Retrieval Analysis Of A 38 Mm Metal-On-Metal Hip Replacement From Multple Dislocator

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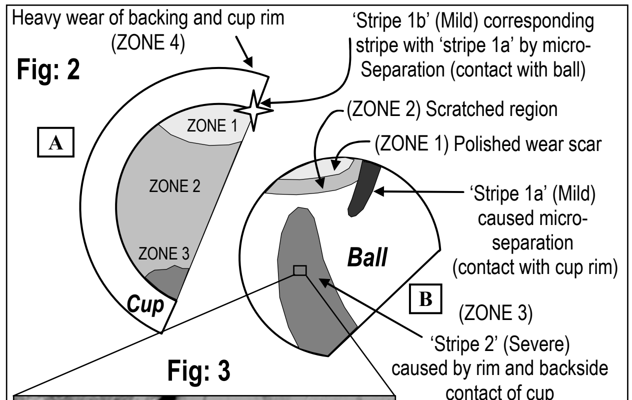
Statement of Purpose: Dislocation remains a common complication in total hip replacements. In 2002, the FDA gave the US approval for large diameter metal-on-metal (MOM) bearings, ranging from 32 to 60 mm and offering improved stability. However, dislocations may occur as a result of sub-optimal surgical technique. The extent of damage to large diameter MOM bearings following dislocation is not well understood, and rarely reported. One concern is backside wear [1]. Most cups are porous coated for bony integration. This coating may become a source of third-body wear. Therefore, the purpose of this retrieval study was to determine the extent backside-to-articular transfer in a modern large diameter MOM bearing that had experienced dislocation.

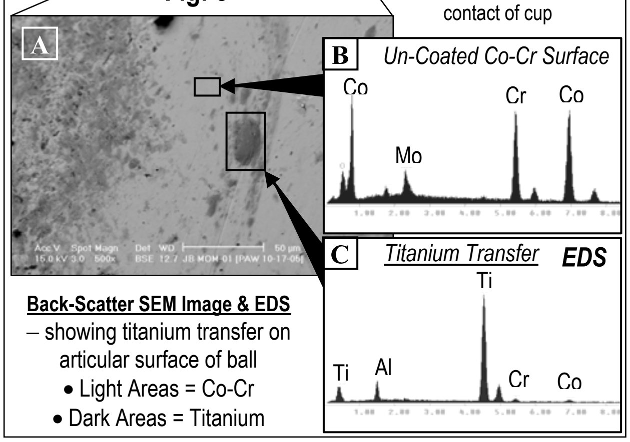
Methods: We analysed a 38mm Co-Cr MOM hip retrieval in our database (M^2A, Biomet, Inc, Warsaw, IN) which showed extensive damage due to dislocation. The CoCr cup was Ti alloy plasma sprayed. The patient was a 51 Y/O male. In the first 3 weeks he had dislocated, and had done so 7 more times, 4 of which were in the last month (N=8). Each time having a reduction. The implant was finally revised at 27 months. The cup was noted to be retroverted 10° with a lateral opening of 60° (Fig 1). The components were marked during revision for orientation with respect to the pelvis. Both cup and ball were examined using reflected light microscopy, SEM (Hitachi), EDS and surface roughness (New View 5000, Zygo). A total of 24 surface scans were performed. Modes of wear were evaluated [1].


Fig. 1

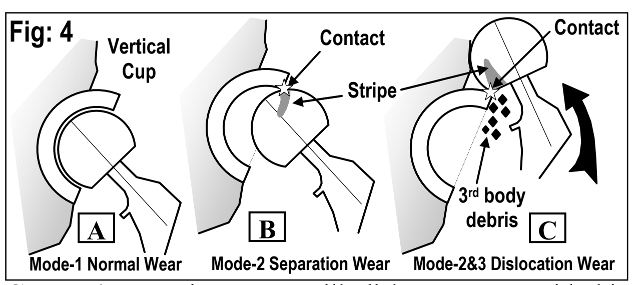
Results: At revision, the surrounding tissue was noted to be grey in coloration. The articular surfaces of both ball and cup were characterized by having: a polished wear scar (Zone 1), multi-directional scratching and discoloration (Zone 2), and wear stripes (Zone 3: Fig 2). Two types of wear 'stripes' were observed on the articular surface of both ball and cup, 'stripe 1(a-b)' caused under micro-separation (Mode-2 wear: Fig 3a), and 'stripe 2' caused by dislocation (Mode-4 Wear: Fig 3b), i.e. ball contact on the backside of cup. The location and confirmation of surface contamination by Ti-debris in zones 2 and 3 was confirmed by BSE and EDS (Fig. 2c) and was most severe with up to 1µm thickness in zone 3. (dark areas: Fig 2a-c), which represented a 65-fold increase compared to a polished region (Zone 1). Within Zones 1 and 2 the surface roughness typically increased 2–30 times from its virgin condition (~8 nm).

Discussion: In this case, dislocation resulted in backside cup wear, releasing and transferring Ti-alloy onto the ball and bearing interface (3rd-body wear debris). Due to the inclination of the cup, micro-separation stripes were evident on the ball and rim of cup superiorly. This stripe phenomena is similar to that reported by [2] for ceramic THRs. The maximum articular Ra was similar to that previously reported [3]. Whether the Ti transfer on the articular surfaces caused higher bearing wear in our case is undetermined. Nonetheless in laboratory studies, additions of Ti particles caused elevated MOM wear [4]. Therefore, large amounts of titanium particles found on the articular surfaces, combined with darkening of surrounding joint tissue within 2 years of implantation, suggests elevated rates of ALL 3-modes of wear [1].





Back-Scatter SEM Image & EDS – showing titanium transfer on articular surface of ball
- Light Areas = Co-Cr
- Dark Areas = Titanium



Conclusion: patients can still dislocate even with big balls. Sources of wear debris are only Modes 1, 2 & 3. MOM bearings aren't as forgiving as M-on-Polyethylene (Mode 3).

References: [1] McKellop *et al*, Clin Orthop, 311, 1995. [2] Walter *et al*, J. Arthroplasty, 19(4), 2004. [3] Scott *et al*, J. Arthroplasty, 15(1), 2000. [4] Lu *et al*, Biomaterials Congress, 183, 2000.

Acknowledgements: The authors thank Hitachi for SEM support.