Metal ion trends following revision of MoM resurfacing to a conventional bearing replacement.

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INTRODUCTION:
Wear and corrosion of metal-on-metal (MM) bearings releases (a) soluble metal ions which collect locally and pass into the systemic circulation and (b) insoluble particles which undergo local deposition and lymphoreticular dissemination. Corrosion of released particles also releases metal ions.

Some authors have suggested that in patients with well-functioning MM bearings metal wear occurs only during the run-in phase. Subsequent metal ion elevation in patients is maintained solely by continued corrosion of these run-in phase particles.

If continued bearing wear occurs throughout the life of the bearing then wear resistance of the bearing is of vital importance. Conversely if MM bearing wear occurs only during the run-in phase, wear resistance is of not much consequence. Attention to optimal macro and micro-geometry of the bearing, irrespective of bearing wear resistance, should determine run-in phase wear and therefore govern metal ion elevation throughout bearing life.

The purpose of the present study is to determine (a) whether corrosion of disseminated particles releases significant amounts of metal ions and (b) whether this release is sustained indefinitely in the absence of continued fresh release of ions and particles from the bearing. If it does continue unabated after removal of the bearing it can be concluded that corrosion of metal wear particles sustains metal ion release throughout the life of the bearing and that bearing wear does not continue throughout bearing life.

METHODS:
Blood levels and daily output of ions are being studied prospectively over two years in 10 patients whose MM resurfacings were revised to non-MM THRs. There were 4 men and 6 women. Mean age of the patients at the time of the primary procedure was 54 years and mean duration to failure was 9.6 years. Reason for revision was osteolysis or aseptic loosening in 6, metal allergy in 3 and femoral head collapse in 1.

24-hour urine and whole blood specimens were collected starting the day of revision arthroplasty and periodically after the revision at 2, 4 and 6 days, 1 month, 2, 6, 12 and 24 months after operation. None of the patients had other MM devices or compromised renal function.

RESULTS:
Pre-revision median levels in urine were cobalt 39µg/day and chromium 17µg/day and blood levels were 8.9 and 5.4 µg/l for cobalt and chromium respectively. As anticipated these were higher than the expected levels in patients with well-functioning metal-on-metal bearings.

Over the first week there is a rapid decline of urine cobalt to 9µg/day and chromium to 7.7 µg/day followed by a period of slow decrease over the next 12 months to 0.6µg/day urine-cobalt (figure 1 and 2) and 1µg/day urine-chromium. At the 1 year stage the levels approach the background levels seen in patients with no MM bearing.

DISCUSSION:
The rate of metal ion reduction following MM bearing revision offers insights into the relative contribution of bearing wear and particulate corrosion towards metal ion release during the life of the bearing. For purposes of determining in vivo metal ion release either from wear or corrosion, daily output of cobalt is the best surrogate measure.

The early steep reduction during the first week following revision supports the short half-life of cobalt. It has been reported1 that 85% of cobalt ions are recoverable in urine in 24 hours and 95% in 3 days. Hence the metal ions that had been released from the bearing before revision are excreted within a few days of revision. At revision the cobalt particles within the joint fluid and capsular tissues also are largely removed.

The protracted above-background metal ion release during the first year can only be explained through corrosion from disseminated particles. However this trend is also not sustained indefinitely and tends to approach control levels at the 1- year stage suggesting that metal ion release from particulate debris also has nearly ceased by this stage.

In conclusion it can be stated that particulate corrosion does contribute to overall metal ion release during bearing life. However particulate corrosion decreases with time and corrosion of run-in phase particles alone is insufficient to explain persistent metal ion elevation in later years in patients with MM bearing devices. Bearing wear continues throughout the life of the bearing. Wear-resistance does have potential consequences to metal ion release.