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Metallosis Presenting as a Progressive Neurologic Deficit Four Years after a Posterior Spinal Fusion for Adolescent Idiopathic Scoliosis: A Case Report

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Abstract

Study Design: Case report

Objective: To report a case of progressive pain and paraparesis secondary to metallosis four years after a pediatric posterior spinal fusion (PSF).

Summary of Background Data: Metallosis as a late complication of pediatric spinal surgery is rarely reported. Myelographic computed tomography (CT) can be helpful in establishing the diagnosis. The use of serum chromium levels as a means of definitive diagnosis has been suggested, but has only been reported retrospectively.

Methods: A 19-year old male presented four years after PSF for adolescent idiopathic scoliosis with sudden onset of pain and neurologic deficits. Radiographs and CT scan suggested infection. Intraoperatively, no purulent material was noted, but black and yellowish corrosive debris was found around the right L1 pedicle screw, so it was removed and the cavity packed with tobramycin impregnated calcium sulfate beads. After surgery, neurologic deficits worsened. CT myelogram showed irregular opacification of the thecal sac at the level of the conus. A posterior laminectomy and decompression was performed with removal of all debris and spinal instrumentation. Metallosis within the spinal canal was noted and serum chromium levels were obtained.

Results: The patient was discharged one week after admission with improvement of pain and gradual improvement in neurologic exam. Three years post discharge, the patient is asymptomatic and exam shows bilateral clonus. Serum chromium levels declined from a high of 4.5 μg/l operatively to 0.8at final follow-up (normal: 0.2 - 0.6 μg/l).

Conclusion: Although uncommon, metallosis should be considered in the differential diagnosis of any late presenting case of pain, infection-like symptoms, or neurologic deficits after pediatric PSF. CT myelography and serum chromium levels may help guide diagnosis; however, surgical exploration is needed for definitive diagnosis and treatment.

Key Words:metallosis; posterior spinal fusion; adolescent idiopathic scoliosis;chromium ion levels; late onset surgical pain (LOSP)

Level of Evidence:4

Introduction

Metallosis is a process of local tissue damage and change in tissue characteristics due to foreign metallic debris.[1] This is a result of direct pressure or displacement of tissue, chemical reactions to free metallic particles, or surrounding tissue reactions not directly in contact with the metallic debris.[1] Definitive diagnosis is by histopathology.[2] Clinical symptoms often mimic infection and can include late operative site pain and, less frequently, neurologic deficits.[3-7] Although metal-related complications caused by orthopedic implants are increasinglyreported following arthroplasty and internal fracture fixation [8,9], there are only fivedocumented cases of metallosis following posterior spinal fusions (PSF) (Table 1).[10-13]We report a unique case of metallosis in a 19-year old male presenting with pain and rapidlyprogressing neurologic deficits four years after PSF for adolescent idiopathic scoliosis (AIS).

Case Report

A 19-year old male four years afterPSF from T4-L1 for AIS with stainless steel implants presented with 3 days of low back pain, urinary hesitancy, and parasthesias on bilateral anterior thighs. He denied trauma, but did report recent tonsillitis. Radiographs and computed tomography (CT)demonstrated cavitation around his right L1 pedicle screw(Figure 1). All laboratory values were normal except for C-reactive protein(CRP) of13.6mg/dl and erythrocyte sedimentation rate(ESR) of43.

Since the presentation strongly suggested infection, a decision was made to operate.No purulent material was seen, however, a black and yellowish corrosive film and tissue was seen around the right L1 screw. There was no evidence of loosening at the

rod/screw interface. The screw was removed (Figure 2), and the bony defect packed with antibiotic beads. Remaining instrumentation was left in situ.

Over the next 48 hours, the patient gradually developed flaccid paraparesis below the knees, hypoesthesis, and urinary retention. RepeatCT scan showedsmall radiopaque material inside the spinal canalnot seen on initial imaging because of metal artifact obscuration. A CT myelogram showed irregular and inadequate opacification of the thecal sac at L1(Figure 3). A posterior laminectomy and decompression from T12 to L2 was performed with removal of all instrumentation. Around the left L1 pedicle screw, gritty yellow-black material was found tracking through the L1 foramen. The material was densely packed between the ligamentum flavum and dura in the posterolateral epidural space causing thecal saccompression at T12-L2. No areas of pseudoathrosis or areas of similar debris were seen.Final pathologic diagnosis was consistent with metallosis. At discharge, the patient had nearly complete sensory and motor recovery, except for residual 2/5 plantarflexion strength and mild urinary retention. Chromium levels decreased from 4.5 µg/linitially to 3.6 (normal: 0.2-0.6) one week later.

Three years post discharge, thepatient was pain free, withouturinary retention, and complete motor and sensory recovery. He had bilateral clonus sustained on the right and 3-4 beats left. Plain films at 2 years demonstrated no further lysis or cavitation at L1 without scoliotic deformity progression. Chromium blood levelswereimproved but still elevated at 0.8µg/l.Representative radiographs are presented in Figure 4 (ABCD).

Discussion

This is the first case of metallosis following PSF for AIS with late-presenting symptoms mimicking infection and rapidly progressing neurologic deficits, no pseudoarthrosis or implantloosening, and serum chromium levels 8 times the normal limit. This differs from the two previously reported AIS cases, one of whichinvolved *propionibacteriumacnes*, the other,pseudoarthrosis with unstable fusion.[10-11]All cases including ours, found CT myelography helpful in diagnosis and reported favorable outcomes following implant removal.

Metal debris in spinal instrumentation is created primarily by fretting at the modular junction of dissimilar metals and to a lesser degree of similar metals.[5]It is increasedwithpseudoarthrosis, even with titanium PSF constructs .[5,14]The consequenceof debris formation is activation of the osteolysis pathway, immune exhaustion, and chronic inflammation with elevated CRP and ESR.[5,15]In our case, metal debris occurred absent pseudoarthrosis or implant loosing.

Serum chromium levels may aid differentiation between infection and metallosis. Studiesof clinically and radiographically asymptomatic PSF patients found that serum chromium levels diminish over time, ranging from 2.7 to 0.3 μg/l, two and four years post-surgery, respectively.[16-18] Other studies suggestthat chromium levels > 0.6 ng/mlindicate implant malfunctionand levels > 3.75 μg/l indicate corrosion in asymptomatic patients.[19-20]Our patient's level was 4.5 μg/l at its peak, and is the only case to track serum chromium in a symptomatic patient.

Very little literature surrounding metal sensitivity testing prior to surgery exists in pediatric spine literature. However, this topic has been reported as it relates to adult arthroplasty.[21-23] In a recent review article by Mitchelson et al., standard screening of all patients for metal hypersensitivity prior to knee arthroplasty was not suggested and

preoperative testing only indicated when there is a history of metal allergy or previous aseptic orthopaedic implant failure.[21-23] The patient presented in this case report did not have a history of any metal allergy or implant failure nor did he undergo any metal sensitivity testing, which is consistent with these guidelines.

In conclusion, a diagnosis of metallosis should be considered in patients following PSF for AIS with late-presenting symptoms mimicking infection and rapidly progressing neurologic deficits. Both CT myelography and chromium levels are helpful in the evaluation; however, surgical exploration is needed for definitive diagnosis and treatment.

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Figure Legends

Fig. 1 Pre-operative CT scan without contrast. Note the cavitation around the pedicle screw in the L1 vertebral body.

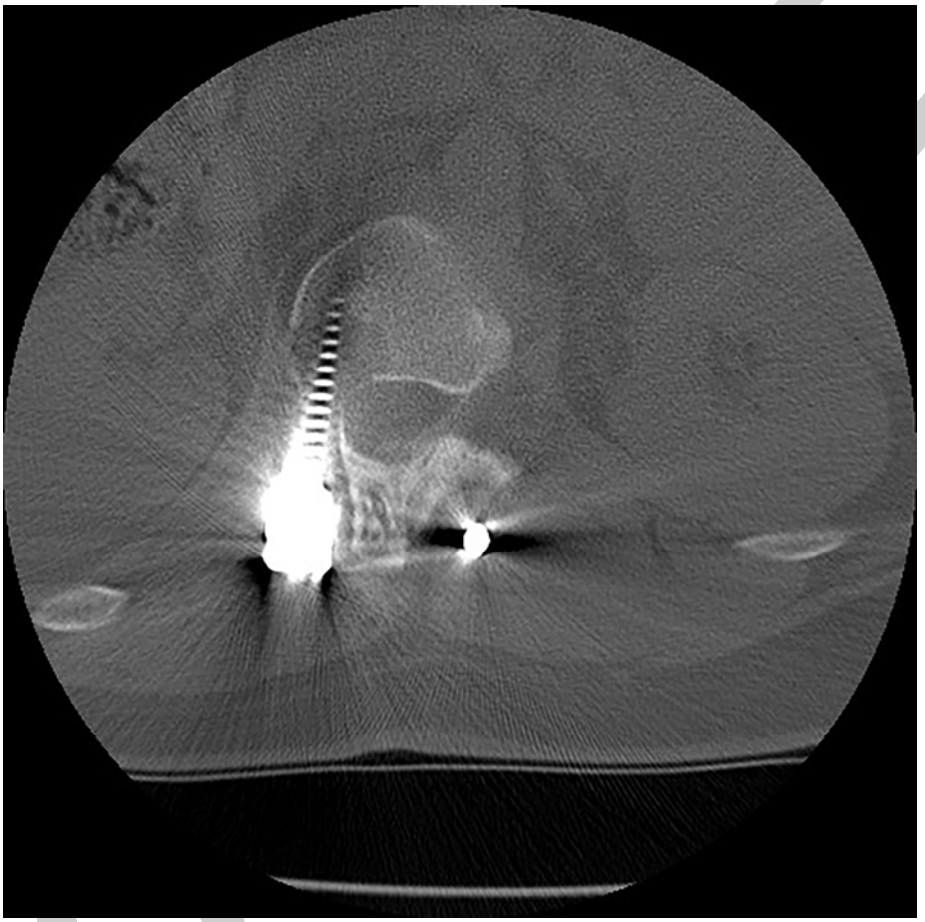


Fig. 2 Photograph of the L1 pedicle screw and rod removed during the first exploratory surgery. Note the black corrosive film and tissue surrounding the screw and rod.

Fig. 3CT-myelogram taken after the first exploratory surgery revealing the block at L1.

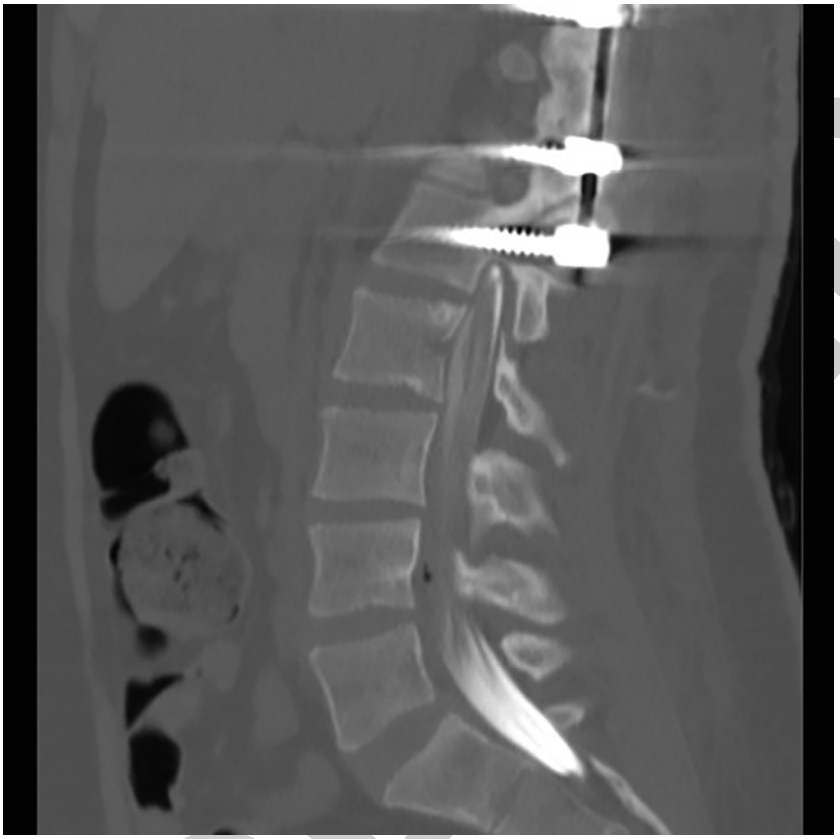
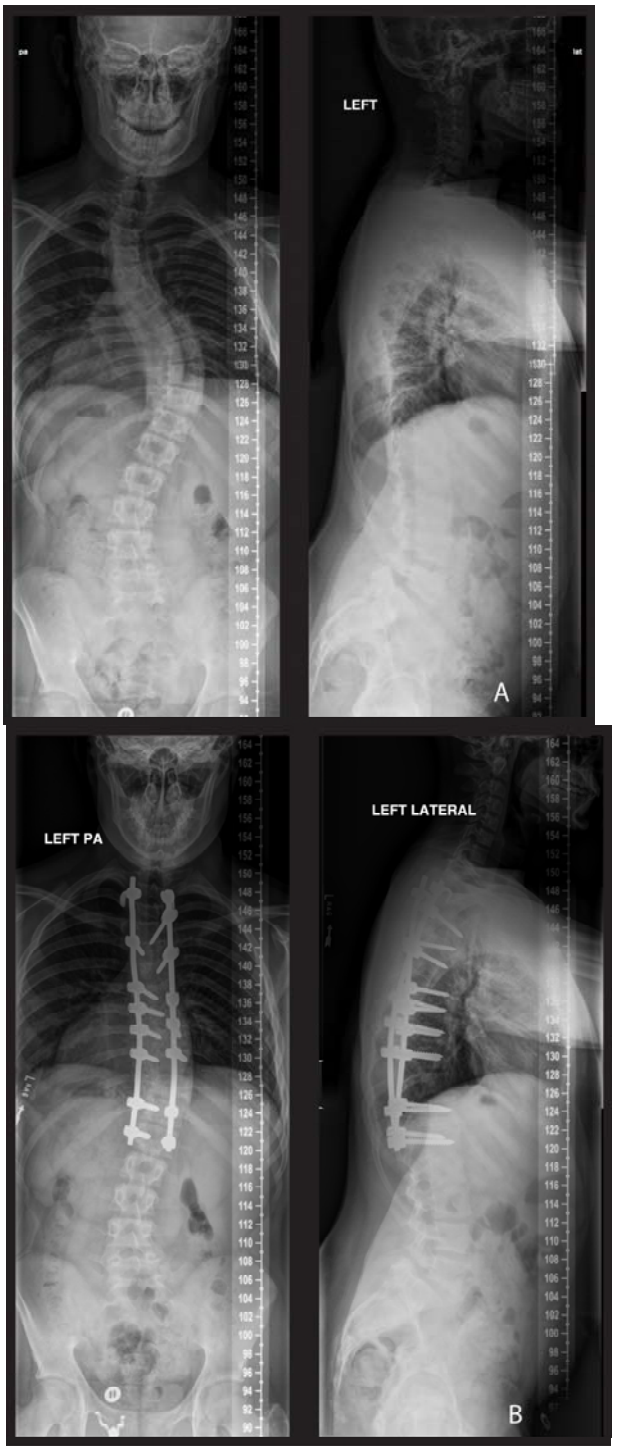
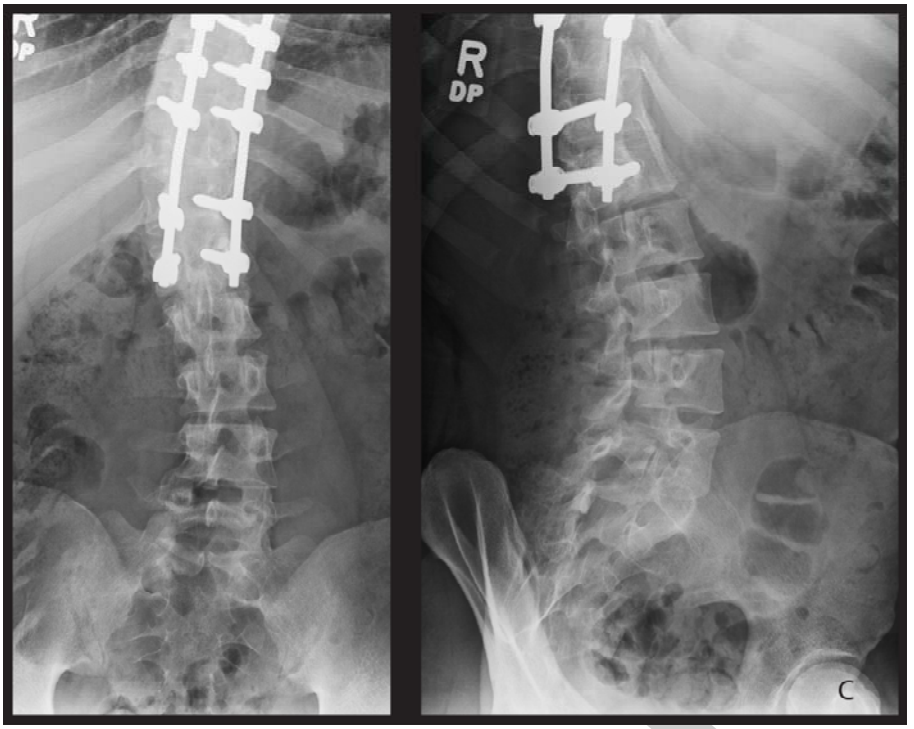


Fig.4 Representative posterior-anterior and lateral or oblique radiographs taken approximately 3 weeks before index operation (A), 1 month after index operation (B), 4 years after index operation and 2-days prior to revision surgery (C), and 2 months after implant removal (D).





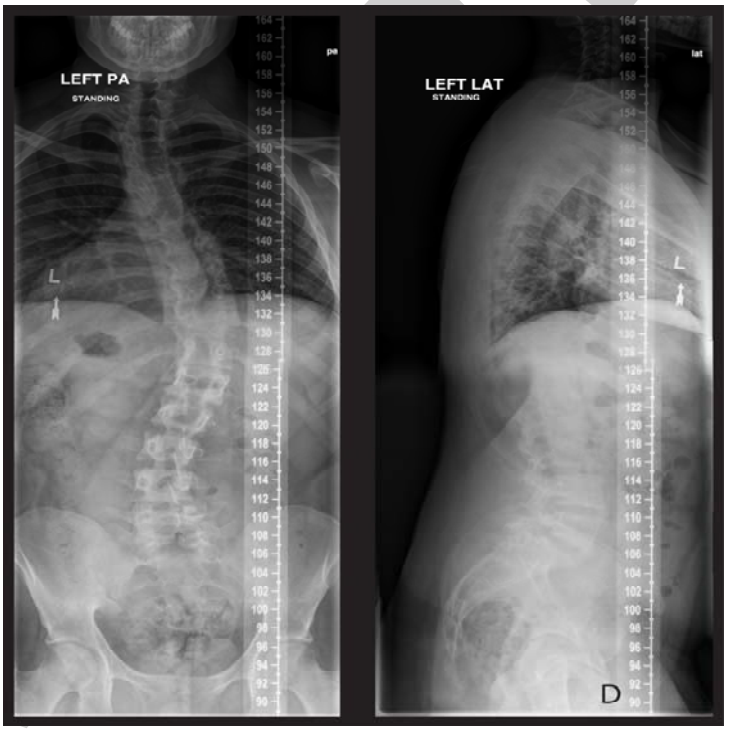


Table 1. Summary of metallosis cases following a posterior spinal fusion reported in the literature. **Key**:AIS = adolescent idiopathic scoliosis; CT = computed tomographic; EMG = electromyographic evaluation; mo = months; MRI = magnetic resonance imaging; PET = positron emission tomographic; yrs = years; * = age at presentation.

›r	*Age (yrs)	Time since index surgery	Index Diagnosis	Implant material and levels fused	Presenting Symptoms	Imaging obtained	Diagnosis
ristein	29	14 yrs	AIS	Stainlesssteel T3-L3	Progressive weakness and parasthesiae of lower limbs	Radiographs, CT, MRI, CT-guided biopsy	Metallosis and propionibacterium acnes
n	14	1 yr	Neurofibro-matosis with scoliosis	Material not specified T2-T10	Continuous pain associated with implantloosening	Radiographs, CT scan with contrast, and PET scan	Metallosis, implant loosening, and unstable fusion
	60	3 yrs	Compression fracture T8 and T9	Stainless steel Levels not specified	Paraperesis and abnormal reflexes	EMG, myelo-graphy, and myelo-CT	Metallosis
ashi	58	11 mo	Degenerative scoliosis	Stainless steel T10-L3	Radicular pain L4-L5	Myelography	Metallosis, implant loosening, and pseudoarthrosis
ashi	59	5 yrs	Degenerative scoliosis	Stainless steel T12-L4	Radicular pain L5	Radiographs, myelography, myelotomo-graphy, and CT	Metallois and implant loosening