

Novel Mechanism Leading to Rare Cases of Isolated Elevated Titanium Post THA

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INTRODUCTION: A common complication following total hip arthroplasty (THA) is metallosis – a term used to describe the release of metal debris associated with orthopedic implants. This debris can lead to elevated serum levels of metal ions, with the most common being cobalt and chromium. Although titanium is frequently found in orthopedic prostheses, it is rarely elevated due to its biocompatibility and the fact that its usage is avoided at bearing sites. A literature review revealed only three previously reported cases of isolated elevated titanium levels with normal cobalt and chromium levels post-THA.¹⁻³ Two of the cases report wear through of a polyethylene liner leading to corrosion of the acetabular cup made of titanium and the other case reports elevated titanium after outer cup impingement led to titanium neck wear.¹⁻³ We present two cases of titanium metallosis post revision-THA with normal to only slightly elevated levels of cobalt and chromium. Both patients originally presented with pain and were found to have mostly isolated titanium metallosis. The study aimed to identify the mechanism leading to elevated titanium without other metal ions.

METHODS: After observing the index case showing cable contact with a revision titanium stem, a second case with the same revision construct and cable contact was observed and similarly investigated for elevated titanium levels, which were found to be present. For both, retrospective chart review was performed. Clinical presentation, bloodwork, imaging, follow-up, treatment, and outcome were recorded. Operative notes were reviewed to determine implants and materials used in past surgeries at all potential contributing arthroplasty locations for each patient.

RESULTS SECTION: Case 1 was a 59-year-old female who presented with pain in both hips 7 years status post revision left THA (ceramic head) including trochanteric claw and cobalt-chrome cable device as well as remote right primary THA (cobalt-chromium head) and a reverse total shoulder arthroplasty (cobalt-chromium-molybdenum glenosphere) one year prior. Serum analysis in Case 1 revealed elevated titanium level of 19.1 ng/mL (normal <10.0 ng/mL), normal chromium level of 1.7 µg/L (normal 0.1 – 2.1 µg/L) and normal cobalt level of <1.0 µg/L (normal 0.0 – 0.9 µg/L). Left hip imaging 3 and 7 years post-op showed breakage initially of one and then two cables encircling the femoral component. Left hip imaging 3- and 7-years post-op showed breakage initially of one and then two cables encircling the femoral component (Fig. 1). CT imaging revealed a point of contact between one of these cables and the titanium femoral stem (Fig. 1). Case 2 was a 56-year-old female who presented with right thigh pain 4.5 years status post revision right THA (ceramic head) with claw plate and stainless-steel cables. Serum analysis in Case 2 revealed an elevated titanium level of 21.4 ng/mL (normal <10.0 ng/mL), a very slightly elevated chromium level of 2.3 µg/L (normal 0.1 – 2.1 µg/L), and a normal cobalt level of <1.0 µg/L (normal 0.0 – 0.9 µg/L). Imaging 4.5 years post-op showed both cables in close proximity to the femoral component with cable breakage, trochanteric escape and non-union (Fig. 1). CT imaging showed a potential point of contact between cable and stem (Fig. 1).

DISCUSSION: The common thread between these two cases is use of cables in contact with femoral titanium stems. Based upon the presence of predominately isolated titanium serum metallosis in the face of cable-stem contact, the mechanism leading to the elevated titanium would appear to be abrasion of the femoral titanium stem surface. This abrasive contact leading to cable breakage in some of the cables was substantial enough to overcome the protective oxide layer created by passivation of titanium that typically prevents titanium ion release from the surface of the femoral component. Although there are other potential sites of metallosis in these cases, no other explanation would seem viable. In the absence of simultaneously elevated cobalt and chromium levels, trunnionosis from the contralateral hip in case 1 is an unlikely source. Typical trunnionosis does not produce elevated titanium levels, ruling this out in both cases. In the absence of radiographic implant body/stem failure creating gross motion between two titanium implants, the body-stem junction is an unlikely source as well. Any slight micromotion at Ti-Ti taper junctions is unlikely to be of great enough magnitude to lead to elevated titanium levels, which is supported by normal titanium levels in similar implants without cables. Isolated titanium elevation in a shoulder arthroplasty has only been reported due to implant failure, of which there was none in this case. Three prior reported cases of titanium dominating metallosis associated with THA were due to abrasion of the titanium acetabular surface by the femoral head after complete wear through of the polyethylene insert in two cases and cup-neck impingement in another. Hence, this represents the first report of cable-body contact induced titanium metallosis and hence a new mechanism for titanium metallosis in THA.

SIGNIFICANCE/CLINICAL RELEVANCE: These two cases suggest cable-femoral component contact as a source for titanium metallosis in revision THA. When cables are used in revision THA, contact with the femoral component should be avoided.

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IMAGES AND TABLES:

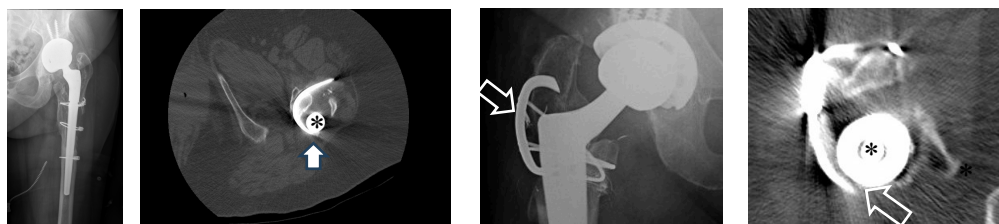


Figure 1: Left to right; Case 1 Anteroposterior left hip view showing breakage of proximal two cables. Case 1 CT scan demonstrating contact between the most proximal broken cable and the titanium femoral stem. Case 2 anteroposterior right hip view showing breakage of one of the cerclage cables. Case 2 CT scan showing potential site of contact between cable and stem.