INTRODUCTION:
Total hip arthroplasty (THA) is an increasingly popular surgical procedure offered in the treatment of arthritic conditions of the hip. It has been well documented that metal ion levels are increased after a primary THA, regardless of the bearing surface. Several modes of metal ion release exist, including: passive dissolution, wear (mechanical), corrosion (electrochemical) and combined mechanical and electrochemical processes (eg. fretting corrosion). In our prior studies we have described the sources and increased metal ion levels of titanium, cobalt and chromium after a primary metal-on-polyethylene THA. It is also well-documented that degenerative joint disease of the hip will often impact the contralateral hip and knee, necessitating a future total joint arthroplasty (TJA). The impact of this second procedure on existing metal ion levels has not been well studied at long-term follow-up.

METHODS:
Twelve patients (63.4 average age, range 55 to 76 years) were included in this study which was approved by the hospital Institutional Review Board prior to initiation. Four males and 8 females all undergoing an initial primary metal-on-polyethylene THA were included. There were 8 subsequent THAs and 4 total knee arthroplasties (TKA) at an average of 102.7 months (range, 36 to 144 months) after the initial procedure. Secondary THAs consisted of 5 hybrid constructs and 3 cementless reconstructions. For all secondary THAs the femoral stem was fabricated from cobalt-chromium and the acetabular component from a titanium alloy. In 5 of the 8 THAs supplemental titanium screws were utilized to secure the acetabulum. All TKAs were cemented in place with a cobalt-chrome femur and a titanium tibial tray.

Blood samples were collected pre-operatively and at 3, 6 and 12 months and annually thereafter. After the blood was allowed to clot the serum fractions were removed under a Class 100 biological safety hood. To prevent contamination all reagents utilized were ultrapure and processing vessels acid-washed to prevent contamination. The serum samples were then analyzed for cobalt, chromium and titanium using high resolution sector field ICPMS (Element 2, Thermo/Finnigan, Bremen, Germany) with detection limits of 0.2 ng/ml for Ti, 0.015 ng/ml for Cr and 0.04 ng/ml for Co. The collective data for the initial THA group was compared to that of patients undergoing a TKA or a THA separately and then combined. Friedman tests were performed to determine statistical significance with a p value > 0.05 defined as the threshold for significance.

RESULTS:
Five year data was available for all 12 patients after their second TJA (average follow-up 96.4 months, range 61-168). Figures 1, 2 and 3 depict the differences in cobalt, chromium, and titanium ion levels after a single joint replacement and after the second surgery, respectively. Patients undergoing a secondary TKA had no significant differences in cobalt, chromium or titanium ion levels up to 72 months after surgery. Whereas patients with a secondary THA had significantly elevated cobalt ion levels at 12 and 48 months; chromium ion levels at 12 and 24 months; and titanium levels at 48 and 72 months. In combining all patients, chromium ion levels were significantly elevated at 12 months and titanium levels at 72 months after the second TJA. In general a second metal-polyethylene THA resulted in elevation of all metal ion levels tested at all time points, reaching significance at the time points described above.

DISCUSSION:
Elevation of metal ions after primary THA is a well-described phenomenon; however, the impact of a second TJA on these levels has not been thoroughly investigated. It is also a relatively common finding to develop degenerative joint disease in an adjacent or contralateral joint necessitating future replacement surgery. The important finding in this study is that fact that metal ion levels did not increase as much when patient had a TKA following a primary THA compared to when they underwent a second THA. The absence of a modular taper in knee replacements suggests that corrosion at the head-neck junction and/or fretting at the screw-cup interface maybe responsible for the elevated metal ion levels observed after a THA and not a secondary TKA. Larger numbers and longer-term follow-up are necessary to determine the extent and impact of these elevated metal ion levels. Similarly, the current study involves relatively small femoral heads (28 mm) and a traditional metal-polyethylene bearing surface. The impact of larger femoral heads and alternative (hard-on-hard) bearings to patients receiving multiple joint replacements may also significantly impact the trends noted in this study.