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CORR Insights

CORR Insights®: Otto Aufranc Award: Large Heads Do Not Increase Damage at the Head-neck Taper of Metal-on-polyethylene Total Hip Arthroplasties

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Where Are We Now?

Large femoral heads offer proven benefits in reducing the risk of dislocation. However, the failure rate of metal-on-metal (MoM) THA increases with head size, and is even larger than hip resurfacing cases using the same design of articulation [1, 3]. This appears to be due to an increased generation of corrosion products at the modular head-neck junction [6].

The question is whether the risk of inflammatory reactions secondary to trunnion wear and corrosion will also increase when larger heads (> 32 mm) are implanted with metal-on-polyethylene (MoP) articulations. Previous studies on this topic have examined relatively small numbers of implants (50 to 80), with conflicting conclusions both in favor [4, 7] and against [5] an association between larger heads and increased fretting and/or corrosion of modular head-neck junctions.

The current study by Triantafyllopoulos and colleagues is part of an ongoing investigation on total joint arthroplasty that addresses one fundamental question: What combination of implant materials, design features, and surgical practices is required to eliminate tissue reactions at modular junctions, preferably with minimal disruption of current procedures? This study has presented interesting data derived from a long-term retrieval collection, which illuminates some of the contemporary controversies in implant performance and its mechanisms of failure.

One of the strengths of the study was that the authors examined a broad assortment of MoP components (n = 154) with six different taper designs and a wide assortment of head sizes, ranging from 22 mm to 44 mm, with 80% ≤ 32 mm. The duration of implantation was also considerable, ranging from a few months to more than 20 years in vivo. They concluded that although fretting or corrosion of the head and the trunnion were common, they were not associated with differences in head size.

This CORR Insights® *is a commentary on the article* "CORR Insights®: Otto Aufranc Award: Large Heads Do Not Increase Damage at the Head-neck Taper of Metal-on-polyethylene Total Hip Arthroplasties *by Triantafyllopoulos and colleagues available at:* DOI: 10.1007/s11999-015-4468-6.

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Where Do We Need To Go?

This conclusion is useful in that the wide span of components and conditions included in the analysis are likely to include cases and conditions reflective of many THA procedures performed today. However, it also means that it is not possible to have large numbers of components of a single alloy composition and a single design of modular connection with a reasonable duration of followup (5–10 years). Moreover, as most surgeons are seeking information concerning their contemporary practices and implant selections, conclusions based on components from previous decades may not be useful in informing the most common practices in THA today (eg, Ti alloy stem, cementless fixation, and current taper designs with minimal offset of the modular head [8]). It also assumes that there are no clustering effects due to the occurrence of specific implant designs and head sizes with specific modes of fixation and types of patients (eg, heavy young males with large femoral heads and mixed alloy modular components). Future studies should specifically evaluate these issues in order to see whether the conclusions here can be generalized, and to what degree confounding variables might have influenced the findings.

Other key controversies, which future investigations might consider, include: (1) Can head diameters approximating the original native femoral head be used in MoP joints without jeopardizing the modular junction? Conversely, are there clinically important differences between outcomes achieved with 28 mm, 32 mm, and 36 mm heads in MoP THA? (2) Do large heads increase the incidence of outliers (ie, patients with severe taper damage) after MoP THA ? (3) Will use of highly wear-resistant polyethylenes (Vitamin-E stabilized formulations) change the effect of head size due to increased bearing friction? (4) What is the effect of factors affecting the frictional forces between the femoral head and the acetabular liner, including surface roughness (third-body damage), clearance of the articulation, and the viscosity of the joint fluid [2]? (5) As most of the material loss in modular joints come from tribo-corrosion of the CoCr head, should metal heads be replaced by ceramic or "ceramicized" heads to minimize the problem [7]? Or perhaps surface treatments (ion implantation, nitride, or diamond-like coatings) are a solution. (6) Finally, does head size affect the ease of correct assembly of the modular junction within the body, especially through smaller incisions leading to inadequate seating and a greater risk of interface contamination?

How Do We Get There?

We should keep some considerations in mind if we are to make meaningful headway in the investigation of trunnionosis and the effect of head size in the future. First, all retrieval analyses and registry studies are of limited value, even for formulation of hypotheses, if they fail to include all variables previously identified as affecting fretting and corrosion of modular components. If future studies fail to include these variables, there is a real risk that "head diameter" will act as a surrogate for other variables not considered in the analysis (eg, BMI, height, bearing clearance), which will not only remain unidentified, but will be misidentified as "head diameter."

Second, conditions present at the joint above the modular junction (at the hip articulation) affect the loads and torques imposed on the trunnion-head interface, and so must be included as part of any analysis, be it clinical or computational.

Finally, once all variables have been quantified (or held constant), sufficient numbers of cases representative of current practice must be included if conclusions reached are to be both valid and relevant to future patients who undergo THA.

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