The Journal of Arthroplasty 31 (2016) 1390–1394

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

AAHKS Symposium: Corrosion at the Head-Neck Junction: Why is this Happening Now?

Treatment of the Failed Modular Neck Stems: Tips and Tricks

Sean A. Sutphen, DO [a], Joanne B. Adams, BFA, CMI [b], Adolph V. Lombardi Jr, MD, FACS [b, c, d, *]

[a] OhioHealth Doctors Hospital, Columbus, Ohio
[b] Joint Implant Surgeons, Inc, New Albany, Ohio
[c] Department of Orthopaedics, The Ohio State University Wexner Medical Center, Columbus, Ohio
[d] Mount Carmel Health System, New Albany, Ohio

ARTICLE INFO

Article history:
Received 19 January 2016
Accepted 26 January 2016
Available online 22 March 2016

Keywords:
head-neck modularity
corrosion
revision total hip arthroplasty
extraction techniques
stability

ABSTRACT

Background: Modular femoral components emerged because of the advantages of recreating limb length, offset, and native femoral version in total hip arthroplasty. Despite its potential benefits, the increase in modularity at the head-neck junction can lead to corrosion and subsequently failure of the implant.
Methods: We present 3 case examples of patients who underwent revision surgery secondary to corrosion of their modular femoral components.
Results: Issues addressed include understanding corrosion at the head-neck junction, presentations of adverse local tissue reactions, efficacy of metal ion testing and metal artifact reduction sequence magnetic resonance imaging, and approaches to revision surgery for failed modular neck stems.
Conclusions: When revision surgery is indicated for failed modular neck stems, we recommend a thoughtful approach with contemporary extraction techniques and options to enhance stability. Furthermore, long-term follow-up is needed to define the growing effect of modularity in total hip arthroplasty.

Total hip arthroplasty (THA) is one of the most successful surgical procedures, offering substantial improvement in a patient's quality of life as well as function [1]. Implant modularity of the THA femoral component became widespread in the late 1980s with modular heads and sleeves, and more recently options for modularity of the neck to the stem body were introduced [2,3]. Benefits of modularity include reduced implant inventory, the capability of retaining the stem and performing a head exchange, and significant intraoperative flexibility to optimize stability, leg length, offset, and neck anteversion [2-4]. However, as of late, there have been concerns over fretting and crevice corrosion at the taper junction [5-7]. Fretting occurs when there is micromotion at the taper junction that causes injury to the passivation layer and metal grains nearest to the implant surface. Microscopic cracks create an aqueous microenvironment that disrupts the passivation layer, outlining the principles of crevice corrosion.

Corrosion at both the head-neck and neck-stem interfaces of modular femoral components have been identified as potential sources of adverse local tissue reactions along with elevated metal ion levels and clinical symptoms [2,3]. Adverse local tissue reactions (ALTRs) can occur secondary to corrosion at the modular femoral head-neck junction regardless of the bearing, and their presentation is comparable to the ALTRs seen in patients with large-diameter metal-on-metal (MoM) bearings. In addition to corrosion, modular femoral components are associated with numerous disadvantages. Fracture of the component at the stem-neck adapter interface has been reported with risk factors including male gender, weight >100 kg, and retroverted titanium necks [8,9]. Sporer et al [10] reported on neck disassociation, but this appears to be a rare occurrence.

Traditionally, the findings of corrosion at the femoral head-neck junction have been made during revision cases with very few cases of catastrophic failure [11,12]. We present 3 cases of patients who underwent revision THA at our institution and had corrosion at

This work was performed at Joint Implant Surgeons, Inc, New Albany, Ohio.

No funding was received in support of this study.

One or more of the authors of this paper have disclosed potential or pertinent conflicts of interest, which may include receipt of payment, either direct or indirect, institutional support, or association with an entity in the biomedical field which may be perceived to have potential conflict of interest with this work. For full disclosure statements refer to http://dx.doi.org/10.1016/j.arth.2016.01.072.

Each author certifies that his or her institution approved or waived approval for the use of human subjects for this investigation and that all investigations were conducted in conformity with ethical principles of research.

* Reprint requests: Adolph V. Lombardi Jr, MD, FACS, Joint Implant Surgeons, Inc, 7277 Smith's Mill Road, Suite 200, New Albany, OH 43054.

http://dx.doi.org/10.1016/j.arth.2016.01.072
0883-5403/

the modular femoral stem-neck adapter junction. The purpose of the present report is to describe tips and tricks in the operative treatment of patients with failed modular neck stems.

Case Example 1

A 56-year-old male patient presented to our facility 2.5 years after undergoing a primary, cementless left metal-on-polyethylene (MoP) THA elsewhere. Implants included a recalled modular neck femoral component. The patient required an iliotibial band tenotomy and gluteus medius repair secondary to chronic trochanteric bursitis 18 months after his primary THA. Patient presented to our center with complaints of significant pain located about the groin that occurred with sitting and ambulating long distances. Conservative treatment in the form of strengthening exercises failed to improve his condition. Patient walked with a limp, but did not require any support for ambulation. Exam revealed his hip flexion was 90° with very limited abduction, adduction, internal rotation, and external rotation. Radiographs demonstrated THA components in satisfactory position and alignment with no significant osteolysis (Fig. 1). Laboratory values were within normal limits, with white blood cell count (WBC) $7.5 \times 10^3/\mu$ (normal 4.0-10.5), erythrocyte sedimentation rate (ESR) 1 mm/h (normal 0-20), and C-reactive protein (CRP) 2.0 mg/L (normal 0-9.9). Aspiration revealed serosanguineous fluid with WBC of 2300/mm^3 and 48% of polymorphonuclear cells with all cultures being negative. Metal ion levels were obtained from the serum and revealed chromium (Cr) 2.2 μg/L (reference interval 0.1-2.1), and cobalt (Co) 3.6 μg/L (reference interval 0.0-0.9). Metal artifact reduction sequence magnetic resonance imaging demonstrated periarticular fluid distending the left iliopsoas tendon sheath with a loculated fluid collection abutting the posterior cortex of the greater trochanter representing a possible seroma. Using the risk stratification algorithm developed by Kwon et al [13], the patient's risk was high, and revision surgery was recommended. On revision surgery, there was significant corrosion observed at the tapered junction of the modular femoral neck and stem (Fig. 2). Revision surgery included revision of the liner, head, and femoral stem using a highly cross-linked polyethylene liner, 36-mm Biolox delta ceramic head (CeramTec GmbH, Plochingen, Germany) with a −3 mm titanium option taper adapter, and a cementless modular, tapered revision stem augmented with cerclage cables. Take home points from this case include the following:

- ALTRs can arise secondary to corrosion at the modular junctions regardless of the bearing surface [3,14].
- When evaluating metal ion levels in the face of corrosion of modular junctions, cobalt ion levels tend to be higher than chromium [3,14,15].
- Metal ion levels may be elevated with in the presence of bearing combinations other than MoM [15,16].

Fig. 1. Anteroposterior radiograph of a 56-year-old male patient who presented 2.5 years after undergoing left primary THA with a recalled modular femoral component demonstrates satisfactory position and alignment. THA, total hip arthroplasty.

Case Example 2

A 49-year-old male presented 4 years after undergoing left primary, cementless THA performed elsewhere with a 58-mm MoP

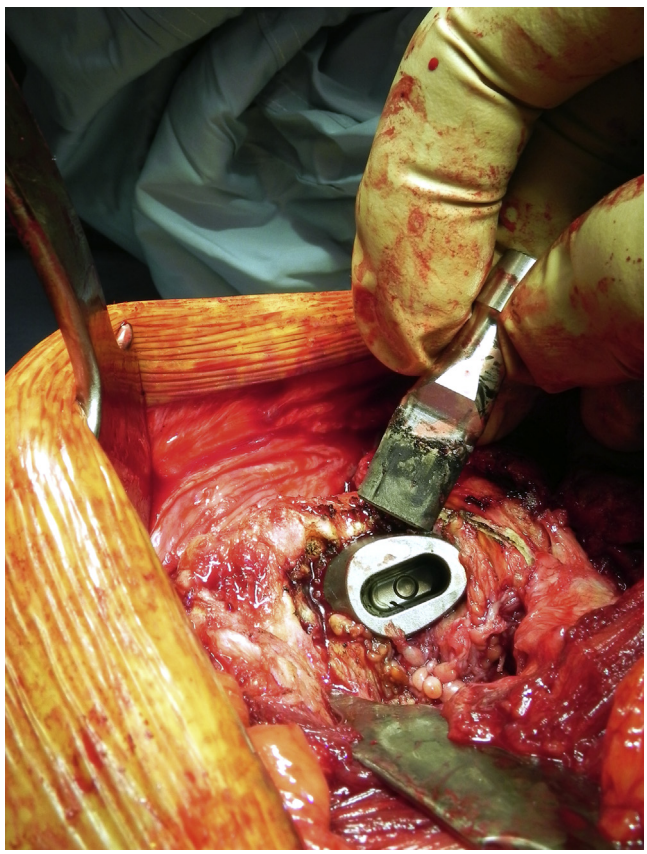

Fig. 2. Intraoperative photograph at the time of revision surgery demonstrates extensive corrosion at the stem body-modular neck tapered junction.