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Head-stem trunnion dissociation due to corrosion in total hip arthroplasty

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Comment on: Matsen Ko L, Chen AF, Deirmengian GK, *et al.* Catastrophic Femoral Head-Stem Trunnion Dissociation Secondary to Corrosion. *J Bone Joint Surg Am* 2016;98:1400-4.

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The use of modularity in implant design in orthopaedics is extremely common, particularly in areas such as total hip arthroplasty (1). It has the advantages of allowing the surgeon to carefully select the perceived correct combination of implants in order to restore the biomechanics of the hip joint, principally leg length and offset. The use of modularity allows a much-reduced inventory of implants in comparison to having all combinations available as monoblock implants. Modularity also provides advantages in the revision situation, such as the ability to perform a debridement with implant retention and modular exchange for infection, ease of access to the acetabular component to facilitate revision and the ability to retain a well-fixed stem in other indications for revision.

Modularity does however have disadvantages, it is another interface at which wear and failure can occur (2) and its successful use is dependent on accurate and correct assembly by the surgeon (3). There are also variations according to implant selection made by surgeons with larger heads requiring greater assembly forces (4). An example of the problems of modularity is demonstrated by modular neck-stem designs in total hip arthroplasty, with high failure rates being demonstrated by the Australian Registry and National Joint Registry leading to the withdrawal of some implants such as the ABGII and Rejuvenate (Stryker, Kalamazoo, Michigan, USA) (5) and exceedingly high early

failure rates observed in some designs (6).

Trunnion wear and corrosion are attracting increasing attention (7) although suggestions that we are facing an epidemic are not justified (8). When the indication for revision surgery is considered, they remain relatively rare reasons for revision in contemporary registries (9) although they are not limited to particular types of construct or materials and may even occur in the absence of a prosthetic bearing surface (10).

Ko *et al.* present a series of catastrophic failures of modular head-stem junctions with dissociation occurring secondary to trunnion corrosion (11). The series includes five case of revision performed in their institution due to this pathology. Head-stem dissociation secondary to wear or corrosion remains a very rare mechanism of failure with only case reports and similar sized small series being reported previously (12-15). In contrast to the series of five cases presented by Banerjee *et al.*, a common stem was present in each of the five cases in Ko *et al.*'s series although given that was the most common stem implanted in that institution, this may be artefactual. Ko *et al.* described a common appearance amongst their five reported cases with gross deformation and beaking of the trunnion leading to loss of support of the femoral head and hence dissociation. Variable amounts of metallosis are described between the cases but given the appearances, it is difficult to say with

any certainty whether these changes led to the failures observed or occurred after the failures occurred. A precise description of the heads used in the series is not provided but it may be worthy of note that Stryker issued a voluntary medical device product field action notice in October 2016 (RA2016-028) for LFIT Anatomic CoCr V40 femoral heads of sizes 36+5 mm, 40+4, +8 and +12 mm, 44+4, +8 and +12 mm. Although this covers the majority of the heads in the series, the authors report the failure of one 40+0 mm head that was not covered by the recall.

As the authors correctly point out, the denominator for the series is unknown, indeed, one of the revised cases was performed at another institution and one of the revisions described performed in another institution. The suggestion that a percentage failure rate due this mechanism is known is therefore at best a guess and should be interpreted with extreme caution. The authors state that the dissociation is likely related to multiple factors including a BMI of $>30 \text{ kg/m}^2$, male gender and the use of large metal heads with increased lengths and high offset stems. Given the small size of the series, the lack of any comparator group and the unknown denominator, such assumptions should be viewed as speculative. As the authors correctly point out, the study lacked any implant analysis, study of metal-ion levels or cross-sectional imaging.

Given the variable onset of symptoms described in the series, it is again difficult to know how many cases there may be that are subclinical or have not yet presented. The authors suggest that early trunnion wear may be detected on periodic radiographic follow up but none of the cases in the series were detected in this manner and it is not known if radiographs would be sensitive enough to detect this. The suggestion that cases with radiologically detectable trunnion narrowing may benefit from augmentation of the femoral trunnion or placement of a sleeve on it, or replacing the femoral head with one of smaller size is not supported by any published evidence and in the presence of macroscopic trunnion damage should be approached with great caution. In the setting of trunnion corrosion, most authors suggest that macroscopic trunnion damage necessitates stem revision (16,17).

Trunnion corrosion, although not likely to achieve epidemic proportions, is a real phenomenon and was first described nearly three decades ago (18,19). Revision for trunnion corrosion accounts for approximately 2% of the revision burden in some large centers (16,17), this apparent rise may be due to increased clinical suspicion and therefore detection bias. Mixed metal couples are at higher risk of

developing corrosion than similar metal couples due to the presence of galvanic corrosion (2). Mechanical load potentiates the initiation of such processes and increased head size (9) and offset (20) exacerbate this. The move towards shorter, thinner trunnions that has occurred over time (8) in order to increase impingement free range of motion and accommodate ceramic heads has further increased the conditions under which trunnion corrosion may occur.

An awareness of the potential for trunnion corrosion and the risk factors for it is important for the contemporary arthroplasty surgeon. Catastrophic dissociation will hopefully remain rare as a failure mechanism and reason for revision. There are a number of steps the surgeon can take to reduce the risk of clinically significant trunnion corrosion occurring, these include careful cleaning of the trunnion prior to impaction, impaction with a single blow at adequate force for the selected components, careful implant selection including consideration of the use of similar metal couples or ceramic heads and avoiding large head sizes and offsets where these are not required.

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Footnote

Conflicts of Interest: The author has no conflicts of interest to declare.

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