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A Plausible Explanation for Recently Observed High Prevalence of Symptomatic MACC

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I read with interest this article by Bergmann et al. I commend the authors for publishing an in-vivo study of total hip arthroplasty forces that most certainly have direct influence on acetabular component implant stability and ingrowth. Several years ago, I published a clinical study examining the lack of acetabular component ingrowth and failure in the more demanding revision setting (1), and I hypothesized that a critical moment was achieved more easily with a high-offset polyethylene component.

My current comment, however, is that the model and measurements in this study may also be germane in understanding why symptomatic mechanically assisted crevice corrosion (MACC) appears to be more commonly observed and reported in recent years (2-5). The torsional moment acting about the trunnion axis (M tors in Figure 1 of the Bergmann et al. paper) has a corresponding torsional force that is one of the components of the resultant contact force (F res). Jauch and colleagues have demonstrated that there is a specific force acting on the head-neck junction beyond which the passivation layer of the junctional metal is broken down, and this force represents the initiation of the MACC process (6). It would be very helpful if Bergmann et al. could publish data specifically for M tors and F res, here or in a separate publication, to determine which of the activities examined exceed the force that can initiate this failure mode.

In our clinical observations we have reported a symptomatic MACC of 3.2% (2). In most cases of MACC that came to revision in that study, not only was visible corrosion present, but also the polyethylene locking ring did not move freely. (This was different than other revisions with this style of acetabular component.) One theory based on this observation is that cross-linked polyethylene may deform slightly or the surface may have cumulative damage over time. As adhesive wear is so minimal with contemporary cross-linked polyethylene, the surface does not “self-burnish,” and this may increase the coefficient of friction at the head/polyethylene surface, and therefore trunnion/bore junctional torque.

MACC is multifactorial, but it depends on initiation of motion at the trunnion junction. By focusing the findings from Bergmann et al. not only on the cup, but also on the forces of the stem trunnion/head bore junction, insight could be gained on why the MACC failure mode seems to be more common today. We

could also use this information to caution our patients as to what activities may be riskier and to improve implant material, design, and surgical technique to improve durability of hip replacements over time.

References

1. McGrory BJ. Acetabular revision with a 7mm Lateral Offset Component Inserted without Cement in Patients Who Have Acetabular Deficiency. J Arthroplasty 20(4) 443-453: 2005.

2. Hussey D, McGrory BJ. Ten-year cross-sectional study of mechanically assisted crevice corrosion in 1352 consecutive patients with metal-on-polyethylene total hip arthroplasty. J Arthroplasty 32(17) 2546-2551: 2017.

3. Levine BR, Hsu AR, Skipor AK, et al. Ten-year outcome of serum metal ion levels after primary total hip arthroplasty. J Bone Joint Surg. 95(6):512-18: 2013.

4. Kwon YM, Rossi D, MacAuliffe J, Peng Y, Arauz P. Risk factors associated with early complications of revision surgery from head-neck taper corrosion in metal-on-polyethylene total hip arthroplasty. J Arthroplasty. 2018; Epub ahead of print.

5. Waterson HB, Whitehouse MR, Greidanus NV, Garbuz DS, Masri BA, Duncan CP. Revision for adverse local tissue reaction following metal-on-polyethylene total hip arthroplasty is associated with a high risk of early major complications. Bone Joint J. 100-B 720-4: 2018

6. Jauch SY, Coles LG, Ng LV, Miles Aw, Gill HS. Low torque levels can initiate a removal of the passivation layer and cause fretting in modular hip stems. Med Eng Phys. 36(9) 1140-6: 2014.

Conflict of Interest: None Declared