduced for acetabular dysplasia as a modification of Chiari pelvic osteotomy. In this method, dome cutting of iliac bone on the lateral aspect is done in order to acquire the accordance with the sphericity of the femoral head and the wide contact area of the iliac bone cutting. In order to elucidate long-term results of dome pelvic osteotomy for developmental dysplasia of the hip, we retrospectively evaluated the clinical and radiographic results in 42 hips of 35 patients at a minimum 25-year follow up.

METHODS: There were 33 women and two men. The mean age of the patients at the time of the surgery was 28.7 years (range, 14 - 48 years). The mean height was 152.2 cm (range, 130 - 175 cm), and the mean weight was 54.8 kg (range, 38 - 73 kg). The mean body mass index (BMI) was 23.6 (range, 17.3 - 30.6). The mean follow up was 27 years and two months (range, 25 - 32 years). Dome pelvic osteotomy was indicated to treat hips with pain and dysfunction because of osteoarthritis secondary to moderate or severe hip dysplasia and was not done for patients without disability because of hip pain. The stage of osteoarthritis before the surgery was graded as pre-arthritis (15 hips), early osteoarthritis (19 hips), and advanced osteoarthritis (eight hips).

RESULTS: Pain score and total score of Harris Hip Score improved, whereas range of motion score reduced during the long-term follow up. Radiographically, the mean center-edge (CE) angle and acetabular head index (AHI) improved from -3° (range, -29 - 15°) and 50% (range, 22 - 77%) before the surgery to 42.6° (range, 22 - 65°) and 95.9% (range, 75 - 100%) after the surgery, respectively. Thirteen hips (31%) had undergone THA at mean 21 years (range, 12.5 - 30.5 years). Kaplan-Meier survival analysis with THA conversion as the end point showed a 61.6% probability (95% CI: 45 - 79) at mean 27 years. For pre-arthritis and early osteoarthritis hips before the surgery, the probability was 69.6% (95% CI: 51 - 88). Between the hips with excellent and good results (22 hips, 52%) and the hips with fair and THA conversion hips (20 hips, 48%), there were no significant differences in the preoperative characteristics except preoperative radiological stage (pre/early/advanced: 12/7/3 vs. 3/12/5, p=0.028, chi-square test) and the preoperative limping (positive/negative: 4/18 vs 10/10, p=0.048, Fisher's exact probability test).

DISCUSSION AND CONCLUSION: Dome pelvic osteotomy is designed to provide a larger weight bearing surface and good congruity along the femoral head in sagittal plane, resulting in reduced joint reaction forces. These results suggest that minimum 25-year results of dome pelvic osteotomy for the acetabular dysplasia are encouraging for pre-arthritis and early osteoarthritis.
Comparison of Hemiarthroplasty versus THR Following Intracapsular Fractured Neck of Femur

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INTRODUCTION: The choice of treatment for intracapsular fracture neck of femur fractures in active patients over 60 years remains unknown. In contrast with previous studies, a recent randomized controlled trial suggested hemiarthroplasty to be the best option - operation duration was shorter, blood loss less and early dislocation rates were lower. However, numbers were small and follow up was short. We aimed to compare the national data for complications following total hip replacement (THR) or hemiarthroplasty in these patients.

METHODS: Hospital episode statistics (HES) data was analyzed for patients over 60 years who underwent hemiarthroplasty or THR surgery for an intracapsular fractured neck of femur in the English NHS between January 2005 and December 2008. Eighteen-month dislocation and revision rates were analyzed.

RESULTS: Following hip fracture, 13,565 patients underwent cemented hemiarthroplasty and 1,196 patients underwent cemented THR. Eighteen-month dislocation rate was significantly higher in the THR patients (2.08% versus 0.54%, OR=3.90, 95% CI 2.81-5.41). However, there was no significant difference in 18-month revision rate.

DISCUSSION AND CONCLUSION: In this national analysis there was no significant difference in revision rates between hemiarthroplasty and THR but dislocation rates were significantly higher in THR patients. Further studies are needed to validate these findings.

Mid-term Follow-up of Periacetabular Osteotomy (PAO) in Patients with Hip Dysplasia

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INTRODUCTION: There are very few published mid to long term studies reporting on the results of periacetabular osteotomy (PAO) for management of hip dysplasia in the young adult. The objective of this study is to report the mid-term follow up of PAO performed in this group of patients with special attention to progression of hip arthritis and conversion to total hip arthroplasty (THA).

METHODS: A total of 266 abductor sparing PAO performed on 235 patients were performed at one institution between 1996 and 2006. Those with less than two-year clinical follow up were excluded leaving 135 hips in 118 patients for review. There were 21 males and 97 females with an average age at the time of surgery of 32 years. Clinical notes were reviewed for pain relief and radiographs were reviewed for progression of hip arthritis according to criteria by Tönnis.

RESULTS: The average clinical follow up was 82.1 mo (range 2 to 14 years). 31 of 135 hips had progression in severity of Tönnis Grade. 103 hips were Tönnis 0, 19 T-I, 3 T-II and 10 radiographs were not available for review. Postop grade was 0 in 87, I in 26, II in 17 and III in four and radiographs were not available in one hip. Thirteen hips (9.6%), required a THA at an average of 82.9 months after the PAO (range 30.6 months to 165 months).

DISCUSSION AND CONCLUSION: Conversion to THA after PAO remains a viable option in patients with hip dysplasia. Further studies are needed to validate these findings.
POSTER NO. P092
Cementless THA with LDH MoM Heads - Short Term Survivorship of 8,059 Hips from the Finnish Arthroplasty Register
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INTRODUCTION: Population-based register data from the National Joint Register of Australia and England and Wales have revealed that the mid-term outcome of cementless large diameter head metal-on-metal total hip arthroplasty is inferior to that of conventional cemented metal on polyethylene total hip arthroplasty. METHODS: Based on data extracted from the Finnish Arthroplasty Register, the risk of revision of 8,059 cementless large diameter head metal-on-metal total hip arthroplasties performed over 2002-2009 was analyzed using Cox regression model. The revision risk of these hips was compared to that for 16,978 cemented metal on polyethylene total hip arthroplasties performed over the same time period. RESULTS: In the Cox regression analysis, there was no difference in revision rates between cementless large diameter head metal-on-metal total hip arthroplasty and cemented metal on polyethylene total hip arthroplasty (RR 0.90, CI 0.74-1.10; p=0.3). However, in female patients aged 55 years or more, cementless large diameter head metal-on-metal total hip replacements showed a significantly increased risk of revision as compared to cemented total hip replacements (RR 1.33, CI 1.04-1.70). CONCLUSION: The inclusion criteria were: early manifestation, stable implant, known pathogen, susceptibility of staphylococci to rifampin, gram-negatives to kinolones, and good condition of soft tissue (abscese of a fistula). From January 1999 through June 2009, 40 patients were included and followed for at least two years. The mean age of the included patients was 68 years, 71% were females. There were 60% total hip, 20% total knee replacements, and 20% of other devices. Among the pathogens the staphylococci predominated, especially Staphylococcus aureus. The average duration of symptoms before inclusions was 35 days. After initial two to four week intravenous therapy with β-lactam antibiotics, intravenously staphylococcal infections were treated with oral ciprofloxacin 750 mg bid + rifampin 450 mg bid, streptococcal and enterococcal infections with oral amoxicillin 750 mg tid. For the methicilin-resistant germs, we used vankomycin instead of β-lactams. For gram negatives we used kinolones, and for anaerobes klindamycin or penicillin. Oral treatment lasted for 10 weeks (knee prostheses six months). RESULTS: There were four recurrent infections, two reinfections with a different pathogen, and one aseptic loosening. The remaining 33 patients are completely free of problems related to the implant involved. Implant survival probability with recurrence as the end point was 97% after one year, 94% after two years and 82% after nine years according to Kaplan and Meier method. DISCUSSION AND CONCLUSION: In carefully selected patients, device retention with antimicrobial treatment for three to six months is an effective approach that gives lasting results. The strengths of the study are: a careful patient selection, precise diagnostic and therapeutic procedures, and long 100% patient follow up.
regard to proximal surface treatment (with or without HA-coating).

METHODS: Bilateral simultaneous sequential THA was performed for 55 patients (110 hips). Thirty-nine men and 16 women (mean age, 46.3 years) received a HA-coated porous-coated titanium stem in one hip and a non-HA-coated porous-coated titanium stem in the contralateral hip. The mean duration of follow up was 15.6 years (range, 15 to 16 years). At each follow up, the Harris hip score, the Western ON and McMaster Universities Osteoarthritis (WOMAC) score, University of CA, Los Angeles (UCLA) activity scores and radiographs were evaluated.

RESULTS: The mean postoperative Harris hip scores (93 vs. 91 points), WOMAC scores (13.1±5.8 vs. 13.8±7.5 points), and UCLA activity score (7.8 point) were similar in both groups. No patient had preference for one type over the other or thigh pain at the final follow up. The mean polyethylene wear rate per year (0.21 ± 0.023 mm vs 0.24 ± 0.025 mm) and incidence of acetabular osteolysis (16% vs. 15%) were similar in both groups.

Femoral osteolysis was confined to calcar femorale in both groups. No femoral component in either group was revised. Kaplan-Meier survivorship analysis revealed that the rate of the survival of the femoral components was 100% (95% CI, 0.95 to 1.0) in both groups at 16 years. The rate of the survival of the cup was 89% (95% CI, 0.85 to 0.95) in both groups at 16 years.

CONCLUSION: After long-term follow up, HA-coating on the porous surfaces of the titanium stem did not improve or diminish the longevity of the stem.

POSTER NO. P096

Intra-Uterine Metal Ion Exposure Assessment through a Controlled Study of Maternal and Cord Blood

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INTRODUCTION: Metal-metal surface replacement (MoMSRA) continues to be used in young women. Systemic metal ion release and its effects cause concern. Do metal ions crossing the placenta in pregnant women have potential mutagenic effects? The hypothesis is that metal ions pass freely through the placenta and there is no difference in maternal and cord metal levels.

METHODS: This is a controlled cross-sectional study of women with MoMSRA. (n = 25, 3 bilateral, mean age 32 years, time from implantation to delivery 60 months). The control group consisted of 24 subjects, mean age 31 years, with no metallic implant and not receiving cobalt/chromium supplements. No patient was known to have renal failure. Whole blood specimens were obtained before delivery and before any infusion or transfusion, and cord blood specimens immediately after delivery.

RESULTS: Cobalt and chromium were detectable in all specimens in both cohorts. In the control group, the difference between maternal and cord levels was only 5 to 7% indicating free passage. Study group cord cobalt (0.88 µg/L) and chromium levels (0.34 µg/L) were significantly lower than maternal cobalt (1.57 µg/L, p < 0.05) and chromium Levels (1.43 µg/L, p 0.05). However there is a significant difference between the cord cobalt levels in the study (0.88 µg/L) and control (0.41 µg/L, p < 0.05) groups.

DISCUSSION AND CONCLUSION: The limitation of this study is that none of the patients in the study had the excessive metal ion levels recorded in recent times in some of the withdrawn resurfacing arthroplasties. The differences between maternal and cord metal ions in the controls indicate that normally the placenta allows an almost free passage of metal ions. Within the range of levels studied, the relative levels of metal ions in the maternal and cord blood in the study group reveal that the placenta exerts a regulatory influence on metal ion transfer.

POSTER NO. P097

A New Registration Method for Imageless Computer Navigation in Total Hip Arthroplasty: A Cadaveric Study

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INTRODUCTION: The recent issues surrounding the problems of metal on metal bearing in hip arthroplasty have reinforced how crucial implant positioning is. One of the main barriers to the adoption of computer navigation is acquiring the anterior pelvic plane (APP). Current registration methods require a repositioning of the patient to access the contra-lateral registration points.

METHODS: We utilized a new lateral registration method on 18 cadaveric hips from nine patients. The complete registration was performed in a lateral decubitus position. Registration points were taken from the ipsi-lateral anterior superior iliac spine (ASIS) and a mid-sagittal point at the lumbar spine (taken through the drapes). All other points were taken from the acetabular cavity and rim. Neither the contra-lateral ASIS nor points at the pubis symphysis had to be acquired. For evaluation purposes, the APP was directly acquired on the bone as a gold standard.

RESULTS: In comparison to this gold standard, the average error for the new registration method was -0.9° (SD 3.2) for inclination and -1.3° (SD 3.8) for anteversion. The results show that statistically within more than 95% of the cases the acetabular component would have been orientated within the “safe zone” as described by Lewinnek et al.

DISCUSSION AND CONCLUSION: This study demonstrates it is possible to construct the APP from registration points taken in the lateral position, with a fully draped patient. This advancement may reduce one of the barriers preventing patients from benefiting from the use of computer navigation, in providing more accurate acetabular component placement.

POSTER NO. P098

Clinical and Radiographic Outcomes of Cementless Total Hip Arthroplasty in Patients Under 30 Years of Age

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INTRODUCTION: Total hip arthroplasty (THA) in young patients has historically been associated with increased complications and poor survivorship. However, older techniques, small numbers, a predominance of inflammatory arthritis, and little documentation of functional improvement are common limitations of these studies. We hypothesized that modern cementless THA performed primarily for non-inflammatory in a group of young patients would lead to similar clinical and radiographic outcomes and revision rates when compared to a cohort of older patients.

METHODS: We performed a retrospective review of 97 consecutive...
cementless THAs performed by a single surgeon from 1996-2008 in 79 patients under the age of 30 with mean 65-month follow up (24-151). The clinical and radiographic outcomes were compared to a randomly selected control group of 100 cementless THAs performed during the same time period with similar follow up in 98 patients over the age of 50. Primary outcome measurements included the Harris hip score, clinical complications, and radiographic analysis focusing on loosening and radiolucency. RESULTS: There was no difference in gender or BMI between the groups. There was a difference in the pre-operative diagnoses of pediatric diseases (55% young vs. 8% old; p<0.001), avascular necrosis (20% young vs. 2% old, p=0.021), and idiopathic osteoarthritis (0% young vs. 86% old, p<0.001), with no difference in septic, post-traumatic, or inflammatory arthritis. The overall rate of perioperative complications was similar between groups, though more transfusions were administered in the young group (15% vs. 5%, p<0.01). There was no difference in the rate of femoral or acetabular radiolucencies nor in the rate of radiographic loosening between the two groups. There was no difference in the HHS at final follow up. The revision rate was higher in the young group (9% vs. 2%, p<0.01). DISCUSSION AND CONCLUSION: Contemporary cementless THA in patients under the age of 30 is associated with similar functional improvement and perioperative complications compared to older patients. The high prevalence of prior pediatric hip surgery in the young THA group may predispose to increased technical difficulty resulting in higher revision rates. Although our revision rate was higher in the young patients, it is favorable compared to older techniques and consistent with the limited data available with modern cementless techniques in patients of similar age.

POSTER NO. P099

**Incidence of Adverse Wear Reactions in Hip Resurfacing Arthroplasty: A Comparison with the Oxford Study**

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INTRODUCTION: This study is to evaluate the risk of revision for adverse wear reaction after metal-on-metal hip resurfacing in our 12-year experience with over 2,361 cases and to compare this to the Oxford Report on “pseudotumors.” METHODS: Between July 1999 and Feb 2011, the same surgeon performed 2,361 metal-on-metal hip resurfacing arthroplasties in 1,956 patients (1,415 male vs. 541 female; 72% vs. 28%) in the United States. The mean age was 51±8 years old. The primary diagnosis was osteoarthritis in 1,817 cases (77%); dysplasia in 251 cases (11%); osteonecrosis in 147 cases (6%). The mean length of follow up was 4±3 years (range: 0.02 to 12 years) compared to four years (range: 0.05 to 9.45) in the Oxford study. The mean femoral component size was 50×4 mm. We used the same criteria for failure, which was “symptoms severe enough to cause revision.” We could not adequately analyze risk factors because we had only three failures in 2,361 cases, (failure rate 0.1%). RESULTS: In this study, the wear related failure rate was 0.1% (3/2361). Failures due to all other causes occurred in 56 (2.4%) cases. Revisions for adverse wear represented 5% of all failures. The three wear related failures (pseudotumors) occurred in two women at a mean of six years (4.77), all with acetabular inclination angles greater than 60 degrees (measured on standing pelvis X-ray). In the revisions for other causes, there was a significant amount of metallosis found in only one case; this was due to titanium shedding from a loose acetabular component. At eight years post-operatively, our Kaplan-Meier cumulative revision rate for adverse wear was 0.8% for all patients, 0% for men and 2.6% for women. In contrast the Oxford group, reported 26 (1.8%) revisions for adverse wear in 1,419 cases and an additional 41 (2.9%) revisions for other causes for a total failure rate of 3.7% with a similar mean follow up. Revisions for adverse wear represented 38% of all failures. The Oxford cumulative Kaplan-Meier revision rate for adverse wear at eight years was 4% for all patients, 0.5% for men and 9.4% for women. DISCUSSION AND CONCLUSION: Our low failure rate due to adverse wear of 0.1% in 2,361 patients over 12 years is in agreement with the results reported from the Newcastle group (0.15% in 670 cases), Schmalzried (0.51% in 588 cases) and the Canadian Hip Resurfacing Group (0.1% in 3,432 cases). It appears that the majority of large reports on adverse wear now do not confirm the surprisingly high rate widely reported by the Oxford Group. Also, in contrast to the Oxford report, all three of our failures occurred in women with acetabular inclination angles of ≥ 60° in the standing X-rays. All three women exhibited an unusual amount of pelvic forward flexion when comparing supine to standing X-rays, resulting in an acetabular measurement that increased by an average of 8 degrees when a standing pelvis X-ray was measured. One reason that acetabular inclination angle may be difficult to correlate to adverse wear in some studies may be the failure to routinely obtain standing pelvis X-rays. Our low failure rate does not justify a policy of discriminating on the basis of age, gender, implant size or diagnosis when offering hip resurfacing. To avoid the rare wear failures in women, it may be advisable to develop operative techniques to avoid high inclination angles on postoperative standing pelvis X-ray, particularly in women.

POSTER NO. P100

**Trends in Total Hip Arthroplasty Bearing Surface Utilization in Medicare Patients**

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INTRODUCTION: Total hip arthroplasty (THA) bearing surface utilization varies widely throughout the U.S. The purpose of this study was to evaluate trends in THA bearing surface utilization by age and gender in Medicare patients. METHODS: The 100% Medicare database was used to stratify THA bearing usage by age and gender in Medicare patients. Instrumental variable analysis (propensity scores) was used to reduce unobserved bias. RESULTS: For men age 65-74, ceramic-on-polyethylene (CoP) usage increased; metal-on-metal (MoM) increased to 2007, but decreased from 2007-2009; metal-on-polyethylene (MoP) decreased to 2007, then increased from 2007-2009; and ceramic-on-ceramic (CoC) decreased. For men age 75-84, similar trends were observed, but CoP increased to 2007 then reMed constant from 2007-2009. For men age 85+, CoC decreased, CoP increased again to 2009; MoM remained at a constant level from 2007-2009. For women age 65-74, CoP decreased from 2007-2009; MoM increased to 2007, then decreased from 2007-2009; MoP increased to 2007 then decreased from 2007-2009; and CoC increased to 2007 then decreased from 2007-2009.
and MoM increased to 2008 but decreased in 2009, while MoP decreased to 2008 but increased in 2009. For women age 65-74 and 75-84, the temporal trends in bearing usage were similar to men in the same age group. For women 85+, CoC decreased; CoP and MoM increased to 2007 then decreased from 2007-2009, while MoP decreased to 2007 but increased from 2007-2009. In 2009, for males, 53% had MoP, 33% MoM, 11% CoP, and 2% CoC. For women, 57% had MoP, 30% MoM, 11% CoP, and 2% CoC.

DISCUSSION AND CONCLUSION: Substantial changes in THA bearing usage have been observed between 2005 and 2009. A large percentage of Medicare THA patients still receive hard-on-hard bearings. Further study is needed to understand what factors are driving these trends.

POSTER NO. P101

◆ Patterns of Failure in Metal-on-Metal Hip Arthroplasty and Implications for Revision
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INTRODUCTION: Previous studies have shown poor results after revision of metal-on-metal hip replacement (MOM-HR) for adverse reactions to metal debris, with high rates of dislocation, loosening and reoperation. The revision burden in MOM-HR is increasing and optimal management remains unclear. We present our revision series, demonstrating the role of pre-operative investigations in classifying such cases, allowing accurate preoperative planning and avoidance of complications.

METHODS: Data were collected prospectively on revisions of MOM-HR at our institution. Patients underwent preoperative radiographs, MRI, CT, and functional scoring. Intraoperative findings were recorded. Scores and complications were recorded at follow up. Patients were classified into five groups by CT, MRI and intraoperative appearance, depending on the degree of muscle or bone loss and presence of pseudotumour or conventional cause of failure.

RESULTS: Thirty-nine hips (36 patients) were revised. Median age was 61 (25-76), M:F ratio was 7:33. Eight patients were found to have ‘conventional’ causes of failure such as infection or impingement. Seven had predominant osteolysis with no pseudotumour, seven had a destructive pseudotumour with muscle loss, two had a well-demarcated large pseudotumour without local destruction. The majority (15) had no findings of significant pseudotumour, muscle or bone loss. Early results at a mean follow up of 20 postoperative months (range 2-44 months) are favorable with one re-operation or bone loss. Early results at a mean follow up of 20 postoperative months (range 2-44 months) are favorable with one re-operation.

DISCUSSION AND CONCLUSION: Metal-on-metal hips fail in predictable patterns, determinable on preoperative imaging. Classifying such cases using imaging findings allows accurate preoperative planning and may lead to better outcomes after revision.

POSTER NO. P102

Sterile Pseudotumour can Explain a High C-reactive Protein
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INTRODUCTION: Surgeons use blood C-reactive protein (CRP) to help diagnose infection in a painful hip arthroplasty and decide between one or two stage revision. However, there are some case examples of a high CRP resulting from a sterile inflammatory pseudotumour seen around metal on metal (MOM) hips. Our aim was to determine the relationship between CRP and infection / non-infection in patients with a pseudotumour adjacent to a painful MOM hip.

METHODS: Ninety-seven patients were seen in our painful MOMHR clinic. Forty-nine patients (11 males and 38 females) with 50 MOM hips fulfilled our inclusion criteria: 1) a painful MOM hip sufficient to require revision, or with an Oxford hip score less than 30 out of 48; 2) a known serum CRP; 3) a metal artefact reduction sequence (MARS) MRI; 4) and a means of determining infection from non-infection (hip aspiration or cultures from revision surgery). A CRP of > 10 mg/L was regarded as elevated. All MRIs were evaluated by two senior musculoskeletal radiologists.

RESULTS: Thirty-two out of 50 hips (64%) had a pseudotumour on MARS MRI, of which 15 (47%) had an elevated CRP. Twelve
out of the 15 (80%) hips with a pseudotumour and an elevated CRP were not infected. The sensitivity and specificity for the presence of a pseudotumour based on an elevated CRP was 0.47 and 0.61 respectively. The sensitivity and specificity of infection in pseudotumour positive patients based on the CRP are 0.50 and 0.54 respectively. This is lower than the accepted values for non-MOMHRs.

**DISCUSSION AND CONCLUSION:** Two-thirds of patients with a painful MOMHR had a pseudotumour on MARS MRI. There was poor correlation between an elevated CRP and a pseudotumour. The sensitivity and specificity were low for diagnosing infection based on CRP in patients with pseudotumours on MRI.

**POSTER NO. P103**

**The Validity of Using Administratively Coded Complication and Comorbidity Data in TJA Outcomes Reporting**

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**INTRODUCTION:** Administrative claims data have increasingly been used in public reporting of total joint arthroplasty (TJA) outcomes and ‘value-based’ physician and hospital payment strategies. However, the accuracy and validity of administrative claims data, particularly with respect to revision TJA procedures, is unknown. The purpose of this study was to evaluate the concordance between administrative claims and the clinical record for 13 commonly reported comorbidities and complications in TJA patients.

**METHODS:** Administratively coded diagnosis and procedure codes obtained from hospital billing records from 1,350 consecutive primary and revision TJA procedures performed at three high volume institutions during 2009 were compared with corresponding clinical documentation, including operative notes and discharge summaries. Administratively coded comorbidities and complications derived from hospital billing records were compared with clinical documentation. Concordance between the administrative and clinical records was determined for each revision TJA-related ICD-9 comorbidity and complication code. **RESULTS:** Concordance was excellent for diabetes and post-op MI (K=0.80), very good for chronic lung disease, coronary artery disease, and post-operative DVT/PE (K=0.60-0.79), and moderate for congestive heart failure, obesity, peripheral arterial disease, bleeding complications, history of DVT/PE, prosthetic-related complications, and post-op renal failure (K=0.40-0.59). All comorbidities and complications had a high degree of specificity (>92%), but lower sensitivity (29-100%), indicating that comorbidities and complications coded in the administrative record were highly accurate, but often incomplete. **DISCUSSION AND CONCLUSION:** Administratively coded comorbidities and complications have moderate to excellent correlation with the clinical record. However, the specificity of administrative claims is much higher than the sensitivity. These findings underscore the need for improved, unambiguous clinical documentation related to TJA procedures.

**POSTER NO. P104**

**Tantalum versus Titanium Acetabular Shells in Young Active THR Patients: A Radiostereometric Analysis (RSA) Study**

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**INTRODUCTION:** In the active total hip replacement (THR) population, maintaining acetabular component stability and limiting polyethylene wear are crucial components to preventing premature implant failure. Titanium with fiber metal coating is among the most common materials used in cementless THR. Trabecular metal, composed of porous tantalum, has a metallic strut design resembling trabecular bone, designed to improve tissue infiltration and limit migration. It is unknown if tantalum offers an advantage over titanium in the biologic fixation of porous-coated acetabular shells. Radiostereometric analysis (RSA) provides highly precise measurements of micromotion that are otherwise not detectable by routine radiographs. Currently, RSA offers measurement accuracy at least an order of magnitude greater than that of conventional computer aided radiographic techniques as well as being able to measure motion defined in all three dimensions.

**METHODS:** In this IRB approved, prospective, randomized, blinded study, 46 patients received a primary THR by a single surgeon. Each patient was randomized to receive a titanium (n=23) or tantalum (n=23) uncemented hemispheric cup. At the time of surgery, tantalum RSA markers were implanted around the liner periphery and 12 markers were implanted into the patient’s femur and periacetabular bone. The patients all received a 28mm femoral head and either a highly cross-linked (n=25) or a conventional polyethylene liner (n=21). RSA examinations, Harris Hip, UCLA, WOMAC, and SF-12 scores were obtained at two weeks, six months, and annually with the furthest patients evaluated through five years. **RESULTS:** The randomized groups had comparable mean age (58 +/- 7 years), preoperative UCLA activity score (5 +/- 2), and BMI (30 +/- 4). In evaluating cup stability, the tantalum shells demonstrated less median translation than the titanium shells at each time-point, but there was no statistical difference between the two shells. At six months, the median translation of tantalum and titanium was -0.01mm and 0.04mm, respectively. Mean UCLA, WOMAC, Harris Hip, and SF-12 PCS and MCS scores improved similarly in both groups through four years, with no significant difference between the groups. **DISCUSSION AND CONCLUSION:** Following THR, both cohorts of patients demonstrated excellent clinical outcomes with statistically significant improvements in function and pain relief with no significant difference between the two groups. Although tantalum porous-coated acetabular shells demonstrated less vertical translation at all time points, there was no statistically significant difference in shell migration, and both shells demonstrated excellent stability with minimal micromotion at four years.
Second Generation Highly Crosslinked Polyethylene: Five Year Linear Wear

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INTRODUCTION: In 1998 first generation highly crosslinked polyethylenes (HXLPE) were introduced and are reported to have low wear. However, concerns exist regarding their mechanical strength and or retained free radicals. Second generation HXLPE were developed to lower wear, maintain mechanical strength, and have oxidative resistance. METHODS: Crosslinking for the second generation material was achieved using a sequential irradiating and annealing process (3 cycles of 3 Mrad followed by heating at 130° Centigrade for eight hours). After machining the specimens were sterilized using gas plasma. In a multicenter prospective study, 155 patients (167 cases) have three year, 124 patients (132 cases) four years, and 46 patients (51 cases) five years clinical and radiographic follow up. RESULTS: The head penetration (wear rate) per year after the first year of bedding-in is 0.024 mm/yr at three years, 0.020 mm/yr at four years, and 0.015 mm/yr over five years. The KM survivorship revision for any reason is 97.8%, and no revision has occurred for a bearing surface failure. No osteolysis has been seen. DISCUSSION AND CONCLUSION: We previously reported linear head penetration rates for the first generation annealed HXLPE and found that the estimated wear rate was 0.034 mm/yr at five years, 0.031mm/yr at 10 years, and was 72% lower than the control conventional polyethylene (0.141mm/yr). The linear wear rate at five years for the annealed second generation highly crosslinked polyethylene is 0.015 mm/yr. and represents a wear reduction of 89% compared to the control and a 56% reduction compared to the first generation annealed at five years.

Risk Factors for Periprosthetic Joint Infection Following Primary Total Hip Arthroplasty

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INTRODUCTION: Periprosthetic joint infection (PJI) is a rare but devastating complication of total hip arthroplasty (THA). The purpose of this study was to identify the specific patient comorbidities and demographic factors that are independently associated with an increased risk of PJI in THA patients. METHODS: A case-control study design was used to compare 499 unilateral primary THA patients from one of six clinical sites who did not develop PJI with 88 unilateral primary THA patients from the same clinical sites who developed a PJI. The impact of 29 co-morbid conditions and other demographic factors on PJI was examined using multivariate Cox regression, controlling for age, sex, race, and all other baseline comorbidities. Both the crude and adjusted hazard ratios for each comorbid condition and demographic factor were calculated and the p-value associated with the hazard ratio was used to rank the significance of the association of each comorbid condition and demographic factor with the risk of PJI. The median time when PJI was diagnosed was 6.6 months after primary THA. RESULTS: Comorbid conditions and demographic factors associated with an increased adjusted risk of PJI (in decreasing order of significance) were depression (HR=1.96, 95% CI: 1.10-3.49; p=0.022), obesity (HR=2.12, 95% CI: 1.08-4.16; p=0.0292), cardiac arrhythmia (HR=2.40, 95% CI: 1.08-5.33; p=0.0318), and female gender (HR=0.55, 95% CI: 0.30-0.991; p=0.0466). DISCUSSION AND CONCLUSION: Depression, obesity, cardiac arrhythmia, and female gender are independently associated with an increased risk of PJI in THA patients. This information is important when counseling patients regarding the risk of PJI following THA, and for risk-adjusting publicly reported THA outcomes.

Patient-specific Prediction of the Three-dimensional Structure of the Human Pelvis Based on Plain Radiographs

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INTRODUCTION: Acetabular component malpositioning during total hip arthroplasty (THA) and hip resurfacing can lead to impingement, instability, accelerated wear, wear-induced osteolysis, irritation of the psoas tendon, pseudotumor in metal-on-metal bearings, and revision surgery for any of these problems. The majority of acetabular components that are placed using traditional methods are malpositioned with studies showing malpositioning rates outside of the Lewinnek “safe zone” between 59% and 78%. Mechanical navigation instruments, docked to the ipsilateral hemipelvis on a patient-specific basis, have been shown to reliably achieve cup positioning when adjusted using CT imaging to within +/- 10 degrees of abduction and anteversion in 70 of 70 patients. The current study assesses the feasibility of achieving similar accuracy when predicting patient-specific three-dimensional structure based on plain radiographs. METHODS: Statistical models of the pelvis were developed using CT studies of 402 hips (101 left female, 96 left male, 94 right female, 111 right male). The material was derived from patients undergoing total hip arthroplasty who had both a preoperative CT study and plain radiographs. Inclusion criteria for model development were the absence of prior surgery or gross pelvic asymmetry. Surgery using the mechanical navigation device was then planned for 57 hips treated by THR using CT imaging as previously described. These 57 hips were not used to develop the statistical model. Exclusion criteria for this group was a history of prior surgery to the pelvis or cancer or radiation treatment to the pelvis. Only one of the 57 hips met the exclusion criteria leaving 56 for analysis. The CT plan was considered the ground truth. Surgery using the mechanical navigation device was also planned using the statistical models together with AP and lateral pelvic radiographic images. The plain radiographs had simple, specific criteria for acceptance that can easily be met by radiology technologists. No magnification markers are required. The cup abduction and operative anteversion errors that would result from planning the surgery using radiographs instead of CT were calculated for a cup that was aimed for 40 degrees of abduction and 25 degrees of flexion. RESULTS: The errors resulting from planning the three-dimensional docking of the mechanical navigation device using statistical models and plain radiographs instead of planning on a 3D model from CT imaging are as follows: Operative Anteversion: mean...
error 2.20 degrees; Standard Deviation: 1.40 degrees; Range: 0.08 to 5.45 degrees; Operative Inclination: mean error 1.95 degrees; Standard Deviation: 1.50 degrees; Range: 0.05 to 5.05 degrees. DISCUSSION AND CONCLUSION: Cup malposition following total hip replacement and hip resurfacing is a critical surgical technique factor that affects outcome. The mechanical navigation device is a simple mechanical navigation device that can be uniquely adjusted for each patient according to the surgeon's cup orientation goal with results that are equivalent to traditional navigation, when based on CT imaging. While CT imaging may be prudent for hips with prior surgery, trauma, or gross pelvic asymmetry, planning the surgery based on plain radiographs is simpler and more practical. The current study demonstrates that simple plain radiographs may be used for pre-operative planning in routine circumstances with small additional errors when compared to CT. These findings suggest that better cup positioning can be routinely achieved using simple plain radiographs, without the need for complex intraoperative navigation systems, and with minimal additional OR time.

POSTER NO. P108

One Intraoperative Dose of Tranexamic Acid is Safe and Effective in Revision Total Hip Arthroplasty

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INTRODUCTION: Revision total hip arthroplasty (THA) has been associated with an increased risk of perioperative blood loss requiring transfusions. Tranexamic acid (TEA) has been proven to be safe and effective in preventing blood loss in primary THA. Our purpose was to study the effect of TEA on blood loss in revision THA. METHODS: We performed a retrospective comparative study on 343 patients who had undergone revision THA between January 2006 and March 2010. A total of 108 patients did not receive TEA while 235 patients received one intraoperative dose of 20 mg/kg of TEA given immediately before skin incision. We then compared changes in hemoglobin, transfusion rates, hospital length of stay, and complications between the two groups. No other routine patient care practices or blood conservation program strategies were altered during this time. RESULTS: There was a significant reduction in hemoglobin (Hb) loss in the TEA group compared to the No TEA group for revision THA (48±18 g/L and 43±18 g/L, respectively, p=0.01) and a significant reduction in transfusion rates (45.4% and 33.6%, respectively, p=0.03) and average amount transfused (1.3±1.9 units and 0.9±1.6 units, respectively, p=0.03). The effect of TEA on Hb loss was most significant in procedures that involved revision of both the femoral and acetabular components (58±18 g/L and 49±18 g/L, respectively, p=0.01). There was not a significant difference in recorded major adverse events with the administration of TEA (9 and 9 respectively). DISCUSSION AND CONCLUSION: One 20 mg/kg intraoperative dose of TEA significantly reduced red blood cells loss and transfusion rates in patients undergoing revision THA compared to a patient cohort who did not receive the TEA protocol. This single dose protocol was not associated in an increased complication rate.

POSTER NO. P109

Prevalence and Treatment of Intra-articular Pathology Recognized at Periacetabular Osteotomy for Dysplasia

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INTRODUCTION: Although periacetabular osteotomy (PAO) is recognized as an effective treatment for symptomatic hip dysplasia in young adults, identification and treatment of associated intra-articular pathology such as chondrolabral injury and abnormal femoral head-neck offset is poorly defined. Routine anterior hip arthroscopy and characterization of intra-articular pathology was performed in a consecutive series of PAOs performed from 2002-2009. Treatment of the identified intra-articular injury is described. METHODS: A total of 149 consecutive PAOs had routine anterior hip arthroscopy and characterization of intra-articular pathology. Prior to these cases, 42 additional PAOs had either no arthroscopy or selective arthroscopy. The average age was 25.8 (range15-47) and there were 133 females and 58 males. The average BMI was 25.5 (range 11-41). The average EBL was 561 cc (range 100-2000 cc). The PAO was performed according to the technique described by Ganz et al., via a modified Smith-Petersen approach. Damage to the acetabular cartilage and labrum, abnormal femoral head-neck offset, and other intra-articular pathology was recorded in a prospective database for each case. Failure was defined as conversion to total hip arthroplasty. RESULTS: Intraoperative findings included decreased femoral head neck offset in 127 hips, a labral tear or degeneration in 23 hips, and various other pathology such as ganglion cysts or loose bodies in seven hips. Femoral head neck offset improvement was performed in 127/149 hips (85%). Labral debridement or repair was performed in 23/149, 15.4%. The mean HHS improved from 60 (range 20-88) to 87 (range 49-100) at last follow up. There were five failures (3.3%) in the routine arthroscopy group compared to six failures in the non-arthroscopy groups (14%). Only one case had secondary FAI due to excessive anterior over coverage requiring anterior debridement. DISCUSSION AND CONCLUSION: Symptomatic acetabular dysplasia is commonly associated with abnormal femoral morphology and/or chondrolabral injury. Treatment, such as labral repair and correction of abnormal femoral head-neck offset, is associated with improved clinical outcome with PAO and may minimize the complication of secondary FAI. Routine anterior arthroscopy at the time of PAO can effectively identify associated intra-articular pathology. Additional future operative modifications, such as the use of hip arthroscopy for simultaneous or staged treatment, may also be beneficial.

POSTER NO. P110

ALTERNATE PAPER: ADULT RECONSTRUCTION HIP III

Clinical and Metal Ion Comparison of 36mm, 40mm and 44mm Metal-on-Metal Total Hip Arthroplasty

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INTRODUCTION: Cobalt-Chromium alloy for metal-on-metal (MM) hip prostheses have superior wear resistance compared to the conventional polyethylene-on-metal prostheses, making it a more suitable alternative for younger patients. The potential
carcinogenic effect of metal ions, mainly Cobalt (Co) and Chromium (Cr), found in the blood of patients with MM hip prostheses is a serious cause of concern. Tissue damage correlates with levels of oxidative stress markers (OSM) such as total antioxidant status (TAS), total peroxides (TP), and nitrotyrosine (NT) which are all thought to be affected by Cr and Co levels. As larger head bearings encourage fluid film lubrication and consequently decrease wear, we hypothesize that metal ion levels as well as oxidative stress markers may correlate with greater wear rates, smaller head bearings and increased physical activity. METHODS: In this prospective study, we followed 90 patients undergoing total hip arthroplasty (THA) with different head sizes of Cobalt-Chromium-Molybdenum prostheses (34 patients for 36mm group, 42 patients for the 40mm group and 14 patients for the 44mm group). Patient follow up and data collection occurred at year 0.16, 0.33, 1 and 2. Patients with bilateral hip involvement, concurrent metal hardware, multiple co-morbidities, inflammatory joint disease or infection were excluded from this study. Whole blood samples collected at each follow-up visit were analyzed by inductively coupled plasma-mass spectrometry (ICP-MS) to determine the levels of Co, Cr and Mo. Serum nitrotyrosine levels were quantified using Nitrotyrosine-EIA essay whereas total peroxide concentration were measured with Biomedica OxyStat assay and TAS with the Oxford Biomedical total anti-oxidant power kit. During each visit, patients’ clinical outcomes were recorded with calculation of both Harris Hip Scores (HHS) and University of CA Los Angeles Activity Scores (UCLA). Mann-Whitney U test was used to compare head bearing sizes with metal ions concentration. Non parametric studies were used to correlate HHS and UCLA scores with metal ions concentration as well as metal ion concentration with oxidative stress markers. RESULTS: Using Mann-Whitney U test, preliminary results failed to show statistical difference in metal ions concentration between each of our study group at any given follow-up time. Nonparametric studies were used for the correlation of the HHS and UCLA scores with each type of ions. For the HHS correlation, we found a Spearman’s Rho of 0.2008 (P=0.0009) for Co, 0.1899 (P=0.0018) for Cr and -0.07923 (P=0.2293) for Mo. For the UCLA correlation, a Spearman’s Rho of 0.2742 (P=0.0001) was found for Co, 0.2253 (P<=0.001) for Cr and -0.0628 (P=0.3637) for Mo. Plasma markers for oxidative stress also show no statistical correlation with metal ion concentration. DISCUSSION AND CONCLUSION: Our results show no correlation between prosthetic head size and concentration of metal ions released in the blood as well as between oxidative stress markers and metal ion levels. No strong correlation was shown to be present between the metal ions concentration and either the Harris Hip Scores or UCLA Activity Scores.

SCIENTIFIC EXHIBITS

SCIENTIFIC EXHIBIT NO. SE01
Acetabular Component Positioning in Total Hip Arthroplasty: An Evidence-Based Analysis
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Introduction: Advocates for navigated hip arthroplasty emphasize the potential for improved component placement. We conducted a meta-analysis of published literature to investigate the claim of increased acetabular component precision.

Methods: We searched major medical and publishers databases making no restrictions for study type, yet restricted results to English language sources. Both authors independently rated the methodological features and the data were aggregated. Results: 738 articles were found, nine of these contained direct comparisons of navigated (NAV) and nonnavigated (N-NAV) THA. These nine studies were of varying methodological quality involving 1479 THA with a mean age of 59.10 years were included, 80.00% had primary osteoarthritis and 42.13% were female. There was no statistically significant difference in mean abduction and anteversion acetabular component angles between the NAV and N-NAV groups. There was a statistically significant difference in the incidence of acetabular component placement in the safe zone, with NAV having significantly more safe placements than N-NAV: safe zone abduction (NAV 90.82%, N-NAV 86.57%, p < 0.0001) and safe zone anteversion (NAV 85.36%, N-NAV 74.82%, p < 0.0001). Dislocation rates were also statistically significant, with NAV having significantly fewer dislocations than N-NAV (NAV 1.03%, N-NAV 2.49%, p = 0.0317).

Discussion and Conclusion: Although this meta-analysis did not find a statistically significant difference in navigated and nonnavigated acetabular component placement, it is clear that final acetabular component angles are more often placed within the safe zone with navigation. Dislocation rate was significantly improved with navigation. These outcomes demonstrate the possible patient benefit from navigation and the resulting tighter control of component position.

SCIENTIFIC EXHIBIT NO. SE02
◆Failure of Modular Necks in Primary Total Hip Replacement: Can We Prevent It?
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Introduction: Modular neck hip prostheses have some advantages respect to monoblock stems. Modular neck stem allow adjusting the CCD-angle, offset, neck version and length independently of stem size. The introduction of the neck-stem coupling increases the risk of mechanical failure. In fact, in the last years several reports described cases of coupling failure. Therefore, more severe minimum requirements for fatigue strength must be defined. The aim of this study was answering two open questions: How could the preclinical validation be improved? What can surgeons do to reduce the risk of failure?

Clinical outcomes of two modular neck prostheses From July 1995 to October 2009, two different modular neck hip prostheses were implanted in our department. The first prosthesis was implanted in 2,558 patients, the second one in 1,932 patients. The two patient groups did not differ in age, sex, body weight (mean 73 kg) and preoperative diagnosis. All patients were regularly followed up. The hip prostheses were similar in stem design, both being anatomically shaped. The neck-stem couplings were also similar in dimensions. However, the two coupling were different in cross section shape: the former had a rectangular-shaped oval cross section, the latter a nut shaped one. Additionally, the second one had an inventory allowing wider corrections. No failures were observed for the first modular neck prosthesis at a mean follow up of 9.2 years (range 5-15). Conversely, 24 mechanical
Results: Wear features and damage were documented and analyzed. White light interferometry with resolution better than 5 nm. Surfaces. Bearing surfaces were imaged using stereo microscopy, in vivo duration 13.8 - 56.7 mos.; all cups had cementless ingrowth designs and 3 resurfacings. Head diameters 36 - 54 mm; in clinical practice. The fatigue strength of the coupling is strongly limited. However, considering the worst configuration available in the inventory, the second modular prosthesis fell down to 40%. A further reduction was observed when coupling contamination was simulated or when the neck was not forced by impaction. Discussion: A more severe requirement should be introduced for preclinical validation of modular neck stems, to predict the failure observed in vivo. In 2010 a new version, fulfilling the proposed minimum requirements, was introduced to the clinical practice. Hence, the final confirmation will be achieved in the following years. Up to date no mechanical failures have been recorded. Anyway, the preclinical validation can not consider errors in the clinical practice. The fatigue strength of the coupling is strongly affected by prosthetic design but also by surgical procedure. Possible mishandling procedures that affect neck strength are contamination of the junction with third body debris, accidental damaging of the coupling, inadequate impaction of the neck.

Discussion and Conclusion: These results show that maintenance of a lubrication layer between MoM surfaces is not achieved. The ubiquity of scratches on bearing surfaces indicates hard debris particles are widespread. Alignment of scratches indicates that dry contact is occurring during low-velocity articulation and reversal. Evidence of rim contact is consistent with re-engagement of the head and the liner following subluxation. These phenomena occur on all designs, and therefore represent a framework for documenting in vivo wear and damage. This has important implications in regard to the performance of all contemporary MoM hips on the market.

Primary and Revision Anterior Supine Total Hip Arthroplasty: An Analysis of Complications and Reoperations
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Introduction: Anterior total hip arthroplasty (ASI-THA) has emerged as a muscle sparing, less-invasive procedure. Reports have focused on a high intra-operative and postoperative complication rate, increased transfusion risk, and questionable clinical benefit. The purpose of this study is to report the early complications and reoperations following primary and revision ASI-THA. Methods: A retrospective review of our electronic database identified 1000 consecutive ASI-THA performed by a single surgeon between January 2007 and December 2010. There were 956 primary and 44 revision THA. The surgical technique has been previously described but involves a supine, anterior approach using a modified Smith-Petersen interval and a standard operative table without traction. Average age, height, and weight were 63 years (SD 12), 68 inches (SD 4), and 198 pounds (SD 50). Results: The transfusion rate was 5%. Intraoperatively there were 3 calcar cracks and 1 canal perforation treated with cerclage cables. There were 4 wound complications requiring debridement. Four hips had significant lateral femoral cutaneous nerve parathesias not resolved at 12 months. One femoral nerve palsy occurred. At up to 40 months follow-up there have been 16 revisions (1.6%): 6 periprosthetic femur fractures, 1 stem subsidence, 2 acetabular failures, 3 dislocations (2 primary, 1 revision), and 3 infections (2 perioperative-revision, 1 acute hematogenous). Discussion and Conclusion: This 4 year experience with primary and revision ASI-THA demonstrates an acceptable perioperative rate of transfusion, complication, and reoperation. Femoral-sided complications appear to be the majority, likely a result of more difficult femoral exposure. The complication rate is higher in revision procedures.

Imaging of MoM Hip Retrievals Offers a New Lexicon of Hip Wear Phenomena Common to This Class of Devices
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Background: Clinical results for current generation MoM devices are mixed, with adverse tissue reaction commonly reported. The recall of a widely used MoM system has heightened interest in echelon, and gouging with plastic deformation.
total hip arthroplasty (THA) has increased survivorship with stable fixation and few failures. Smoking is considered a risk factor for surgical complications including transfusion, infection, and cardiac. We hypothesized that the early results of ultraporous metal acetabular reconstruction would be unaffected by smoking in complex primary and revision THA.

**Methods:** Between 1999 and 2009, ultraporous acetabular components were used in 535 hips (500 patients) for 160 complex primary and 375 revision cases. Of these patients 17% were smokers, 29.5% previous smokers, 49.0% non-smokers, and 4.5% unknown. Early failures possibly related to negative effects of smoking were considered any infection, failure of in-growth, or periacetabular fracture. Failures not considered related to smoking included dislocation and implant breakage.

**Results:** There were 33 failures at an average of 18 months post-operative for a failure rate of 6.2%: 15 infections, 13 failure of ingrowth, 3 dislocations, and 1 each liner fracture and periacetabular fracture. The failure rate in smokers was 11%, in non-smokers 3.8%, and in previous smokers 5.3% (Pearson’s 6.5; p<0.01). With only smoking related failures included, the rate was 9% in smokers and 3.6% in non-smokers (4.6; p=0.03). With previous smokers included as smokers failure is 9.2% (6.2; p<0.01) and included as non-smokers 5.8% (3.7; p=0.05).

**Discussion and Conclusion:** Even with ultraporous metal technology, smoking is a significant risk factor for early failure in complex primary and revision THA. Quitting smoking reduces the inherent risk. Smoking cessation should be considered during preoperative education.

**SCIENTIFIC EXHIBIT NO. SE06**

**Hip Society: Algorithmic Approach to Diagnosis and Management of Metal-on-Metal Arthroplasty**

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**Introduction:** The evolution of hip arthroplasty has been plagued by challenges including polyethylene wear with subsequent osteolysis and dislocation. Metal-on-metal (MoM) arthroplasty was reintroduced specifically to address these issues. It has been estimated that since 1996 more than 1,000,000 MoM articular couples have been implanted worldwide. With increasing clinical experience a number of adverse reactions to metal debris have been identified. This metal debris may be generated from the bearing couple or from tapered junctions. Well-functioning MoM arthroplasties have demonstrated a 3-5X increase in cobalt and chromium levels, which appears to be independent of head diameter and reaches a steady state after approximately two years. However, significant ion release may lead to type IV hypersensitivity - an immune response that results in an undesirable outcome such as pain, loosening and osteolysis. These excessive ions may cause direct cytotoxicity. A typical histological appearance has been termed aseptic lymphocytic vasculitis associated lesion (ALVAL). A small number of patients will develop so-called pseudotumors, which are fluid-filled masses, histologically containing giant cells, metal debris and necrotic tissue. **Methods:** Patients with MoM arthroplasty generally fall into one of the following clinical scenarios: 1) an asymptomatic patient with well positioned components that have a good clinical track record; 2) same but with components that have a suboptimal record, or even recalled components; 3) asymptomatic patient with suboptimal component position; 4) symptomatic patient with well-positioned components; 5) symptomatic patient with suboptimal component position; 6) asymptomatic patient with mildly, moderately or highly elevated cobalt or chromium levels, with or without abnormal imaging (ultrasound or MRI); 7) mildly symptomatic patient with normal ion levels or marginally elevated ions with or without abnormal imaging. Case examples for each clinical scenario will be presented along with an algorithmic approach to management of the patient. The general approach to all patients returning for follow-up with a MoM arthroplasty begins with a detailed history. Patients should be queried regarding any episodes of pain, discomfort or compromise of function. Symptomatic patients should be closely evaluated for all intra-articular and extra-articular causes of hip pain. In large head MoM arthroplasty, aseptic loosening of the acetabular component maybe the source of pain and is frequently difficult to diagnose. Ruling out sepsis as a possible cause of pain is clearly indicated. Plain x-ray evaluation should be carefully performed to rule out loosening and to assess component position. Laboratory evaluation commences with ESR and CRP, which may be elevated. Serum metal ions at an approved laboratory facility should be obtained. An aspiration is performed. A cloudy to creamy fluid with a predominance of monocytes is often indicative of MoM failure; however, cell count should be obtained as well as culture and sensitivity. Finally, imaging studies should include ultrasound or metal artifact reduction sequence (MARS) MRI of the hip joint, specifically evaluating for fluid collections about the hip. If an adverse reaction to metal debris is suspected then revision to metal or ceramic-on-polyethylene is indicated and can be successful. A delay in revision maybe associated with extensive soft tissue damage (ie: necrosis) and hence poor clinical outcome for the revision.

**Discussion and Conclusion:** In summary, a systematic approach to the evaluation of patients with MoM arthroplasty should be adopted.

**SCIENTIFIC EXHIBIT NO. SE07**

**Impact of Patient Characteristics on Direct Medical Costs in Total Hip and Knee Arthroplasty**

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**Introduction:** Total hip arthroplasty (THA) and total knee arthroplasty (TKA) are two highly cost-effective procedures. It is unclear how the costs of these procedures are affected by demographics, indications, comorbidities and short-term complications. The purpose of this study was to determine the impact of patient characteristics and short-term complications on direct medical costs in THA and TKA during the index hospitalization and 90-day window following surgery. **Methods:** The study population included more than 19,000 primary or revision THA and TKA procedures between 1/1/2000 - 09/31/2008 at a large tertiary care center in the Upper Midwest. Clinical data were obtained from the institutional Total Joint Registry and included demographics, dates and types of procedures, indication for surgery and arthroplasty complications (infections, cardiovascular, fracture, thromboembolitic). Residency, payor status and Comorbidities were derived from administrative data (Elixhauser method). Total direct medical costs during index hospitalization and the 90-day window following each procedure were obtained from the Olmsted County...
Introduction:

Richard H. Walker

After Primary Total Hip Arthroplasty

Effect of Computer-Assisted Navigation on Dislocation

SCIENTIFIC EXHIBIT NO. SE08

When health policy and payment decisions are made, risks further select patient comorbidities, diagnoses and demographic factors and 90-day window following surgery vary with patient age and hospital and professional costs during the surgical encounter by patient characteristics and implant costs. An increase in the number of a patient’s preoperative comorbidities was associated with higher costs. Average hospital costs for both the surgical encounter and the preoperative comorbidities was associated with higher costs than revisions for instability. An increase in the number of a patient’s preoperative comorbidities was associated with higher costs. Among the various comorbidities examined, coagulopathy, lymphoma and metastatic cancers were associated with the highest costs. Presence of any postoperative complication was associated with 20-25% higher costs and the most costly complications were vascular (myocardial infarction, bleeding) and infections events.

Conclusions:

In both THA and TKA, the costs of initial hospitalization and follow-up care are significantly affected by patient characteristics and implant costs. An increase in the number of comorbidities and selected specific comorbidities also drive the costs higher. The proportion of different kinds of hospital and professional costs during the surgical encounter and 90-day window following surgery vary with patient age and comorbidities. For revision surgery, the much higher implant costs observed represent a controllable factor likely most amenable to cost containment efforts for those procedures. The continued failure to account for the increased overall costs associated with select patient comorbidities, diagnoses and demographic factors when health policy and payment decisions are made, risks further reducing access to care for those patients in greatest need.

SCIENTIFIC EXHIBIT NO. SE09

Effect of Computer-Assisted Navigation on Dislocation After Primary Total Hip Arthroplasty

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Introduction:

Dislocation [DL] after primary total hip arthroplasty [THA] is a common complication with reported rates between 1 and 5%. Optimal acetabular component [AC] position and increased femoral head [FH] size have been associated with reduced dislocation rates. Computer-assisted navigation [CAN] has introduced a new method to optimize THA AC position. We reviewed our initial series of primary THA performed with CAN, hypothesizing that primary THA using CAN would have a low prevalence of DL and could offset the advantage of larger FH sizes.

Methods: This study included the initial 100 consecutive primary THA performed by a single surgeon using CAN (GrpNAV, N=100, 2009-10), with a mix of metal- and ceramic-on-polyethylene [MOP, COP] bearing surfaces, which were compared to three multi-surgeon series from the same institution previously studied regarding DL and FH size. Prior series included a consecutive ceramic-on-ceramic [COC] series (GrpCOC, N=320, 1997-2005) and that series’ concurrent matched cohort metal-on-polyethylene series (GrpMOP, N=268, 1997-2005), performed prior to common use of large FHs, and a consecutive mixed bearing series, including MOM, COP and CAN (GrpLRG, N=300, 2008), performed at the height of use of large MOM FHs. All 984 THA in the 4 series were performed via a posterolateral approach by joint replacement fellowship faculty. Minimum follow up was six months in GrpNAV and one year in the other cohorts.

Results: In GrpNAV, mean AC abduction was 41° with 100% 30-50° and mean ANT 20° with 78% 10-30°. There were no DLs. DL rates varied from 5% (GrpMOP) to 0% (GrpNAV), with significant differences between GrpMOP and each of the other cohorts, but not among GrpNAV, GrpLRG, and GrpCOC (all <1.5%). Mean FH head size was graduated, GrpMOP (28mm) < GrpCOC (33mm) < GrpNAV (36mm) < GrpLRG (38mm), with significant differences between GrpMOP vs GrpCOC, GrpCOC vs GrpNAV, and GrpNAV vs Grp LRG. FH size appeared to be protective regarding DL, to a limit. For all groups, dislocation rate was 2%, with significant differences regarding ≥28mm (5%) vs ≥32mm (1%) and ≥32mm (3%) vs ≥36mm (1%), but not regarding ≥36mm (2%) vs ≥38mm (1.4%). DL rate was not significantly different regarding GrpLRG (1%) vs GrpNAV (0%). However, no dislocations occurred in GrpNAV while employing significantly smaller FH size (≥40mm 18% of GrpNAV vs 42% of GrpLRG; ≥44mm 1% of GrpNAV vs 22% of GrpLRG).

Conclusion: Reviewing single institution series totaling 984 THA dating from 1997 to 2010 and representing eras of predominantly 28mm MOP, 32mm COC, 36-44mm MOP/MOM, and navigated 36mm MOP/COP bearing surfaces, a FH size ≥36mm appeared to be dislocation protective. However, advantage with FH size ≥36mm could not be demonstrated. The use of CAN in THA offered a promising tool for minimizing instability (DL 0%). A navigated THA series with predominantly 36mm FH size demonstrated a DL rate equivalent to a non-navigated series with significantly larger FH size, offering an alternative to reliance on MOM THR with 40-44+ mm head sizes for the purpose of minimizing DL.

SCIENTIFIC EXHIBIT NO. SE09

Groin Pain After Total Hip Arthroplasty

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Introduction: Persistent groin pain after total hip arthroplasty (THA) is an under-reported and under-treated complication. As complications with alternative bearing surfaces (most significantly metal-on-metal) have come to light, authors have recently recognized an increased incidence of groin pain in metal-on-metal THA, hip resurfacing, and conventional metal-on-polyethylene THA. The overall incidence of groin pain after hip arthroplasty has been reported in the literature to be as high as 18%. There are multiple possible causes and the treating surgeon must follow a methodological approach to diagnosis and treatment. Methods: At our institution we have developed an algorithmic approach to management of groin pain after THA. The evaluation of groin pain should begin in all cases by ruling out infection.

The FDA has not cleared the drug and/or medical device for the use described in this presentation (i.e. the drug or medical device is being discussed for an off label use). For full information refer to page 14. An alphabetical faculty financial disclosure list can be found starting on page 19.
Methods: The study was to develop a specific, comprehensive, evidence-based and recommendations of specialist referral. The objective of this TJA. Many articles that address this topic are limited to generalities so-called "medical clearance" and preoperative optimization for literature lacks a consistent and detailed methodology to achieve. Groin pain in patients with MOM THA follows along the same path as above but also includes evaluation of the hip with metal subtraction MRI and also serum ion levels.

Results: In this scientific exhibit we will present the step by step algorithmic approach to management of groin pain following THA. We will present the outcome of surgical intervention for a select group of patients in whom percutaneous and/or open release of iliopsoas was performed. The technique and outcome of revision THA for patients with "malpositioned" acetabular component in whom iliopsoas bursitis and/or impingement existed will also be discussed. We will present the outcome of cross sectional studies in a group of patients in whom subtle component loosening was detected. The outcome of management of extrinsic pathology that had masqueraded as groin pain will be presented. Finally the outcome of revision THA for patients with MOM failure (groin pain with/without pseudotumor) will be discussed.

Discussion and Conclusion: The management of groin pain following THA can be a source of frustration for both the patient and the surgeon. Based on extensive experience managing patients with this problem, we have developed an algorithmic approach to this problem that enables us to reach a diagnosis in these patients in a timely fashion. The joint registry database at our institution will be the source of data on patients with groin pain who were treated at our institution and will provide rationale behind each intervention. We believe this scientific exhibit is likely to be of great benefit to general orthopedic surgeons or those specializing in hip arthroplasty who not infrequently encounter this problem in their patients.

Preoperative Risk Stratification and Risk Reduction for Elective Total Hip and Knee Reconstruction

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Introduction: Modern surgical technique and perioperative care have reduced the incidence of systemic and local complications after total joint arthroplasty (TJA). Nevertheless, the elective nature of TJA, the rising prevalence of co-morbidities in TJA candidates, and the recent modifications in government reimbursement policies have provided additional impetus to fully evaluate and address risk factors prior to surgery. The existing orthopaedic and primary care literature lacks a consistent and detailed methodology to achieve so-called "medical clearance" and preoperative optimization for TJA. Many articles that address this topic are limited to generalities and recommendations of specialist referral. The objective of this study was to develop a specific, comprehensive, evidence-based algorithmic approach to risk-stratify and triage TJA candidates.

Methods: A systematic literature search was performed of multiple electronic medical databases focusing on specific conditions falling under major categories including: cardiology, pulmonology, hematology, rheumatology, nephrology, hepatology, peripheral vascular disease, immunosuppression, transplant medicine, neuromuscular disease, endocrinology, metal hypersensitivity, drug/alcohol/tobacco abuse, infectious disease, dentistry, obesity, age, and malnutrition. For each topic, emphasis was placed on studies that examined total hip or knee arthroplasty, were published within the past ten years, represented higher levels of evidence, and dealt specifically with preoperative risk factors or the effect of treatment of risk factors prior to surgery. When studies specific to TJA were unavailable, general orthopaedic, general surgical and medical literature was used.

Results: Based on available literature, a screening protocol and 50-point checklist encompassing a wide variety of potential patient conditions was formulated. Specific recommendations were provided for the associated risk for each condition as were recommended measures to allay that risk. For multiple topics, high level of evidence TJA studies specifically addressing the effectiveness of preoperative risk stratification and treatment of relevant co-morbidities were lacking. Inferences from caseseries and from general surgical and medical literature were necessary in some situations.

Discussion and Conclusion: Orthopaedic surgeons are frequently referred patients from physicians who are unaware of the risks of TJA in the presence of multiple co-morbidities. At the same time, "medical clearance" and "preoperative optimization" are typically left to the discretion of the medical consultant or primary care physician and do not always address appropriate risk factors for complications during or after TJA. Every surgeon or institution should have a rational, uniform approach and a set of evidence-based criteria in assessing and preparing patients for TJA. These measures will help minimize postoperative complications and adverse events associated with known risk factors. This algorithmic approach was implemented at the authors' institution in October 2010 and its validity as a means of reducing peri-operative morbidity associated with TJA is currently being prospectively evaluated.

Development and Early Results of the ANCHOR Hip Preservation Surgery Study Group

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Introduction: Hip preservation surgery has become more commonplace over the past decade. Contemporary literature primarily includes single-surgeon retrospective case series. There is a need for more sophisticated clinical outcome studies with large patient cohorts. The academic network of conservational Hip Outcomes Research (ANCHOR) is a multi-center study group developed to investigate the diagnosis and treatment of hip preservation procedures. The purpose of this exhibit is to present the rationale, developmental design, data collection process and early enrollment results of the ANCHOR Hip Preservation study group.

Methods: The initial A NCHOR study group includes 9 institutions with 13 surgeons. Initial efforts were directed at...
consensus regarding clinical outcome measures, preoperative and post-operative radiographic measures, clinical nomenclature, surgical procedure data collection and standardized clinical outcome endpoints. Multi-center data collection, data transfer, quality assurance, and data input were then developed. **Results:** Prospective, multi-center data collection began in 2008 and continues. To date, 1303 consecutive joint preservation cases have been enrolled. 63% of patients are female, the average patient age is 26 years. These cases include comprehensive clinical, exam, radiographic and patient questionnaire data. 458 PAO and 845 FAI cases are being studied. Periacetabular osteotomy was most commonly performed for classic acetabular dysplasia followed by Perthes disease and acetabular-based impingement. FAI procedures were most commonly performed for combined cam and pincer deformities. The most commonly utilized FAI procedures include hip arthroscopy 60%, surgical dislocation 28%, and periacetabular osteotomy 3%. **Discussion and Conclusion:** Development of prospective multi-center longitudinal data collection for hip preservation procedures is feasible and has been accomplished by the ANCHOR study group. These data provide clinical epidemiology information on pre-arthritic hip disorders and will serve a basis for multiple future longitudinal cohort studies.

**SCIENTIFIC EXHIBIT NO. SE12**

**Pathologic, Serologic, and Tribologic Findings in Failed Metal on Total Hip Arthroplasty**

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**Introduction:** Revision of failed metal on metal (MOM) total hip arthroplasty (THA) is increasingly prevalent. Various biologic responses to MOM implants, including pseudotumors, aseptic lymphocytic vasculitis-associated lesions (ALVAL), and now more generically, adverse local tissue response (ALTR) have been described. In a series of revised MOM implants we investigated serum cobalt and chromium levels, the pathologic tissue examinations and a tribologic analysis of the retrieved implants. We hypothesized that the host biologic response (pathology) could be correlated with the serologic and tribologic findings. **Methods:** Seventeen patients underwent revision of failed or asymptomatic MOM THA at an academic medical center. Serum cobalt and chromium levels were measured per a standard protocol. Retrieved tissue and implants from sixteen subjects were sent for a detailed pathologic exam as well as a tribologic analysis of the implants, performed at a dedicated tribology lab. Pathologic findings were classified in two main categories: Group 1 (10/16 patients) was macrophage/necrosis dominant while Group 2 (6/16) patients was fibrous/lymphocyte dominant. **Results:** Group 1 had a mean Cobalt level of 128.7 (range 60.8-198.9) and mean Chromium level of 41.2 (range 15.6-62.1) and Group 2 had significantly lower mean serum Cobalt and Chromium levels (Co 5.1 vs Cr 2.2, p<0.01). Metallosis was documented as a common intraoperative finding in Group 1 but not Group 2. On tribologic examination the dominant finding on all retrievals was polar stripe wear corresponding to edge loading at the rim of the cup, and did not differ between the two pathologic groups. **Conclusion:** Variability in the biologic response to MOM THA implants can be seen despite similar tribologic wear patterns. However, intraoperative findings of metallosis and high serum metal ion levels were correlated with pathologic findings of necrosis. Our findings would suggest that high serum metal ion levels may be associated with advanced tissue damage, and we would recommend that ion levels should be routinely monitored in MOM THA patients and consideration given for early revision in patients with markedly elevated levels.

**SCIENTIFIC EXHIBIT NO. SE13**

**Managing the Infected Total Hip: New Solutions to an Old Problem**

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**Introduction:** Infection after total hip arthroplasty (THA) is a devastating complication. The annual rates of primary THA increased 50%, from 47/100,000 in 1990 to 69/100,000 in 2002. The incidence of infection after primary THA is between 1-2% and is higher in populations with metabolic, immunological, dermatological, and nutritional risk factors. With the current infection rates and the emergence of resistant strains, infection in THA is becoming a major problem that surgeons in the US have to face. Within the use of certain measures, such as preoperative preparation, patient nutrition, clean surgical techniques, and antibiotic cement, there has been a decreased incidence of infection. However, once infection develops, the strategies change focus towards eradication or suppression of infection while preserving the patient function and minimizing patient morbidity. **Methods:** A comprehensive search of the literature was performed, using Medline, to find peer-reviewed articles on infection after THA. Microbiology, risk factors, timing of presentation, and diagnostic and management algorithm and outcome data on infection control were reviewed. **Results:** Microbiology, risk factors, timing of presentation, and diagnostic and management algorithm and outcome data on infection control were reviewed. **Discussion and Conclusion:** The purpose of this exhibit is to highlight current methods to diagnose infection after THA and strategies to manage established deep infection after THA. The exhibit will present a systematic approach to diagnosis of infected THA at different postoperative periods and strategies to manage an infected THA. The emphasis will be on surgical techniques of component removal, advances in spacer options in a two stage re-implantation, selection of antibiotics in cement and currently utilized strategies to determine timing of re-implantation. Information will be provided in the value of preoperative serological markers, hip aspiration and synovial fluid analysis as well as role of pre and intra-operative biopsy in deciding time of re-implantation. Moreover, the exhibit will discuss current salvage techniques to manage reinfection after revision THA. Finally, a multi-disciplinary protocol to minimize infection will be highlighted. A systematic approach to diagnose and manage infected total hip arthroplasty, incorporating modern techniques, has been proven to yield improved results.

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Methods: The evaluation of femoroacetabular impingement (FAI) have greatly progressed, defining the exact pathomechanism of how and when patients develop hip pain and subsequent arthritis is still lacking. This exhibit will present a multidisciplinary approach of hip kinematics/kinetics, advanced MR imaging as well as biomechanical analysis to better understand FAI.

Methods: Three groups of patients are being prospectively evaluated: Asymptomatic individuals with cam deformity; symptomatic patients undergoing unilateral hip surgery with bilateral deformities; and a control group. All patients underwent 3D motion analysis as well as advanced MR imaging with T1Rho cartilage mapping and quantitative computer tomography to assess subchondral bone density. In addition, surgical specimens were taken intraoperatively of the cam lesion for biomechanical testing.

Results: Motion analysis has shown that the FAI group had attenuated hip abduction, frontal range of motion (ROM) and sagittal ROM during gait which may be caused by muscle weakness and soft tissue restriction. The decreased frontal pelvic ROM could result from limited mobility at the sacro-lumbar joint. During squatting, the FAI group showed a limited sagittal pelvic ROM, which contributed to their decreased squatting depth. Postoperatively, squat performance improved, likely because of the combined effects of increased knee and ankle angles as well as an increased posterior pelvic pitch. Some studies in the literature have shown an inverse relationship between a Magnetic Resonance parameter, T1rho, and the proteoglycan content in articular cartilage. Taking advantage of the non-invasive character of MR, we are using this quantitative imaging technique, T1rho, to assess the integrity of articular cartilage in the three different subject groups. Our group has found statistically significant differences between FAI and healthy asymptomatic patients. T1rho values in FAI patients were higher than in controls, indicating a lower PG content, as expected. Typical bone sclerosis was seen in quantitative CT imaging. Comparison to MR findings can help explain the role of subchondral bone density changes in degeneration. Cartilage from the cam deformity showed lower stiffness and higher permeability compared to cadaveric controls, as expected in arthritic cartilage. Further fitting with a fibril-reinforced finite element model demonstrated lower fibril stiffness, indicative of compromised collagen fibrils. Correlation of cartilage mechanical properties with clinical symptoms and radiographic signs is currently being investigated.
Introduction: There are numerous causes of poor acetabular component orientation such as poor visualization, increased patient BMI, mechanical guide inaccuracies, and changes in patient position during implantation. Negative outcomes may include dislocation, impingement, wear, length, and revision. The combination of newly developed techniques incorporating patient-specific morphology and quantitative technology may improve acetabular component orientation and thus patient outcomes.

Methods: Existing literature was used to review conventional techniques for acetabular component orientation including benefits and disadvantages of using these techniques. Next, more recently developed techniques, including anatomic landmark and patient-specific morphology, along with quantitative technologies such as computer-aided navigation, were explored; again placing particular attention on the benefits and the disadvantages of these methods.

Results: Acetabular component position using conventional techniques is particularly influenced by variables such as patient size, deformity and/or position regardless of surgeon experience and practice volume. Anatomic landmark and patient-specific morphology, when used alone or in conjunction with quantitative technology, demonstrate a reduction in intra- and inter-surgeon acetabular component variability.

Discussion and Conclusion: Acetabular component placement has long aimed for standardized safe-zones rather than a patient-individualized target-zone. As the population needing THA increases, the prevalence of complications and problems will increase even if the incidence decreases. Therefore, reliable methods for improving acetabular component alignment should be welcome. Incorporating anatomic landmark, including patient-specific morphology, has the potential to provide more accurate and individualized target zones particularly when coupled with quantitative technology such as computer-aided navigation, thus improving the precision of acetabular component placement.

Discussion and Conclusion: Because of the complexity of hip biomechanics as well as the three-dimensional nature of the impingement deformity, a multidisciplinary approach provides a better assessment of this dynamic pathology.

Improving the Accuracy of Acetabular Component Orientation: Avoiding Malposition

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Discussion and Conclusion: Total Joint Arthroplasty (TJA) is a successful surgical procedure being offered to nearly 1 million in the United States each year. However, TJA failures represent an immense burden on orthopedic healthcare. Over 12 years ago we established a multicenter retrieval program that examines the etiology of failure of joint prostheses by performing integrated analyses of the clinical, patient, and implant factors contributing to the need for revision surgery. The program has been funded by the National Institutes of Health over the past decade. This scientific exhibit will discuss the structure, the role, and recent findings of this retrieval program.

Methods: There are currently 10 clinical revision centers and two regional, university-based retrieval analysis centers in biomedical engineering departments that collaborate in the retrieval program. The clinical centers are based in the Northeast, South, Midwest, and Southwestern regions of the United States and are intended to represent a nationwide collection of hip and knee devices from a variety of manufacturers. The revision centers include not only urban academic centers, but also urban non-teaching and rural community hospitals. Each revision center has a dedicated clinical coordinator who is responsible for obtaining informed consent and clinical data collection. As a consecutive series of revisions at each center, the retrieval collection represents an unbiased sampling of both short and long term revisions. The prostheses and the retrieved tissue (selected cases) are packaged and transported to retrieval centers for analyses. The multidisciplinary personnel at the retrieval analysis centers include biomedical engineers, biologists, and students who perform surface analysis, histological examination, particle analysis and chemical characterization of the explants.

Results: To date, 1,454 hip and 985 knee prostheses have been retrieved between 2000 and 2011. Many of the findings of the Retrieval Program have been published previously (26 peer-reviewed journal articles and 45 conference abstracts). In this scientific exhibit we will present recent findings of the analyses which includes information on metal-on-metal failures, squeaking in ceramic bearings, and in vivo oxidation of highly cross linked polyethylene. Particular attention is given to the difference in performance of different HXLPE formulations, the penetration rate of various femoral heads (aluminum ceramic, zirconium ceramic, ZTA, metal, and oxinium) on different types of HXLPE, and the influence of femoral head size on penetration rate with HXLPE.

Discussion and Conclusion: Our academic mission is to expand the multicenter research collaboration into a nationally representative network of revision surgeons, biomedical engineers, and biologists to better understand the complex conditions contributing to hip and knee revision surgery in the United States. However, the success of retrieval analysis hinges upon the participation of all stakeholders, including not only researchers, but also patients, hospitals, manufacturers, and, through public NIH funding, society. One of the most important, and perhaps
the most cost effective, strategies to reduce the national revision burden is to better understand the etiology of failure of TJA so that revisions can be avoided in the future. This scientific exhibit will allow us to demonstrate how such a program can be designed, operationalized, and deliver value to patients and orthopedic health care. We invite orthopedic surgeons who routinely perform revision surgery and have an interest in retrieval analysis to join our unique research collaboration.

**Scientific Exhibit No. SE18**

**Porous Coatings**

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**Introduction:** Total Joint Arthroplasty (TJA) is a successful surgical procedure being offered to nearly 1 million in the United States each year. However, achieving reliable and durable fixation between the implant and host bone has historically presented a challenge and aseptic loosening remains a leading reason for revision surgery. Although the use of bone cement provides reliable fixation, concerns about the durability of the cement mantle led to the development of porous coatings to promote direct integration between the implant surface and host bone. In this exhibit, the rationale for and clinical performance of these coatings will be reviewed and supplemented with analysis of implants retrieved in a multicenter retrieval program.

**Methods:** Arthroplasty device manufacturers’ websites were surveyed to identify the current generation of porous coatings that are being actively marketed. A survey of the available literature was performed to identify the design characteristics of the current generation of porous coatings and to compare the current generation to historical coatings. Particular care was taken to include clinical survival and any analysis of bony ingrowth in retrieved devices. Further, 2439 devices retrieved in a multicenter retrieval study were screened to identify devices from the newest generation of porous coatings. The retrieved devices were examined for evidence of bone ingrowth, and a subset was examined to quantify bone ingrowth using scatter scanning electron microscopy.

**Results:** The newest generation of porous coatings demonstrates open-celled structures with increased porosity, and a higher coefficient of friction than previous generations. Clinical studies have demonstrated that bone loss due to stress shielding can be reduced because of the decreased stiffness at least one of the advanced porous coatings. It has also been demonstrated using RSA that component migration can be reduced by using advanced coatings. With the exception of case studies, study of bone ingrowth into the newest generation of coatings was generally limited to animal studies. Our collection of retrieved advanced coatings included a sufficient number of porous tantalum coated devices to examine bone ingrowth in multiple anatomical locations. The extent and degree of ingrowth into acetabular shells, femoral stems, patellas and tibial trays from short-term retrievals was in the range of that observed in retrieval studies of sintered beed or titanium mesh coatings. Complete bridging of bone from the surface through the porous coating was observed regionally in multiple components.

**Discussion and Conclusion:** Our investigation of the literature demonstrates that the initial results for advanced porous coatings are promising. However, there is still a gap in clinical knowledge regarding the ultimate extent of ingrowth that will be achieved in humans and whether the use of these advanced coatings will result in a reduction in revision rates for aseptic loosening. Our academic mission is to expand the multicenter research collaboration into a nationally representative network of revision surgeons, biomedical engineers, and biologists to better understand the complex problems contributing to hip and knee revision surgery in the United States. One of the most important, and perhaps the most cost effective, strategies to reduce the national revision burden is to better understand the etiology of failure of TJA so that revisions can be avoided in the future. We invite orthopedic surgeons who routinely perform revision surgery and have an interest in retrieval analysis to join our unique research collaboration.

**Scientific Exhibit No. SE19**

**Understanding and Accurately Tracking the Reasons for 90-Day Readmission Following Total Joint Arthroplasty**

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**Introduction:** Readmission after Total Joint Arthroplasty (TJA) places a great burden on the health care system. As reimbursement systems place increased emphasis on quality measures such as readmission rates, understanding and accurately tracking the causes for readmission becomes increasingly important.

**Methods:** We queried an electronic database for all patients who underwent Total Hip Arthroplasty (THA) or Total Knee Arthroplasty (TKA) at our institution from 2006 through 2010. We identified those who had been readmitted within 90 days of the original procedure. We then collected demographic and clinical data as well as readmission diagnoses by ICD-9 code. We compared rates of readmission using a chi-squared test. In addition, two senior-level orthopaedic residents performed a blinded analysis of de-identified medical records of 87 random patients and assigned a diagnosis and ICD-9 code for that readmission encounter. The resident-derived diagnoses were then compared with the coder-derived diagnoses and analyzed for agreement using binomial proportion with 95% exact confidence limits.

**Results:** 6436 patients underwent THA or TKA during the study period. This cohort of patients represented a diverse payer mix, including Medicare 43.4%, PPO 36.5%, HMO 10.2%, and Self-Pay/Other 9.9%. Readmission rates were as follows: unilateral THA, 190 of 2546 (7.46%); bilateral THA, 0 of 13 (0%); unilateral TKA, 288 of 3553 (8.11%); bilateral TKA, 32 of 337 (9.50%) for a combined rate of 7.92%. There was no significant difference in the rate of readmission among unilateral THA, unilateral TKA, and bilateral TKA (p=0.36). While there was a wide variety of readmission diagnoses, the top three were cellulitis (ICD-9 Group 682, 4.97%), procedure-related complications (ICD-9 Group 996, 15.51%), and wound complications (ICD-9 Group 998, 18.49%). In comparing the readmission diagnoses, we found that 22 of 87 patients were incorrectly coded for a rate of 25.3% (95% CI = 16.6%, 35.8%). The most common incorrect coding was related to post-operative stiffness and need for manipulation after TKA. There were several mis-categorizations regarding postoperative infection (cellulitis vs. wound dehiscence vs. deep infection).

**Conclusions:** Readmission within 90 days after THA or TKA...
occurs with substantial frequency. Postoperative stiffness requiring manipulation (within ICD-9 Group 996) and wound complications (within ICD-9 Group 998) are the most common reasons for readmission. Procedure-related complications and wound complications accounted for more readmissions than any single medical complication. We also found that readmission diagnoses are frequently coded incorrectly. The rate of mis-coding suggests the need for regular audits and highlights the need for clear documentation in the medical record. A clearer understanding of the factors related to complications should make a reduction in their occurrence possible; however, use of readmission diagnoses without specific attempts to assure their accuracy may not be an appropriate quality measure given the frequency with which errors occur.