Case Report

Adverse Local Tissue Response Lesion of the Knee Associated With Morse Taper Corrosion

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Abstract: Modularity in arthroplasty components has increased options for solving complex issues in primary and revision procedures. However, this technology introduces the risk of accelerated metal ion release as a result of fretting or passive crevice corrosion within the Morse taper junction. Cobalt toxicity locally and systemically has been described with hip metal bearing surfaces and may be accentuated with ion release from Morse tapers. This is a case report of a knee adverse local tissue response lesion associated with corrosion within the Morse taper of a revision knee arthroplasty in the absence of systemic metal allergy. **Keywords:** ALTR, knee, corrosion, Morse taper.
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Modularity in joint arthroplasty components has increased options for solving complex issues in primary and revision procedures. However, this technology introduces the risk of accelerated metal ion release as a result of fretting or passive crevice corrosion within the Morse taper junction [1]. Usually associated with electrolytic effects when dissimilar metals are present in a saline medium, even differential oxygen gradients within fluid in the taper junction may result in corrosion of the surfaces. Although ionic cobalt (Co) and chromium (Cr) can result in tissue reactivity for those with metal allergy, local high ion concentrations in tissues may result in cell death and tissue necrosis in the absence of true allergy. Cobalt toxicity, local and systemic, has been described with metal-on-metal (MOM) bearing surfaces and may be accentuated with ion release from Morse tapers [2]. This is a case report of knee adverse local tissue response (ALTR) associated with corrosion within the Morse taper of a revision knee arthroplasty in the absence of systemic metal allergy.

Case Report

A 65-year-old man had a left primary posterior stabilized total knee arthroplasty performed elsewhere in 1999 for osteoarthritis, which was complicated by a medial femoral condyle fracture. There was a history of an old football injury to the knee. The primary arthroplasty eventually failed from lateral joint laxity likely secondary to unrecognized posterior lateral corner instability. He then had 2 procedures to reestablish posterior lateral corner stability to the knee including an Achilles tendon allograft in 2002. These eventually failed because of a combination of varus collapse of the previously fractured medial femoral condyle and stretching out of the posterior lateral corner reconstruction. No evidence of concomitant infection was present. The knee became globally unstable with loss of supporting femoral metaphyseal bone, ligaments, and femoral condyles due to extensive osteolysis. The patient's sole medical comorbidity was controlled hypertension; his body mass index was 26. Ambulation was significantly impaired requiring a motorized chair. A revision was performed in 2009 with a Limb Preservation System device (DePuy Orthopaedics, Warsaw, Ind). This is a rotating platform hinged prosthesis of CoCrMo alloy, a Food and Drug Administration–approved device for salvage of massive bone loss situations or tumor resection. Recovery from the procedure was without issue, and he returned to full employment. Fourteen months later, he required a primary right cruciate-retaining total knee arthroplasty because of progressive osteoarthritis, which was uncomplicated. Approximately 20 months from the Limb Preservation System left knee arthroplasty, the patient began to experience knee swelling, loss of motion, and exquisite pain with no systemic signs. He also developed a knee area skin

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rash with redness and hypersensitivity to touch but not involving the wound. Constant unproportional pain, poorly controlled with narcotics, was the major symptom. Radiographs were unchanged from the original postsurgery images and exhibited no change in component orientation, radiolucent lines, or osteolysis. The initial suspicion was infection despite the absence of febrile episodes. The complete blood cell count and differential were normal, but erythrocyte sedimentation rate and C-reactive protein were elevated at 122 mm/h and 162 mg/L, respectively. Multiple knee aspirations showed clear fluid and no growth including tuberculosis (TB) and fungus with cell counts less than 200 white blood cells/mm^3. The serum ion level for Co was elevated at 30 μg/L; Cr and Nickel were not detected. The T-lymphocyte proliferation test was negative for any metal allergy. No clinical signs of systemic ion toxicity were identified; however, liver indices of alkaline phosphatase, alanine aminotransferase, and immunoglobulin G (IGG) were elevated. Progression in pain, physical deterioration due to sleep deprivation, and knee induration with focal skin changes of impending ischemia prompted surgical exploration. At surgery, minimal clear joint fluid was present, which showed less than 800 white blood cells/mm^3. The joint capsule was thickened and densely fibrotic with a shiny surface that appeared avascular. Intraoperative synovial lining frozen section showed no cells present. The prosthesis components were well fixed; the poly surfaces and bearings showed no visible wear damage. The sole finding was a bloom of black encrustations at the Morse taper junction of the distal femoral component and its well ingrown porous-coated intramedullary femoral stem extension. See Figs. 1 and 2. Final assessment of the black material by energy-dispersive x-ray spectroscopy identified peaks for oxygen, chromium, and molybdenum, suggesting that the black encrustations may be chromium and molybdenum oxides, which can be corrosion products of a cobalt/chromium/molybdenum alloy. The taper junction was very tight with no evidence of taper disassociation and required strong force to disengage it. Upon separating the taper, it was immediately apparent that corrosion was present within it with discoloration and etching of both sides of the join. An extensive capsule debridement was performed. Permanent sections of the resected capsule showed sheets of eosinophilic fibrous tissue devoid of cells and no evidence of aseptic lymphocytic-dominated, vasculitis-associated lesion (ALVAL). Multiple cultures of the joint fluid and capsule showed no bacterial, fungal, or TB growth. As no Co- and Cr-containing rotating platform hinge device is currently Food and Drug Administration approved in the United States, a new distal femoral component was applied to the original ingrown femoral stem as a temporary fix. The hinge components were then reassembled. The areas of full thickness necrotic skin were debrided and covered with a gastrocnemius flap and eventually split skin grafting. The prior severe pain was immediately relieved. At 8 months after the exchange procedure, serum chromium was 0.7 μg/L, and cobalt was 2.3 μg/L. There are no clinical signs of the previous syndrome, and he retains the revised components. The patient continues to be employed.

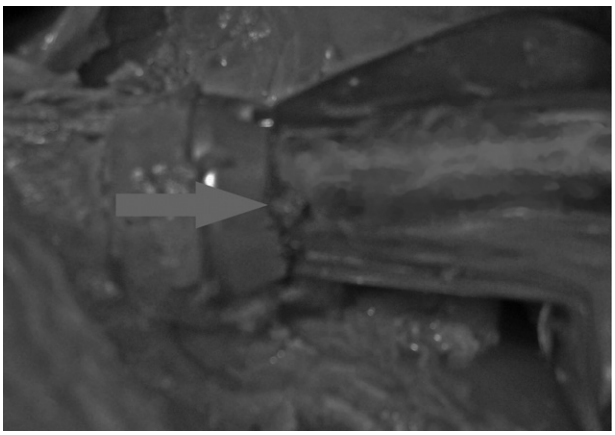

Fig. 1. The encrustation bloom at the modular junction between the distal femoral component and the intramedullary femoral stem is noted by the arrow.

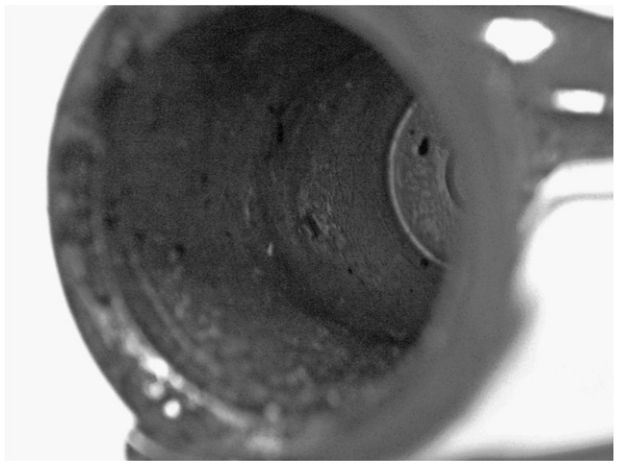

Fig. 2. The disassembled taper shows the black encrustations on the femoral stem component of the join. Similar changes were also evident on the walls of the mated distal femoral component.

Discussion

This is a unique occurrence of an ALTR lesion of the knee likely associated with crevice corrosion of a Morse taper junction in a revision total knee arthroplasty. A similar episode in a modular total hip arthroplasty was reported by Svensson et al [3] in 1988. The characterization of metal ion–related tissue reactions continues to evolve. Although initial reports associated with MOM hip components emphasized