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Diagnosis Taper Corrosion: When Is It the Taper and When Is It Something Else?

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ABSTRACT

There has been an increasing use of modularity at the head-neck junction in total hip arthroplasty to more closely mimic the native anatomy, allowing for optimal leg length and stability. Corrosion at this junction in metal-on-polyethylene bearings can lead to an adverse local tissue reaction (ALTR). This increasingly prevalent condition should be considered in the differential diagnosis of hip pain and difficulty ambulating. A recent symposium by the American Academy of Hip and Knee Surgeons described the diagnosis, etiology, management, and prevention of taper corrosion. This article describes the history, physical, plain and advanced imaging findings, laboratory tests, and other diagnoses that should be taken into consideration when diagnosing taper corrosion. The presence of ALTR due to taper corrosion can mimic other diagnoses such as periprosthetic joint infection, instability, or aseptic loosening. Serum metal levels have been found to be the most effective screening tool for identifying corrosion, but other common causes of hip pain and difficulty ambulating should always be ruled out with the use of radiographs and common laboratory techniques before diagnosing ALTR due to corrosion.

Modularity at the head-neck junction has become an integral part of total hip arthroplasty (THA), allowing the surgeon to optimize both leg length and stability. In 2012, Cooper et al [1] described 10 patients who developed corrosion at the head-neck junction in a metal-on-polyethylene bearing THA that lead to a symptomatic adverse local tissue reaction (ALTR) requiring revision surgery. Since that time, similar series have been described by others [2–6]. Hence, this entity has now become a part of the differential diagnosis of the patient with a painful THA. Not unlike the diagnosis of periprosthetic joint infection (PJI), the diagnosis of corrosion at the head-neck junction can be challenging as the presenting signs and symptoms can be variegated.

History and Physical Examination

When generating a differential diagnosis for the patient with pain after a THA, common entities such as PJI, implant loosening, instability, tendinopathy and radicular, or referred spinal pathology should be ruled out first. However, once these entities have been evaluated, corrosion at the head-neck junction should be considered as a cause of pain. In some cases, patients with ALTRs due to corrosion have presented with a late dislocation or with a new limp secondary to destruction of the abductor musculature [7].

Most patients present with pain, most commonly located in the groin. However, pain in the buttocks or thigh has also been observed. While the typical time to onset of symptoms is approximately 2 to 4 years postoperatively, we have seen patients who have presented before 2 years postoperatively and some who have presented more than 20 years postoperatively. Some patients may also present with painless swelling around the hip or of the entire lower extremity.

As part of the evaluation, a review of the prior operative note is critical to identify not only the surgical approach (which can be helpful for planning the revision procedure if needed in the future) but also the implanted components. If not specified in the operative note, the implant stickers or log from the operating room should be obtained to confirm the make, model, and size of the implanted

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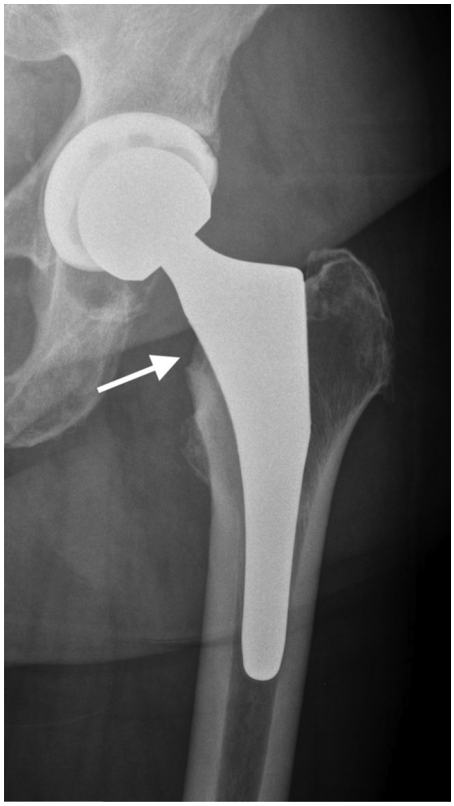

Fig. 1. Anteroposterior view of the left hip showing an osteolytic lesion at the base of the calcar in a patient with ALTR due to taper corrosion.

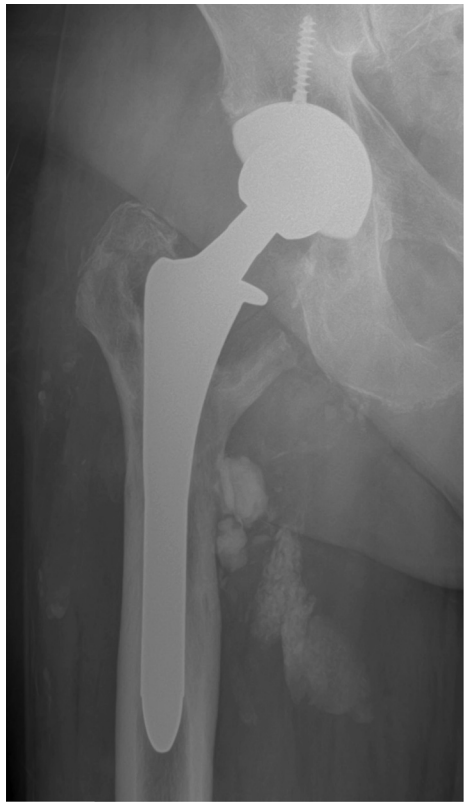

Fig. 2. Anteroposterior view of the right hip showing extensive proximal femoral osteolysis with calcific debris in the setting of ALTR due to taper corrosion.

components. Certain implants should raise your suspicion of a problem related to corrosion at the head-neck junction. Specifically, the risk is greater with a metal as opposed to a ceramic head, larger diameter as opposed to smaller diameter heads and with longer head ball lengths [2]. While this is not exclusively a large head phenomenon (we have seen corrosion reactions most commonly with 32-mm heads in our series), large diameter heads are theoretically at higher risk due to greater frictional torques at the modular connection. It has been reported that this phenomenon may be clustered around certain stem types [2–5].

Plain Radiographs

A careful review of the patient's plain radiographs is critical for identifying the cause of pain. As previously discussed, the physician must rule out implant loosening or failed ingrowth of cementless components by either identifying signs of osseointegration that rule loosening out or identifying signs of loosening such as progressive migration. Once loosening has been ruled out, subtle radiographic findings may suggest an adverse local tissue reaction. While at first glance the radiographs may appear negative, we occasionally do see osteolytic lesions, typically in the calcar area (Fig. 1). In other cases, dramatic radiographic abnormalities are seen (Fig. 2).

Laboratory Testing Including Serum Metal Levels

When evaluating any patient with a painful or failed THA, a screening erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) are obtained as a first-line screening for PJI as per the American Academy of Orthopaedic Surgeons Clinical Practice guideline [8]. Although these may occasionally be elevated in the face of ALTR, these values can assist the clinician in ruling in or out PJI [2]. Specifically, if the ESR and CRP are both negative, PJI is unlikely [9].

We have found the measurement of serum metal levels to be the best single test for identifying corrosion at the head-neck junction in the patient with a metal-on-polyethylene bearing THA. Prior work from our center has identified what these values should be in a well-functioning cobalt-chromium alloy on polyethylene primary THA [10]. In that prospective 10-year study of patients with a hybrid hip (cobalt-chromium alloy cemented stem and a titanium cup) and either a cementless cobalt chromium alloy or titanium alloy stem with a titanium cup, the serum cobalt and chromium levels were never greater than 1 parts per billion (ppb). In subsequent reports of ALTR secondary to corrosion at the head-neck junction, the serum metal levels are almost universally greater than 1 ppb with mean serum cobalt in the study by Plummer et al of 11.6 ppb and a mean serum chromium of 2.7 ppb [2]. It is quite typical to see a serum cobalt level that is higher than the serum chromium. In the same report by Plummer et al, all patients who were treated with an exchange of the modular cobalt-chromium alloy head to a ceramic head demonstrated a reduction in their serum cobalt and chromium levels to less than 1 ppb at a mean of 2 years postoperatively.

Furthermore, in a recent study by Fillingham et al, measurement of serum cobalt was found to be the best test for diagnosing corrosion at the head-neck junction in a metal-on-polyethylene bearing THA [11]. In this study of 64 patients suspected of an ALTR, measurement of serum chromium and the cobalt-to-chromium ratio was also found to be helpful but not as accurate as the serum cobalt which had nearly perfect testing