23 Delayed Neurological Deficit and Surgical Site Infection After Pedicle Subtraction Osteotomy in a Revision Case

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23.1 Introduction

This case highlights 2 feared complications of adult deformity surgery: the development of a new neurological deficit and deep surgical site infection. The neurological deficit in this patient had a delayed onset. This is an atypical occurrence, and its management differs from that of deficits detected on intraoperative neuromonitoring. As to the surgical site infection, the patient was at high risk for this complication. Following appropriate treatment, she had an infection relapse 13 months later, which required a partial 2-stage implant exchange.

23.2 Case Description

23.2.1 Background

Patient: a 71-year-old woman

Comorbidities: hypertension, type II diabetes, allergy to non-steroidal anti-inflammatory drugs

She had undergone 4 previous lumbar surgeries:

Instrumented L4/5 fusion in 2000
Instrumentation lengthening and L3/4 fusion in 2006
L3 pedicle subtraction osteotomy (PSO) in 2010
Revision surgery to treat cerebrospinal fluid leakage in 2010

During the last revision surgery, samples sent to the microbiology laboratory yielded coagulase-negative staphylococci (CoNS). The patient completed an 8-week course of antibiotics and wound healing was uneventful. At follow-up visits, she reported persistent imbalance and instability (Fig. 23.1), but no low back pain. CT scans showed solid fusion. Because of the persistent symptoms, she was scheduled for an L4 PSO in 2012. Preoperative neurological examination using the ASIA score indicated an intact neurological status with no sensory or motor deficits. At the preoperative evaluation, the ODI and SRS-$22_{subtotal}$ scores were 64.4 and 2.06, respectively.

23.2.2 Surgical Procedure

The patient underwent implant removal, instrumentation from T12 to ilium, L5/S1 transforaminal lumbar interbody fusion (TLIF), and L4 PSO. Antibiotic prophylaxis with cotrimoxazole

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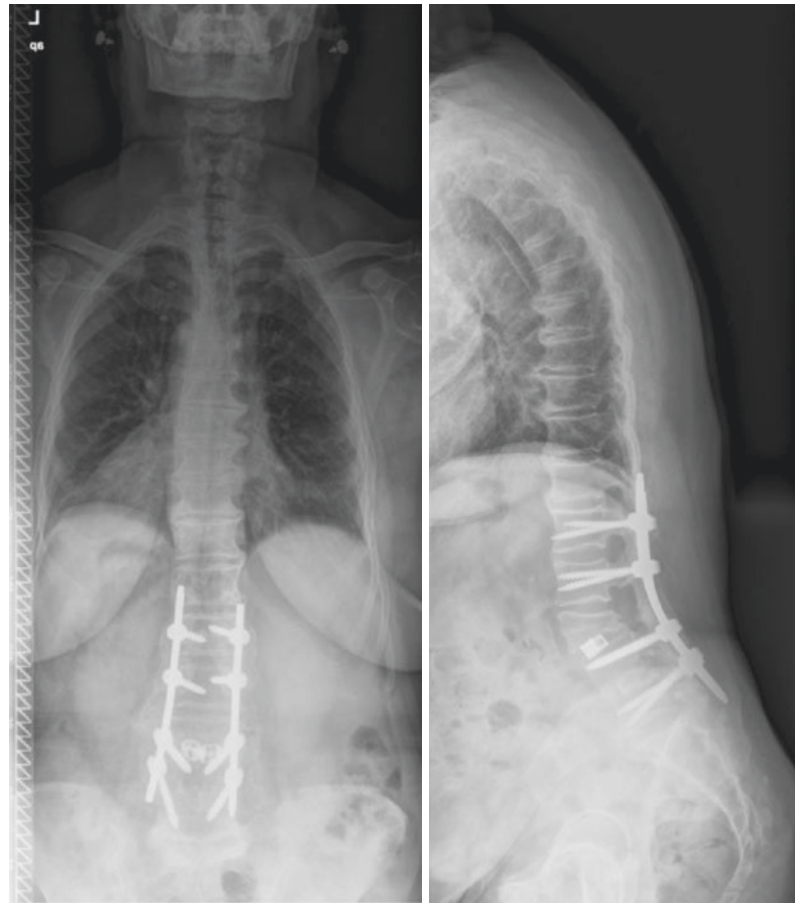

Fig. 23.1 Preoperative radiographs

was administered, as it provided the best coverage for the CoNS causing the previous infection. Surgery lasted 585 min and the estimated blood loss was 2300 mL. Intraoperative neuromonitoring, including motor evoked potentials (MEP) somatosensory evoked potentials (SSEP), and electromyography, was uneventful throughout the procedure. Wound closure included application of topical vancomycin. The patient was extubated in the evening and showed full motor scores in both lower extremities.

23.2.3 Neurological Complication

Three days after surgery, new weakness developed in the bilateral hip flexors and knee extensors (right 1–2/5, left 2–3/5) and the patient was unable to stand. On CT examination, the implants were properly positioned and there was some postoperative hematoma, but no clear signs of dural sac compression (Fig. 23.2). Due to the acute neurological changes and her inability to maintain an upright position, a revision was planned to examine all the affected nerve roots. MRI was not available at such short notice, and it was decided not to delay surgery until MRI could be performed. It is unlikely that the MRI findings would have changed the decision to carry out revision surgery in the situation of acute neurological impairment.

Revision surgery was performed the following day. Cotrimoxazole was used for antibiotic prophylaxis. The L2 to L5 nerve roots were bilaterally exposed and further decompressed along the foramina. The intraoperative findings were quite unremarkable, and the operating surgeon did not detect any stenotic areas. After

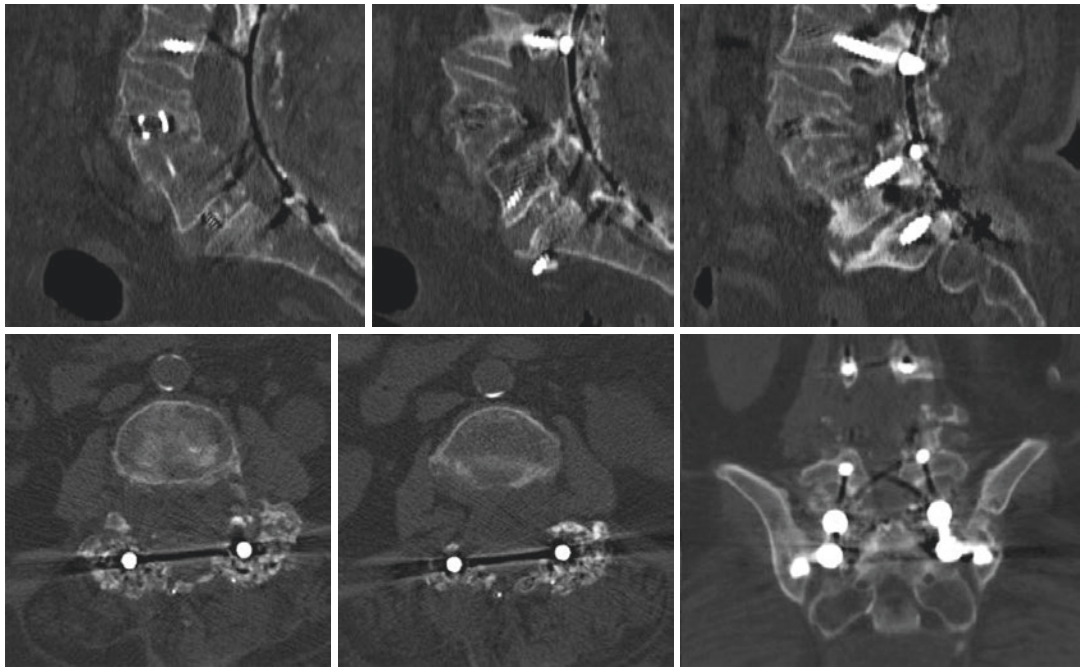

Fig. 23.2 Postoperative CT images

surgery, the motor deficit improved, and 3 days after revision, weakness was 4/5 in both extremities. The motor deficits had fully recovered by 2 years after surgery. The postoperative MRI examination ruled out ischemia and showed no remaining compression (Fig. 23.3).

23.2.4 Infectious Complication

Initial wound healing was good, but on day 14 after revision surgery, the wound showed a purulent secretion with no signs of sepsis. Two days later, surgical debridement and wound lavage were carried out. The implants were left in place. Culture of intraoperative samples yielded *Escherichia coli* resistant to ampicillin and gentamicin. Tailored antibiotic therapy was started. After completing a 2-week course of intravenous antibiotics, the wound had healed successfully and the patient was discharged with an additional 3-month oral antibiotic

Fig. 23.3 Postoperative MRI showing no signs of ischemia or compression

regimen. Further wound healing was uneventful and follow-up visits showed no other complications. One year after surgery, the patient consulted because of a fistula with secretions on the left side of the wound. CT examination showed solid fusion of the construct. The patient was scheduled for a new surgical debridement and 2-stage implant exchange. The implants on the left side, connected with the fistula, were removed (Fig. 23.4). *E.coli* grew in all samples, and showed the same resistance pattern as the strain from the previous infection. Three weeks after partial removal of the instrumentation and antibiotic treatment, reinstrumentation was performed (Fig. 23.5). The patient received oral ciprofloxacin for 6 months following the debridement procedures. Wound healing was uneventful in both staged surgeries.

23.2.5 Final Follow-Up

Two years after the last revision procedure, the patient has full strength and is able to stand and walk without aids. She still has some dysesthesia in both feet, which makes her feel insecure. The dysesthesia is likely related with her diabetic polyneuropathy. The spine is well balanced, with a GAP score of 2, and the x-rays show good correction and solid fusion (Figs. 23.6 and 23.7). However, the patient's perception of her current status is unfavorable. At 5 years following the

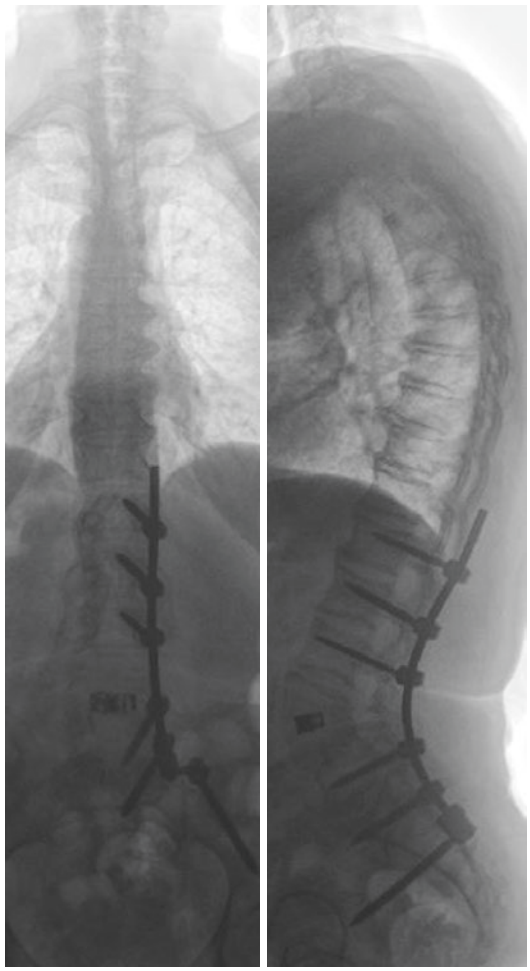

Fig. 23.4 Partial implant removal

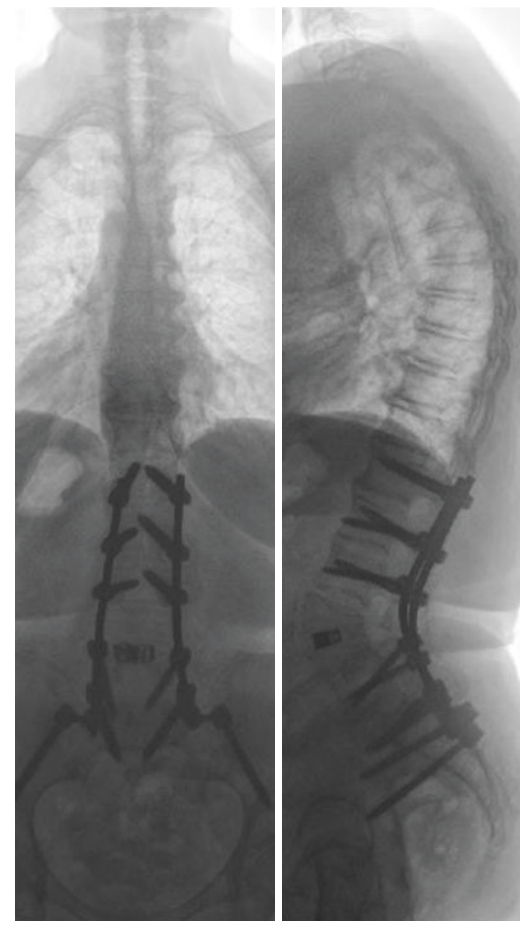

Fig. 23.5 Radiographs following reinstrumentation

original procedure, the ODI and SRS-$22_{subtotal}$ scores were 52.5 (−11.9) and 3.83 (+1.77).

23.3 Discussion

The case presented describes a relatively high-risk patient with diabetes and 4 previous surgeries, who experienced 2 major complications of spinal deformity surgery, both requiring revision surgery. Complex surgeries, as quantified by the Adult Deformity Surgery Complexity Index (ADSCI) are clearly related with a higher risk of developing major complications [1]. Acknowledging this risk is paramount to plan proper perioperative and postoperative care, and to provide adequate counseling for the patient.

As is true for any complex reconstruction procedure of the adult spine, PSO surgery is associated with a degree of neurological risk [2]. A reasonable explanation for the neurological deficit occurring 3 days after the procedure could not be found. Intraoperative neuromonitoring had been uneventful and the patient's neurological examination immediately after surgery was normal. The literature contains few reported cases of delayed postoperative neurological deficit. The largest series includes 92 cases and is the result of a survey carried out in deformity surgeons by the SRS [3]. The cause of the deficit was unknown in 42% of patients, and was attributable to ischemic injury in 38%, cord edema in 4%, and cord compression caused by the instrumentation or a hematoma in 16%. Among the total, 68%

Fig. 23.6 Final alignment according to the GAP Score

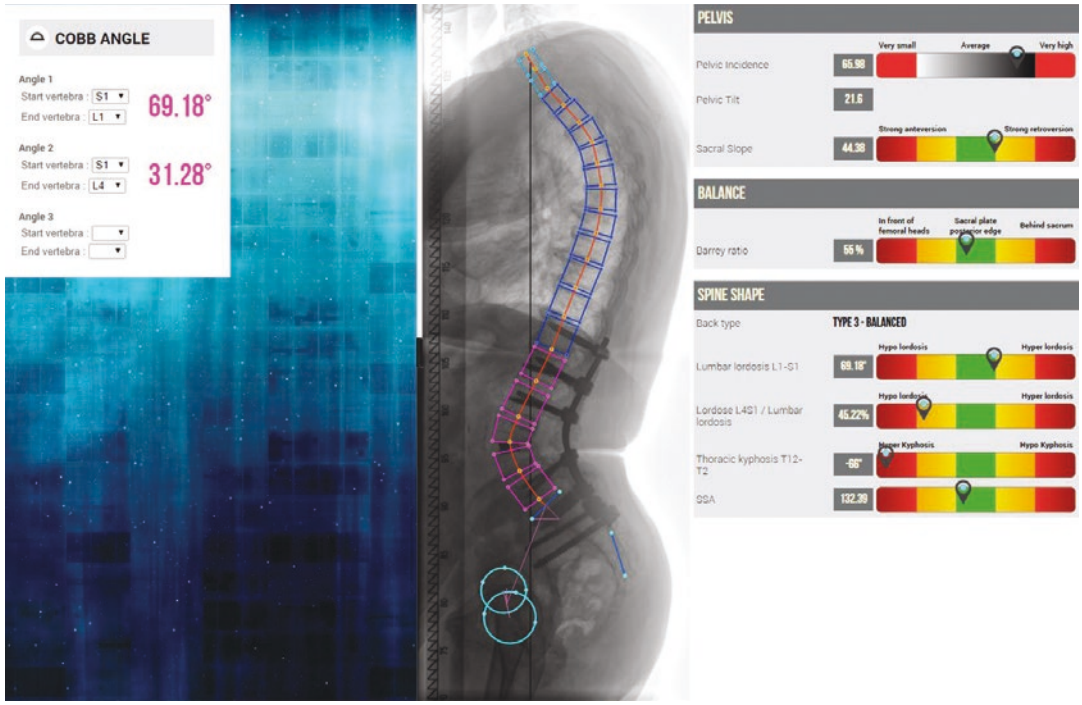

Fig. 23.6 (continued)

Fig. 23.7 Clinical photographs at final follow-up

underwent revision surgery. The prognosis for recovery was found to be better in patients with cord compression than in those with an ischemic cause (86% vs 51%, p = 0.048).

The patient reported here had no signs of compression due to the instrumentation. Some hematoma was seen on CT, but there were no clear signs of dural sac compression. In a previously operated patient, such as the one described, the scarred dural sac may not tolerate compression resulting from osteotomy shortening, and buckling can occur. In a review of 12 PSOs with postoperative neurological deficits [4], some degree of dorsal impingement or subluxation was thought to be the cause in 7 patients, and dural buckling in the remaining 5 patients. Only 3 of the 12 patients had permanent impairment.

Decision-making in this setting is especially challenging as there is pressure "to do something", but there are no clear guidelines or rules to rely on. Due to the considerable disability implied by this type of complication, revision surgery was carried out the following day to investigate residual dural compression or buckling. The intraoperative findings were rather unremarkable, and therefore, all the nerve roots were further decompressed. Dexamethasone was administered for 24 h. Shortly after revision, the neurological symptoms improved, which suggested that further decompression had provided some relief to the neural structures. We cannot know whether the patient might have improved without revision surgery. However, the evidence that compression-related neurological deficits have a better prognosis for recovery supports the idea that the area should be inspected to ensure that all neural structures are free.

Regarding the surgical site infection, the patient had several factors placing her at a high risk for this complication: 4 previous surgeries, a previous infection at the same site, diabetes mellitus, and a long, complex procedure. Dexamethasone administration for 24 h after revision surgery is an additional risk factor for infection. Prophylactic measures included tailored antibiotic prophylaxis and further standard of care measures, such us preoperative skin lavage with chlorhexidine. At the time of revision surgery, an indwelling catheter remained in place from the first procedure. This is a plausible port of entry for gram-negative bacteria (GNB) [5], and the most likely source of infection in our patient. To provide broader coverage against GNB, a combination of gentamycin with standard prophylaxis is an option. However, the strains causing our patient's infection were gentamycin resistant; hence, it is likely that the addition of gentamycin to the prophylactic regimen would not have changed the final outcome in this particular case.

Infection relapse has been described in around one quarter of patients with spinal surgical site infections [6]. The risk factors for treatment failure are uncertain. Some authors have suggested that long-term antibiotic suppression therapy may be helpful to avoid relapses [7], but the available evidence does not suffice to support this measure in all patients. Furthermore, there are no available guidelines on the ideal duration of antibiotic treatment in this clinical situation. In general, antibiotics are given for 3 months, as was done in the present case. Implant removal is usually the best treatment option for infection relapses several months later, as it is the only way to remove the biofilm of microorganisms adhering to the implants. Regarding reinstrumentation, a higher loss of correction rate has been described in adolescent idiopathic scoliosis patients undergoing implant removal without reinstrumentation for late infection [8], but there are no data regarding this issue in adult spinal deformity. Nonetheless, higher rates of implant failure and rod breakage are associated with 3-column osteotomies [9]; hence, it seems reasonable to enhance support with reinstrumentation to avoid further failures. As the infection was confined to only one side, half the implants could remain in situ, providing some stability at the beginning. Regarding the antibiotic treatment to use, there are no standards for cases of relapse. After consultation with the hospital Infectious Diseases Department, directed antibiotic treatment was given for 6 months, and there were no further relapses after 5 years of follow-up.

Pearls

- Delayed onset neurological deficits after PSO might be related to compression and dural buckling or ischemia
- Revision surgery is justified to ensure nerve root decompression and optimise final neurological outcome
- Implant exchange should be considered in cases with recurrent SSI not solved with debridement, antibiotics and implant retention

Editorial Comment

Surgical site infection is a increasing problem in complex spine surgery. The philosophy of early agressive debridement is always recommended. No "wait and see strategy" should be performed. Vacuum assisted closiure, would be an alternative of tretament with promising results concerning woundhealing.

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