COA Paper Session 16: Hip Reconstruction 2 ●

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A Large Diameter Head Metal-Metal THA Releases a Significantly Greater Amount of Metal Ion Compared to Hip Resurfacing

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Purpose: The long term exposure to metal ions released from metal-metal articulations is worrying. Studies have shown comparable ion level between metal-metal HR and 28mmTHA. No study has analyzed the amount of ion released from LDH-THA. We compared the amount of ion released from HR and LDH-THA from the same manufacturer. **Method:** Whole-blood concentrations of Cobalt was measured prospectively (pre op, 3, 6, 12, 24 months) with HR-ICPMS in 74 HR and 54 LDH-THA with the same metal bearing characteristics and acetabular component (monoblock Cobalt-Chrome with titanium plasma-spray coating). The femoral head of LDH-THA was inserted on a titanium stem with a Cobalt-Chrome adapter sleeve to adjust offset and leg length. **Results:** Demographic data was similar. The pre op Cobalt level (ug/L) were 0.10 vs. 0.11, 3 months 0.90 vs. 0.84, 6 months 0.90 vs. 1.28, 12 months 0.68 vs.1.75, and 24 months 0.56 (5.6X preop level) vs. 1.82 (16.5X preop level) in the HR and LDH-THA groups, respectively. The cobalt level decreased after 6 months in HR, whereas it was still increasing at 2y with LDH-THA. **Conclusion:** In order to reduce wear and ion release from metal-metal bearing, most manufacturers focus research on improvements at the bearing surfaces. This study has shown that the simple addition of a sleeve with 2 modular junctions can results in a dramatic increase in ion release, diminishing the value of improvements made at the bearing surface. The total amount of ion released from a metal-metal implant should be considered globally and as such, better modular taper designs should be developed.

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A Prospective Randomised Clinical Trial - Does Head Size Effect Metal Ion Levels in Metal-on-metal THAs

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Purpose: Metal-on-metal articulations are an increasingly popular choice as an alternate bearing surface in total hip arthroplasty (THA) and Resurfacing implants. One advantage of a metal-on-metal bearing is the use of larger diameter femoral heads with hip simulator data demonstrating reduced wear. We performed a prospective, multicentre, randomized, blinded clinical trial comparing 28mm to 36mm metal-on-metal bearings assessing multiple validated outcome measures and serum, erythrocyte and urine metal ions. **Method:** Ninety-one patients were randomized to receive a metal-on-polyethylene (34), a 28mm metal-on-metal (25) or a 36mm metal-on-metal (32) insert. All patients received the same acetabular and femoral component. Patients were evaluated pre-operatively, at 6, 12 months and annually thereafter, including an evaluation of serum, erythrocyte and urine cobalt, chromium, and titanium, outcome measures (WOMAC, SF-12, Harris Hip Score) and radiographs. **Results:** At a minimum two years follow-up there were no differences in WOMAC, SF-12, Harris Hip scores or radiographs. Patients receiving metal liners had significantly ($p<0.001$) elevated metal ion measurements compared with the polyethylene control group, however there were no differences between the 28mm and 36mm metal-on-metal bearings (Median serum Co (mg/L): 0.14(poly), 0.77(28mm), 0.73(36mm). Median erythrocyte Co (mg/L): 0.11(poly), 0.42(28mm), 0.42(36mm). Median urine Co(mg/day): 0.44(poly), 4.55(28mm), 5.42(36mm)). (Median serum Cr(mg/L): 0.17(poly), 1.29(28mm), 0.91(36mm). Median erythrocyte Cr(mg/L): 1.10(poly), 1.10(28mm), 1.20(36mm). Median urine Cr(mg/day): 0.27(poly), 1.92(28mm), 2.02(36mm)). **Conclusion:** Both cobalt and chromium ion measurements were significantly elevated in the blood and urine of the patients randomized to receive the metal-on-metal bearings at all time intervals. There were no differences seen between the 28mm and 36mm metal-on-metal bearings, keeping all other variables identical. The larger diameter bearing therefore provides the potential clinical advantages of improved range of motion and stability, while providing a similar metal ion profile. While reduced wear is seen with larger diameter metal-on-metal bearings in-vitro, we could not demonstrate a reduction in blood or urine metal ion levels in-vivo.

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Randomised Controlled Trial Comparing Metal on Metal versus Metal on Polyethylene Articulation in THA

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Purpose: A single blind prospective randomised controlled trial comparing the Metal-on-polyethylene articulation with the ï¿½Metasulï¿½ metal-on-metal articulation in THA. **Method:** The clinical and radiological findings of the consecutive patients who were enrolled in the RCT at the participating centres were recorded prospectively. The clinical evaluation was performed with the Harris scoring system as well as the Oxford Hip Scoring Sheet. The computer randomised option was revealed to the operative surgeon only after the patient was anaesthetised, during the recruitment period (June 1998 to July 2004). Of the total of 378 patients, 2 died prior to the final review and 63 were lost to follow-up. The final study group contained 315 patients, with 159 patients in the metal-on-polyethylene group and 156 patients in the metal-on-metal group. **Results:** The indication for the hip arthroplasty for majority (309 patients) was primary osteoarthritis. The average age at the time of the surgery was 68.2 years and the average duration of follow-up was 85 months (42-115). There was an improvement of the Oxford hip scores from an average of 37 per-operatively to 16 post-operatively. The Harris hip scores also improved from an average of 47.0 pre-operatively to 87.3 post-operatively. The patient groups were statistically similar with respect to age, sex and duration of follow-up, and the final outcome scores revealed no statistical difference between the two groups. **Conclusion:** The clinical results obtained with the use of the ï¿½Metasulï¿½ articulation are comparable to those obtained by the metal-on-polyethylene articulation encouraging the use of this alternative bearing surface.

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Reconstruction of Acetabular Hip Biomechanics with Surface Replacement Arthroplasty

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Purpose: Precise biomechanical reconstruction of the hip joint by a hip arthroplasty is essential for the success of this procedure. With the increasing use of surface replacement arthroplasty (SRA), there is a need for better understanding of the key factors that influence the anatomical and the biomechanical parameters of the resurfaced hip joint. The goal of this study was to examine the influence of SRA on the vertical and horizontal offset of the hip. **Method:** Twenty-one hips from 12 embalmed cadavers were resurfaced with a Birmingham Hip resurfacing. The thickness of the acetabular bone was measured pre- and post-reaming in 6 acetabular zones. Radiographs were taken before and after the procedure with a scaling marker. For statistical analysis, the paired Student's T-test with a confidence interval of 95% and a significant p-value of $p<0.05$ was used. **Results:** The mean acetabular bone loss was 3.8 mm, 5.9 mm, 9.3 mm, 10.6 mm, 8.5 mm and 3.6 mm in zones 1 to 6. The "polar length loss" is the cumulative displacement of the femoral and the acetabular articulating surface in zones 2 to 5. This displacement indicates a shortening of the neck plus a medio-cranial displacement of the acetabular articulating surface and was 4.3 mm, 7.5 mm, 9.4 mm and 7.7 mm (zone 2-5). The radiographic center of rotation (COR) was significantly medialised (mean 6.2 mm) and displaced in the cranial direction (mean 6.9 mm) ($p<0.00001$). The mean total (femoral plus acetabular) horizontal and vertical offset change was 6.4 mm and 9.5 mm respectively ($p<0.00001$). There was a significantly higher vertical offset change in the acetabulum than in the femur ($p=0.0006$). This resulted in a significantly larger change in vertical than in horizontal offset ($p=0,04$). **Conclusion:** The displacement of the acetabular COR was responsible for 60% of the total vertical and 99% of the total horizontal offset change. The femoral side did not compensate for this displacement. SRA did not restore the biomechanics of the native hip.

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A Surgical Treatment Algorithm Using the Lateral Plate and Cable System for Periprosthetic Fractures of the Femur Around a Well-fixed Stem

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Purpose: Plate and cable alone constructs to treat periprosthetic fractures around a well-fixed femoral stem in total hip replacements, have been reported with high failure rates. The aim of this study was to evaluate the results of our surgical treatment algorithm to reliably use lateral plate and cable constructs in these fractures. **Method:** One hundred and six periprosthetic fractures in 102 patients were treated between 1996 and 2006. Forty-five fractures were pre-operatively assessed as Vancouver type B1 fractures. The joint was always dislocated and stability of the implant was meticulously evaluated. This led to the identification of nine (20%) unstable stems leaving 36 fractures to be real B1-type fractures. The fracture was considered to be suitable for lateral plate and cable alone fixation if the medial cortex was not comminuted and an anatomical reduction of the medial cortex could be achieved. Twenty-nine B1- and 5 C-type fractures had been treated with a single lateral plate and cable construct. The mean length of follow-up was 43.2 months. The paired Student's T-test with a confidence interval of 95% and a significant p-value of $p<0.05$ was used to compare the pre- and post-operative UCLA hip scores. **Results:** Four (12%) patients died within one month from surgery leaving 30 patients for follow-up. Twenty-nine fractures united at a mean of 6.4 months. One B1-type construct failed due to inappropriate proximal fixation. Two fractures united uneventfully with a mean of 8° of varus alignment of the proximal fragment. One patient with a C-type fracture sustained a fracture distal to the tip of the plate. There were three plate infections (8.8%). There was no significant difference between the pre- and post-operative UCLA hip scores (25 versus 23 resp.). **Conclusion:** These fractures represent a difficult problem with a high complication rate of 30%. The presented treatment algorithm contributed significantly to the 97% union rate with plate and cable alone constructs that was comparable to the union rates achieved with combined plate and strut graft fixation.

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Results of Two Methods of Femoral Shortening Osteotomy in Hip Arthroplasty for High Riding Developmental Dysplasia of the Hip

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Purpose: Total hip arthroplasty in high riding congenital dislocation of the hip is a challenging procedure. In order to position the cup in the true acetabulum, femoral shortening osteotomy is often needed. The purpose of our study was to evaluate the results of two different methods of femoral shortening osteotomy. **Method:** Thirty-one total hip arthroplasties were performed in 29 cases with high congenital hip dislocation. The acetabular cups were placed at true acetabulum and femoral shortening osteotomies of the femur were performed at proximal (14 hips, group 1) or distal femur (17 hips, group 2). After a mean follow up of 4.2 years, all 31 hips were evaluated with Harris Hip Scores and X-rays. Technical difficulties and complications were also reported. **Results:** The mean increase in Harris Hip Score was 51 in group one and 52 in group two. There was one peroneal nerve palsy and one early dislocation in group 1, while there was no such perioperative complications in group 2. One acetabular cup and femoral stem were revised in group 1. Non-union happened in two cases of group 2. Special shape (cylindrical, non-tapered and longer than standard) femoral stems were needed for most proximal osteotomy patients. **Conclusion:** Hip arthroplasty, with insertion of cup at true acetabulum and femoral shortening osteotomy in patients with high congenital dislocation, can produce good results. Either proximal or distal femoral shortening osteotomy could have advantages and disadvantages. Proximal shortening osteotomy is a more challenging procedure, may need special stem design, and could compromise stem fixation.

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Results of In-cement Revision of Infected Total Hip Arthroplasty

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Purpose: Removal of all foreign material is the normal practice at the time of revision arthroplasty for sepsis. However, removal of well-fixed bone cement is time consuming, can result in significant bone stock loss and increases the risk of femoral shaft perforation or fracture. We have performed two-stage revision for infection in a series of cases in which we have left oseeointegrated femoral cement at the first stage and we present the results of this technique. **Method:** All patients underwent two-stage revision for infection. At the first stage the prostheses and acetabular cement were removed but when the femoral cement mantle demonstrated good osseo-integration it was left in-situ. Following Girdlestone excision arthroplasty (GEA), patients received local antibiotics delivered by cement spacers, as well as systemic antibiotics. At the second stage the existing cement mantle was reamed, washed and dried and then a femoral component was cemented into the old mantle. **Results:** Sixteen patients (M:F 5:11) had at least three years follow up (mean 80 months, range 43 to 91). One patient died of an unrelated cause at 53 months. Recurrence of infection was not suspected in this case. The mean time to first stage revision was 57 months (3 to 155). The mean time between first and second stages was 9 months (1 to 35). Organisms were identified in 14 (87.5%) cases (5 Staphylococcus Aureas, 4 Group B Streptococcus, 2 Coagulase negative Staphylococcus, 2 Enterococcus Faecalis, 1 Escheria Coli). At second stage, five (31.2%) acetabuli were uncemented and 11 (68.8%) were cemented. There were two complications; one patient dislocated 41 days post-operatively and a second patient required an acetabular revision at 44 days for sudden loss of fixation. No evidence of infection was found at re-revision. One patient has been revised for recurrent infection. Currently no patients are suspected of having a recurrence of infection. **Conclusion:** Retention of a well-fixed femoral cement mantle during two-stage revision for infection and subsequent in-cement reconstruction is safe with a cure rate of 93%. Advantages include a shorter operating time, reduced loss of bone stock, improved component fixation and a technically easier second stage procedure.

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Acetabular Revisions Using Anti Protrusion (Ilioischial) Cage and Trabecular Metal Cup Constructs for Severe Acetabular Bone Loss Associated with Pelvic Discontinuity ? Preliminary Results with 1 to 6 Years Follow Up

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Purpose: Pelvic discontinuity associated with bone loss is a complex challenge in acetabular revision surgery. Reconstruction with anti protrusion cages, Trabecular Metal (Zimmer, Warsaw, Indiana) cups and morselized bone (Cup-Cage) constructs is a relatively new technique used by the authors for the past 6 years. The purpose of the study was to examine the clinical outcome of these patients. **Method:** Thirty-two consecutive acetabular revision reconstructions in 30 patients with pelvic discontinuity and bone loss treated by cup cage technique between January 2003 and September 2007 were reviewed. Average clinical and radiological follow up was 38.5 ± 19 months (range 12 – 68, median 34.5). Failure was defined as component migration > 5mm. **Results:** In 29 (90.6%) patients there was no clinical or radiographic evidence indicative of loosening at latest follow up. Harris Hip Scores improved significantly ($p<0.001$) from 46.6 ± 10.4 to 78.7 ± 10.4 at 2 year follow up. In 3 patients the construct migrated at 1 year post surgery. One construct was revised to anti protrusion cage with a structural graft while the other was revised to a large Trabecular Metal cup. The third patient is scheduled for revision. Complications included 2 dislocations, 1 infection and 1 partial peroneal nerve palsy. Two patients died due to unrelated reasons at 1 and 3 years post surgery, respectively. **Conclusion:** Treatment of pelvic discontinuity by Cup-Cage construct is a reliable option based on preliminary results which suggest restoration of the pelvic mechanical stability. However, patients should be followed closely in order to detect cup migration until satisfactory bony ingrowth into the cup takes place.

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Trabecular Metal Cups for Large Acetabular Defects with Up to 50% Host Bone Contact in Revision Total Hip Arthroplasty: Preliminary Results with 2 to 6 Years Follow Up

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Purpose: Acetabular component revision in the context of large, contained bone defects with less than 50% host-bone-contact traditionally required roof reinforcement or antiprotrusio cages. Trabecular Metal (TM) cups (Zimmer, Warsaw, Indiana) may offer a viable treatment alternative. The objective of this study was to evaluate the clinical and radiological outcome of this mode of treatment. **Method:** Fifty-four hip revision acetabular arthroplasty procedures performed with TM cups for contained defects offering ≤50% contact with native bone were prospectively followed. Average follow-up was 45 months (range 24-71). All patients were clinically and radiographically evaluated for evidence of loosening or failure. **Results:** Contact with bleeding host bone ranged from 0 to 50% (average 23%). At latest follow up 43 (79.6%) arthroplasties had excellent or good results, 8 (14.8%) cases had medium or fair results and 3 cases (5.6%) had poor results. Two cups failed and had to be revised. Two additional cups had radiological evidence of probable loosening. Overall preliminary survivorship of the revision acetabulae was 96%. Complications included 4 dislocations and 1 sciatic nerve palsy. **Conclusion:** Treatment of cavitary defects with less than 50% host-bone contact with using TM cups, without structural support by augments or structural bone grafts, is a viable option.

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Cost Effectiveness Analysis of Revision Total Hip Arthroplasty and Revision Total Knee Arthroplasty

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Purpose: The purpose of our study is to compare hips to knees in regards to the cost per increase in function, to determine the relationship of economic investment to improved quality of life. **Method:** During the year 2005, a total of 23 TKA and 41 THA revisions were performed for aseptic mechanical failure. Patients were enrolled prospectively and quality of life questionnaires including the SF-36, WOMAC, Harris Hip Score (HHS), and Knee Society Score (KSS) were collected prior to and following their procedure at two year follow-up. The total cost of the procedure including the hospital, implant, and surgeon fee were implemented in a cost effectiveness model to calculate the mean cost per SF-36, WOMAC, and HHS or KSS point gained. Demographical variables and co-morbidities were collected to determine risk factors for low cost-effectiveness. **Results:** The majority of patients had significant improvement in SF-36, WOMAC, HHS and KSS scales. Patients with THA revisions experience a cost per point increase for HHS of $3,000, and $500 per point SF-36 compared to knee patients who experienced a cost per point increase for KSS of $2,000, and $2,800 per point SF-36. The WOMAC exhibited similar cost effectiveness in the subscales of pain, stiffness and functioning. **Conclusion:** There are few studies that have compared the cost effectiveness of total joint arthroplasty revision procedures. Given the increasing cost of health care expenditures, prioritization of funding for the different health practices will become necessary. This study demonstrates that revision THA and TKA are relatively cost effective procedures compared to other non-orthopaedic interventions.