Surveillance of Dual-Mobility Hip Systems: Damage Mode and Clinical Data Analysis

Conner D. Ahlgren, Camilla Cascardo, Michael Maxwell, Mark S Karadsheh[1], Drew Douglas Moore[2]
[1]Michigan Orthopaedic Surgeons, [2]Beaumont Health, Royal Oak

INTRODUCTION: Hip instability following total hip arthroplasty (THA) is often cited among the most common indications for revision surgery. Dual mobility (DM) implants are designed to increase stability with a larger jump distance and greater impingement-free range of motion. Thus, DM THA use continues to increase for both primary and revision THA, currently comprising up to a third of all revision cases. Given the widespread use of these implants, characterizing in vivo damage and clinical failure modes provides an important insight into the durability of these relatively new components. The purpose of this study is to investigate the micro- and macroscopic damage modes that may potentially contribute to clinically significant component failure, including the novel damage mode of screw ring damage in DM THA components using an updated retrieval registry.

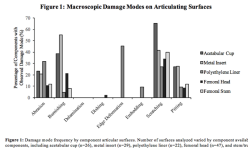
METHODS:

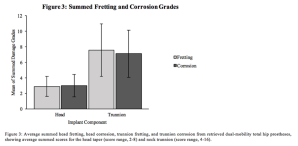
Under an institutional review board approved implant retrieval protocol, 51 DM THA systems were analyzed. Each component was examined for standard damage modes and graded for fretting and corrosion following the Goldberg et al. classification system. Clinically-relevant data were collected from medical records. Analysis was completed using Spearman rank order correlation and Mann-Whitney U-tests, with $p < 0.05$.

RESULTS:

The average duration of implantation among this patient population was 12 months. Top reasons for revision included mechanical complications (n=15, 27%), infection (n=12, 22%), and dislocation (n=9, 16%). Scratching (n=26, 65.4%) was the most common standard damage mode on articular surfaces of acetabular cups, burnishing (n=29, 55.2%) on metal inserts, and edge deformation (n=22, 45.5%) on polyethylene liners. Screw ring damage was noted on 10.34% (n=3) of available acetabular liners, significantly increased incidence of acetabular and femoral osteolysis were noted when this damage mode was present (P=0.019 and P=0.022, respectively). Average summed fretting and corrosion scores were 2.9 and 3.0 for heads (two regions, 2-8 summed scores possible), and 7.6 and 7.1 for stems (four quadrants, 4-16 summed scores possible), respectively. Summed fretting and corrosion grades were strongly, positively correlated for both the heads ($P < 0.001$) and the trunnions ($P < 0.001$). Femoral head fretting and corrosion scores were consistent in proximal and distal regions of the head taper and strong positive correlations were observed between fretting and corrosion grades (P= 0.002 and P<0.001, respectively). Duration of implantation significantly correlated with summed femoral head corrosion (p=0.044), no such correlation was observed in femoral stem fretting or corrosion scores. Presence of infection was strongly positively correlated with femoral stem summed fretting and corrosion scores (P=0.0015; P=0.0023, respectively). Stem alignment showed no significant differences in fretting and corrosion summed scores.

DISCUSSION AND CONCLUSION: This series demonstrated damage following short-to-midterm implantation in DM THA. Fretting and corrosion summed scores were mild-to-moderate with a significant increase in corrosion seen on femoral heads with longer implantation and a significant increase in trunnion fretting and corrosion in the setting of infection. Screw ring damage had an incidence of 10.34% and may be related to acetabular and femoral osteolysis. Though limited by sample size, this study indicates trends that merit further evaluation with regard to DM THA component wear.





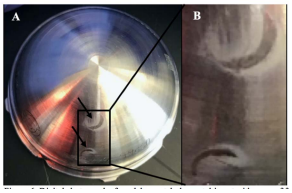


Table 1: Reasons for Implant Revision

Reason for Revision	No. of Patients*	Percentage of Patients
Mechanical complication	15	27%
Infection	12	22%
Dislocation	9	16%
Periprosthetic fracture	6	11%
Pain	5	9%
Acetabular-associated loosening	2	4%
Hematoma	2	4%
Seroma	1	2%
Inflammatory reaction	1	2%
Limb length discrepancy	1	2%
Unknown	1	2%

Table 1: The reasons for implant revision documented in patient medical charts are listed in descending order of frequency. *Four patients had two reasons documented in their medical chart.