



## Case Report

# Metal allergy hypersensitivity after posterior thoracic spinal fusion: A case report and review of the literature

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## ABSTRACT

**Background:** Spine surgeons rarely consider metal allergies when placing hardware, as implants are thought to be inert.

**Case Description:** A 32-year-old male presented with a skin rash attributed to the trace metal in his spinal fusion instrumentation. Patch testing revealed sensitivities to cobalt, manganese, and chromium. He underwent hardware removal and replacement with constructs of commercially pure titanium. His skin findings resolved at 2 weeks after surgery and were stable at 6 weeks.

**Conclusion:** Hypersensitivity to metal (i.e., metal allergy) should be considered before performing instrumented spinal fusions.

**Keywords:** Hypersensitivity, Instrumentation, Metal allergy, Spinal fusion, Thoracic

## BACKGROUND

Instrumentation used during spinal fusions is traditionally thought to be inert, and thus, spine surgeons rarely consider metal hypersensitivities. Metal allergies have been described in other surgeries such as total hip and knee arthroplasties, with an allergy to nickel reported as the most common, followed by palladium, cobalt, potassium dichromate, and vanadium.<sup>[9]</sup> Here, we present a case of metal hypersensitivity/allergy in a patient 2 years after thoracic pedicle screws/rods were placed for a traumatic thoracic spinal fracture. Within 2 weeks of removing the instrumentation and replacing it with commercially pure titanium, his skin findings resolved, with stable resolution at 6 weeks postoperatively.

## CASE PRESENTATION

A 32-year-old male presented with a rash 2 years after a thoracic spinal fusion for a T5-T6 fracture-dislocation with complete spinal cord injury (T5 sensory level, ASIA A). He had undergone an uncomplicated T4-T8 posterior pedicle screw and rod fusion. The instrumentation consisted mainly of titanium with small quantities of other metals (i.e., including aluminum,

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vanadium, and cobalt chrome) [Table 1]. Three weeks postoperatively, the patient developed a rash with an epicenter near the surgical site; it would intermittently wax and wane. He did not have local or systemic signs of infection. Two years later, he presented with multiple oval patches measuring 6 × 6 cm–8 × 8 cm on his posterior trunk/thoracic area extending into his right axilla [Figure 1a]. An allergist was consulted, and skin patch testing demonstrated hypersensitivities to cobalt (II) chloride hexahydrate 1%, manganese (II) chloride 0.5%, and chromium (III) chloride 2%; there was no sensitivity to titanium.

### Removal and replacement of instrumentation

As the patient had not formed a complete arthrodesis at T5-T6 and had the presence of metal allergies, he had the prior instrumentation removed and replaced with commercially pure titanium [Figure 2]. No steroids or prolonged antibiotics were used, eliminating these as possibilities for the resolution of the rash. The patient demonstrated full resolution of the rash within 6 weeks after surgery [Figure 1b and Figure 1c].

### Pathology

Pathological findings compatible with an allergic eczematous dermatitis on hematoxylin and eosin staining of skin plaques demonstrated spongiotic dermatitis with multifocal parakeratosis scale crust and superficial to mid-dermal perivascular lymphocytic infiltrate with occasional eosinophils [Figure 3a]. In addition, muscle sections demonstrated chronic inflammation, occasional eosinophils, basophilic fibers, atrophy, nuclear clumping, and increased internal nuclei [Figure 3b].

## DISCUSSION

Pedicle screw and rod constructs are often placed without consideration of metal hypersensitivity. These sensitivities are often attributed to trace metals that result in a delayed-type IV immune reaction, although a type III reaction may also play a role.<sup>[4]</sup> Symptoms most frequently included localized dermatitis, delayed wound healing, recurrent pain, swelling, and erythema around the implant and/or instrumentation insertion area.<sup>[9]</sup>

### Screening for metal allergies before instrumented spinal fusions

Spine surgeons should consider the risk of metal hypersensitivity before implanting spinal instrumentation. In elective cases, the patient's medical history should be scrutinized for past metal hypersensitivity or occupational exposure to metals. Of the 15 case reports of allergy to spinal implants, the majority (87%) were due to disc arthroplasty (most commonly containing cobalt and chromium), with only two cases of pedicle screw instrumentation [Table 2].<sup>[1-3,5,6,8,10-12,14,15]</sup> Notably, allergies attributed to disc replacements are likely due to corrosion and wear debris occurring secondary to load-bearing stress, increasing the risk for corrosion.<sup>[7]</sup>

### Testing for metal allergy

Patients with hypersensitivity reactions may be difficult to differentiate from the much more common wound infection complications. Where allergy to an implant is considered, patch testing should be performed. If hypersensitivity

**Table 1:** Medtronic Solera MAS pedicle screws and rod composition breakdown.

Instrumentation part	Composition material	Percentage of material
Tulip head	Cobalt chrome (Chromalloy)	26.0–30.0% Cr 66.0% Co 5.0–7.0% Mo 1% Ni<1% C, N
Crown	Commercially pure titanium	98.9% Ti<1.1% C, H, Fe, N, O
Inner ring (within head)	Cobalt chrome (chromalloy)	26.0–30.0% Cr 66.0% Co 5.0–7.0% Mo 1% Ni<1% C, N
Bone screw	Titanium alloy	5.50–6.50% Al 88.1–91.0% Ti
Rod	Titanium alloy	3.50–4.50% V<1% C, H, Fe, N, O 5.50–6.50% Al 88.1–91.0% Ti 3.50–4.50% V<1% C, H, Fe, N, O

Cr: Chromium, Co: Cobalt, Mo: Molybdenum, Ni: Nickel, C: Carbon, N: Nitrogen, Ti: Titanium, H: Hydrogen, Fe: Iron, O: Oxygen, Al: Aluminum, V: Vanadium

**Table 2:** Reported cases of instrument allergy after spine surgery.

Author	Type of spine surgery	Age, gender	Hardware removal (Y/N)	Metal allergy (suspected or confirmed)	Allergy testing (Y/N)	Allergy test result	Histology findings	Drug allergies	Notable medical history
Cavanaugh <i>et al.</i> , 2009	Artificial cervical disc replacement from C5 to C6	38, F	Y	Cobalt-chrome (suspected)	n/a	n/a	Amorphous eosinophilic tissue, chronic inflammation consisting of lymphocytes, and vascular proliferation	n/a	n/a
Berry <i>et al.</i> , 2010	Previous Maverick TDR at L4-5	35, F	n/a	Cobalt-chrome (suspected)	n/a	n/a	Benign, reactive, large granuloma	n/a	No known allergy to metals
Guyer <i>et al.</i> , 2011	Case 1: L5-S1 TDR with Kineflex Spinal Motion Inc. Prosthesis	41, M	Y	Chromium (suspected)	n/a	n/a	Extensive areas of necrotic fibroconnective, adipose tissue with chronic inflammation on margins, lymphocytes, and macrophage infiltrate, focal accumulations of degranulating eosinophils	n/a	n/a
Guyer <i>et al.</i> , 2011	Case 2: L4-5 TDR – Kineflex Spinal Motion Inc. implant	56, F	Y	Chromium (suspected)	n/a	n/a	Necrotic adipose, fibroconnective tissue chronic inflammation on borders, inflammatory cells (lymphocytes, macrophages, eosinophils)	n/a	n/a
Guyer <i>et al.</i> , 2011	Case 3: C5-C6 TDR – Kineflex Spinal Motion Inc.	45, F	Y	Chromium (suspected)	n/a	n/a	Fibroconnective tissue with small viable areas showing chronic inflammation, inflammatory cells (lymphocytes, macrophages, some degranulating eosinophils)	n/a	n/a
Guyer <i>et al.</i> , 2011	Case 4: L5-S1 TDR – Maverick (Medtronic) prosthesis	45, M	Y	Chromium (suspected)	n/a	n/a	Necrotic nonvascular tissue predominant necrotic fibrous and adipose tissue, focal, poorly defined histiocytic palisades, scattered foreign body, giant cells with surrounding lymphocytic infiltrate	n/a	Occupational exposure to cobalt chromium

(Contd...)

Table 2: (Continued).

Author	Type of spine surgery	Age, gender	Hardware removal (Y/N)	Metal allergy (suspected or confirmed)	Allergy testing (Y/N)	Allergy test result	Histology findings	Drug allergies	Notable medical history
Zairi <i>et al.</i> , 2013	Metal-on-metal L5-S1 TDR –Maverick (Medtronic) prosthesis	53, F	Y	Cobalt-chloride and chromium (confirmed)	Y	Positive reaction for 1% cobalt chloride and chromium on testing –type IV hypersensitivity	Granulomatous mass with diffuse metallic wear debris particles	n/a	n/a
Zielinski <i>et al.</i> , 2013	Placement of bilateral posterior VEPTRs – Synthes Inc.	6, M	Y	Titanium, niobium, molybdenum, iron, aluminum, and others (confirmed)	Y	Hypersensitive to titanium, niobium, molybdenum, iron, aluminum, and others not listed	n/a	n/a	No known hx to metals
Shang <i>et al.</i> , 2014	Spine – PLDF bilaterally for lumbar disc herniation	52, F	Y	Suspected allergy but not specified	N	N	Infiltration of lymphocytes with massive fibroblasts and neocapillaries, ALVAL	n/a	Metal skin allergy of many years
Lagier <i>et al.</i> , 2015	C5-6 Total cervical disc arthroplasty	52, F	Y	Chromium, nickel sulfate (confirmed)	Y	Sensitization to contact with chromium and nickel sulfate on testing, not sensitive to cobalt, titanium, and molybdenum	n/a	n/a	No known hx of allergies
Goodwin <i>et al.</i> , 2018	Case 1: wide laminectomy with facet resection and AFRS, L4-5	59, M	Y	Cobalt (confirmed)	Y	Severe cobalt allergy	n/a	Drug reaction with eosinophilia postoperative	n/a
Goodwin <i>et al.</i> , 2018	Case 2: laminectomy facet resection, AFRS, L4-5	69, F	Y	Cobalt (confirmed)	Y	Cobalt allergy (delayed reaction)	n/a	n/a	n/a

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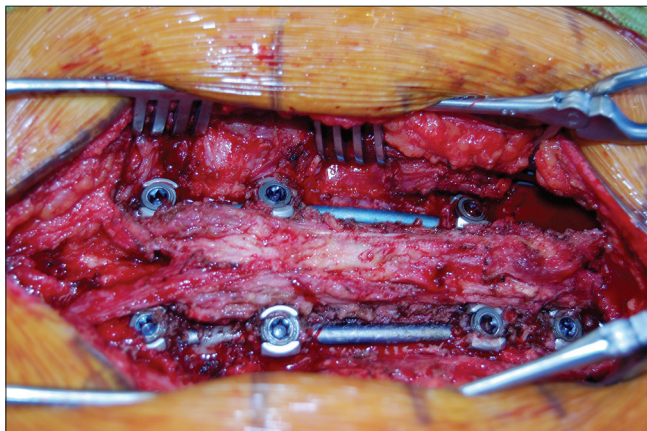
**Table 2: (Continued).**

Author	Type of spine surgery	Age, gender	Hardware removal (Y/N)	Metal allergy (suspected or confirmed)	Allergy testing (Y/N)	Allergy test result	Histology findings	Drug allergies	Notable medical history
Towers and Kurtom, 2020	Spine – bilateral pedicle screws fixation, T9-L1	67, F	Y	Suspected allergy but not specified – possibly titanium	n/a	n/a	No biopsy sample taken	Clonazepam	Bee venom, nickel allergy (childhood)
Curley <i>et al.</i> , 2020	Spine – ALLIF – Titan sports interbody, L5-S1	41, F	Y	Nickel sulfate hexahydrate, iridium chloride trihydrate, sodium tetrachloropalladate hydrate, iridium chloride, stannous chloride, palladium chloride, and gold sodium thiosulfate dihydrate (confirmed)	Y	Broad spectrum of metals, 3+to nickel sulfate hexahydrate	n/a	n/a	Crohn's disease like symptoms postoperative, peri-incisional dermatitis postoperative
Kim, 2020	Spinal arthrodesis with rods and pedicle screws, remnant screw fragment at L3	38, n/a	Y	Nickel (confirmed)	Y	Nickel	n/a	n/a	No previous metal contact listed

TDR: Total disc replacement, PLDF: Posterior lumbar decompression and fusion, VEPTR: Vertical expandable prosthetic titanium rib, AFRS: Anatomic facet replacement system, ALIF: Anterior lumbar interbody fusion, ALVAL: Aseptic lymphocyte-dominated vasculitis-associated lesion

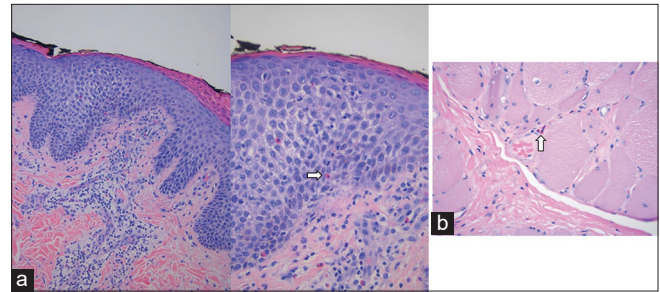


**Figure 1:** Skin findings. Left: View of skin findings from the back. Right: View from the right side. (a) Pre-operative presentation of rash. (b) Resolution of rash two 2 weeks after operation. (c) Persisting resolution of rash six 6 weeks after operation.



**Figure 2:** Intraoperative imaging. Previous hardware with metal allergens that were removed and replaced.

to the implant is confirmed, the implant should be removed and replaced with other available systems such



**Figure 3:** Histopathological examination. (a) Hematoxylin and eosin-stained sections from skin plaques demonstrated spongiotic dermatitis with multifocal parakeratosis scale crust and superficial to mid-dermal perivascular lymphocytic infiltrate with occasional eosinophils (arrow). These findings are compatible with an allergic eczematous dermatitis. Left:  $\times 20$ , right:  $\times 40$ . (b) Muscle sections demonstrated chronic inflammation, occasional eosinophils (arrow), basophilic fibers, atrophy, nuclear clumping, and increased internal nuclei. Hematoxylin and eosin stain at  $\times 40$ .

as commercially pure titanium, hydroxyapatite, stainless steel, calcium phosphate, polymethylmethacrylate bone cement, carbon fiber-reinforced polyetheretherketone, and tantalum.<sup>[13]</sup> The pathological specimens as well as resolution of the rash after hardware removal and replacement with a commercially pure titanium implant support the conclusion that the reaction was most likely due to a hypersensitivity reaction.

## CONCLUSION

Before instrumented fusions, patients should be screened for a history of metal allergies, and allergy patch tested if necessary. For those with symptoms/signs of a metal allergy to spinal instrumentation, removal of the construct is a key, with or without replacement if a pseudoarthrosis is present.

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## Declaration of patient consent

Institutional Review Board (IRB) permission obtained for the study.

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## Conflicts of interest

There are no conflicts of interest.

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