INTRODUCTION:
Ion levels can be indicative of in vivo bearing performance of metal-on-metal hip replacements. The toxic effects of elevated ions are still not understood, but it is thought that they are associated with adverse reactions, such as pseudotumors. De Smet et al found strong correlations between cobalt and chromium serum levels with femoral wear measured with CMM, concluding that ions can serve as useful diagnostic for metal-on-metal bearing wear. The purpose of our study was to assess the effect of component orientation on ion levels in patients with MOM hip resurfacings.

METHODS:
Seventy-five patients with unilateral Conserve Plus metal-on-metal hip resurfacing arthroplasty and who were at least 2 years post-op were drawn for serum cobalt and chromium ions. For patients with multiple draws, the highest draw was used. This study cohort included all patients who came into our clinic to have ion studies done, including patients with pain, impingement, radiolucencies, and possible metal sensitivity. Approval from the Institutional Review Board and Informed Consent were obtained for this study. Serum cobalt and chromium ion levels were measured using ICP-MS. Component positioning was determined using EBRA (Einzel-Bild-Roentgen-Analyse, University of Innsbruck, Austria). The contact patch-to-rim (CPR) distance, which uses abduction and anteversion to estimate how close the highest-stress articular contact rim is to the acetabular cup edge, was calculated using a method previously published by Langton et al. The serum cobalt to serum chromium ratio (Co/Cr) was also calculated. Parameters were compared between patients with Co/Cr greater than or equal to 1 vs. patients with Co/Cr less than 1. There were 57 patients with Co/Cr<1, and 18 patients with Co/Cr>1. Parametric data was analyzed using the Student’s t-test and non-parametric data with Mann-Whitney-U test. Correlations were tested using the Pearson test. P-value of 0.05 was significant.

RESULTS SECTION:
CPR distance was inversely correlated to serum cobalt (r=-0.5292, p<0.0001) and serum chromium (r=-0.5865, p<0.0001). Cup abduction was positively correlated with serum cobalt (r=0.3867, p=0.0006) and serum chromium (r=0.4961, p<0.0001). Cup anteversion was also positively correlated with serum cobalt (r=0.5167, p<0.0001) and serum chromium (r=0.5069, p<0.0001). Head size did not correlate with neither serum cobalt (r=-0.0907, p=0.439) or serum chromium (r=0.0958, p=0.4136).

DISCUSSION:
We found strong correlations between component orientation and serum cobalt and chromium levels. This supports a study by Langton et al, which also found positive correlation between ion levels and cup abduction and anteversion. The study also found highly significant correlations between CPR distance and blood and serum cobalt and chromium levels in ASRs and BHRs; the authors concluded that CPR distance may be a reliable indicator of the vulnerability of the joint to edge-loading, which has been proposed as an important mechanism in increased wear in metal-on-metal components. Hart et al in a study of painful metal-on-metal hips found that serum cobalt levels were significantly different compared to well-functioning ASRs and BHRs; the authors concluded that CPR distance takes size, component design (coverage) and orientation into account, and this study shows that those factors are important in ion levels in patients with MOM hip resurfacings.

REFERENCES:

<table>
<thead>
<tr>
<th>variable</th>
<th>Co/Cr≤1</th>
<th>Co/Cr&gt;1</th>
<th>p value</th>
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</thead>
<tbody>
<tr>
<td>CPR (mm)</td>
<td>14.1(5.5-19.9)</td>
<td>16.5 (5.0-25.4)</td>
<td>0.0319</td>
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<tr>
<td>abduction</td>
<td>46.8 (34.7-68.2)</td>
<td>43.6 (25.5-65.7)</td>
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<td>anteversion</td>
<td>22.9(10.6-40.7)</td>
<td>17.3 (3.4-35.5)</td>
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<tr>
<td>head size</td>
<td>47.9 (42-54)</td>
<td>47.1 (40-56)</td>
<td>0.4782</td>
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<tr>
<td>serum Co (µg/L)</td>
<td>21.3(6-175.3)</td>
<td>2.9 (0.4-86.7)</td>
<td>0.0016</td>
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<tr>
<td>serum Cr (µg/L)</td>
<td>13.1 (0.5-88.7)</td>
<td>4.4(0.51-91.5)</td>
<td>0.2125</td>
</tr>
</tbody>
</table>

Figure 2: Co/Cr≤1 vs. Co/Cr>1

DISCUSSION:
We found strong correlations between component orientation and serum cobalt and chromium levels. This supports a study by Langton et al, which also found positive correlation between ion levels and cup abduction and anteversion. The study also found highly significant correlations between CPR distance and blood and serum cobalt and chromium levels in ASRs and BHRs; the authors concluded that CPR distance may be a reliable indicator of the vulnerability of the joint to edge-loading, which has been proposed as an important mechanism in increased wear in metal-on-metal components. Hart et al in a study of painful metal-on-metal hips found that serum cobalt levels were significantly different compared to well-functioning ASRs and BHRs; the authors concluded that CPR distance takes size, component design (coverage) and orientation into account, and this study shows that those factors are important in ion levels in patients with MOM hip resurfacings.

REFERENCES:

Figure 1: CPR vs. Serum Ions

CPR distance was significantly smaller in patients with Co/Cr ≥1 (p=0.0319). Anteversion (p=0.0169) and serum cobalt (p=0.0016) was significantly higher in patients with Co/Cr ≥1. Head size (p=0.4782), abduction (p=0.2241) and serum chromium (p=0.2125) were not significantly different between the two groups.