

Allergic contact dermatitis due to titanium in a total knee replacement

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Titanium alloys are used with increasing frequency in total joint arthroplasty due to their high resistance to corrosion, strength, and biocompatibility. Despite being considered hypoallergenic, there have been a growing number of reports describing titanium allergy.

CASE REPORT

A 64-year-old woman was referred with a 10-month history of a progressively enlarging pruritic plaque overlying the left anterior knee joint (Figure 1). The lesion developed 4 to 6 weeks following a left total knee arthroplasty with a Genesis 2 total knee system (cobalt/chromate alloy in the femoral component, titanium alloy [Ti-6Al-4 V] in the tibial base plate). There was associated pain and decreased range of motion in the affected knee. There was no improvement with antibiotics, antifungals, or topical betamethasone dipropionate 0.05% ointment. Fungal skin scrapings were negative. Biopsy of the plaque showed spongiosis with an upper dermal infiltrate of lymphocytes and eosinophils. A plain radiograph of the affected knee showed an effusion.

The patient was patch tested to our prosthetic joint series and her own products using AllergEAZE skin patch chambers and allergens obtained from AllergEAZE (SmartPractice, Phoenix, Arizona) and Chemotechnique Diagnostics (Vellinge, Sweden), according to International Contact Dermatitis Research Group guidelines. She developed positive patch test reactions to titanium oxalate 5% pet. and manganese chloride 2% pet. and irritant reactions to potassium dichromate 0.5% pet. and 0.25% pet., respectively (Table S1). Of interest she did not react to the other titanium allergens tested, specifically titanium dioxide 10% pet., titanium 10% pet., and titanium nitride 5% pet., or to aluminium chloride hexahydrate 2% pet., aluminium powder "as is", vanadium 5% pet., or vanadium (V) oxide 10% pet., which were present in small amounts in the titanium alloy. Neither did she react to cobalt chloride hexahydrate 1% pet. We were not aware of any manganese in the prosthetic joint components.



FIGURE 1 Eczematous plaque overlying the left anterior knee joint

Fifteen months following the initial joint arthroplasty, the titanium-containing tibial component was removed and replaced with a polyethylene module. The cobalt and chromium femoral component was left in place. She made a full recovery following removal of the titanium.

DISCUSSION

Allergy to titanium-based alloys in metallic knee replacements presents with varied symptoms including pain, decreased range of movement, dermatitis, delayed wound healing, edema, and persistent fever.^{1,2} It is often diagnosed late, as symptoms regularly mirror common complications.³ In our patient, the location of the eczematous plaque over the affected knee joint associated with the impaired range of motion made us suspicious that titanium allergy was relevant to her joint replacement failure.

Titanium allergy may be a less common cause of prosthetic joint failure; however, it should remain a possible diagnosis for patients who present with the symptoms described. As exposure to titanium increases, we may see a rise in allergy rates. If the allergy is suspected, patch testing to all titanium allergens available should be considered, as in this patient, only one titanium allergen reacted. Lymphocyte transformation test can also be performed. If allergy is confirmed and the clinical index of suspicion is high, consideration should be given to removing any titanium-containing materials.

CONFLICT OF INTERESTS

None to declare.

AUTHOR CONTRIBUTIONS

Kate Dear: Data curation; investigation; methodology; resources; writing-original draft. **Aaron Boyce:** Conceptualization; supervision;

writing-review and editing. **Adriene Lee:** Conceptualization; supervision; writing-review and editing.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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Online supplemental Table 1: Occupational Dermatology Research and Education
Centre prosthetic joint series with strength of individual reactions at day 2 and 3

Allergen name	Reaction day 2	Reaction day 3
Nickel sulfate hexahydrate (5.0 % pet.)		
Potassium dichromate (0.5 % pet.)	IR	IR
Epoxy resin, Bisphenol A (Araldite) (1.0 % pet.)		
Cobalt chloride hexahydrate (1.0 % pet.)		
Titanium dioxide (10.0 % pet.)		
Copper sulfate pentahydrate		
Palladium chloride (2.0 % pet.)		
Aluminium (III) chloride hexahydrate (2.0 % pet.)		
Tin (50.0 % pet.)		
Cadmium chloride (1.0 % aq.)		
Zinc (2.5 % pet.)		
Copper (I) oxide (5.0 % pet.)		
Vanadium (V) oxide (10.0 % pet.)		
Aluminium (100.0 pwd)		
Potassium dichromate (0.25 % pet.)	IR	IR
Methyl methacrylate (2.0 % pet.)		
Titanium nitride (5.0 % pet.)		
Titanium (10.0 % pet.)		
Vanadium (5.0 % pet.)		
Ferric chloride (Iron (III) chloride) (2.0 % pet.)		
Tungsten (Wolfram) (5.0 % pet.)		
Molybdenum (5.0 % pet.)		
Manganese (II) chloride (2.0 % pet.)	++	+
Gentamicin sulfate (20.0 % pet.)		
Benzoylperoxide (1.0 % pet.)		
Titanium oxalate hydrate (5.0 % pet.)	+	+
Vancomycin hydrochloride (10.0 % aq.)		
Zirconium dioxide (0.1 % pet.)		
Tantalum (1.0 % pet.)		
Sodium tungstate dihydrate (2.0 % aq.)		
Niobium (V) chloride (0.2 % pet.)		

Commento [WU1]: