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Editor
Nancy E. Epstein, MD
Clinical Professor of Neurological Surgery, School of Medicine, State U. of NY at Stony Brook

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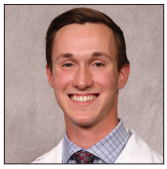
Case Report

Delayed stenosis associated with sublaminar band placement in the thoracic spine for proximal junctional kyphosis

David Gibbs[1], Andrew James Grossbach[2], Noah Mallory[1], Nathaniel Toop[2], Stephanus Viljoen[2]

[1]Department of Neurological Surgery, College of Medicine, The Ohio State University, [2]Department of Neurological Surgery, The Ohio State University Wexner Medical Center, Columbus, United States.

E-mail: *David Gibbs - david.gibbs@osumc.edu; Andrew James Grossbach - andrew.grossbach@osumc.edu; Noah Mallory - noah.mallory@osumc.edu; Nathaniel Toop - nathaniel.toop@osumc.edu; Stephanus Viljoen - stephanus.viljoen@osumc.edu



***Corresponding author:**
David Gibbs,
Department of Neurological Surgery, College of Medicine, The Ohio State University, Columbus, United States.

david.gibbs@osumc.edu

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ABSTRACT

Background: Proximal junctional thoracic kyphosis (PJK) is common following adult spinal deformity (ASD) surgery and may require revision operations. In this case series, we present delayed complications associated with the use of sublaminar banding (SLBs) for PJK prophylaxis.

Case Description: Three patients underwent long-segment thoracolumbar decompression and fusions for ASD. All had undergone SLB placement for PJK prophylaxis. All three subsequently developed neurologic complications secondary to cephalad spinal cord compression/stenosis requiring urgent revision surgery.

Conclusion: The placement of SLBs placed to prevent PJK may lead to sublaminar inflammation contributing to severe cephalad spinal canal stenosis and myelopathy following ASD surgery. Surgeons should be aware of this potential complication and may consider alternatives to SLB placement to avoid this complication.

Keywords: Arthrodesis, Myelopathy, Proximal junctional failure, Proximal junctional kyphosis, Sublaminar bands

INTRODUCTION

PJK is a common complication following corrective surgery for adult spinal deformity (ASD). PJK, radiographically defined as an increase in the sagittal Cobb angle to ≥10° or at least a 10° increase in the segmental kyphosis, affects up to 45% of all patients with 60% becoming symptomatic within 3 postoperative months.[2,4] Some patients experience progression of PJK to proximal junctional failure (PJF) resulting in the onset of new myelopathy, pain, structural deterioration, kyphosis, hardware failure, and/or progressive stenosis. Any of these complications may warrant additional surgical intervention.[3,5,6]

To reduce/prevent PJK, sublaminar bands (SLBs) were introduced to expand the transition zone between the instrumented and noninstrumented proximal junctional levels following long-segment thoracolumbar constructs.[1] Here, however, we found that three patients undergoing extensive thoracolumbar fusions where SLBs were placed, all developed severe myelopathy/

stenosis attributed to the SLBs, requiring removal of these devices. In short, SLBs may expand the proximal stress transition zone, but their safety/efficacy must be questioned.

CASE SERIES

Three patients with ASD averaged 69.3 years of age and underwent long-segment thoracolumbar surgical decompressions and fusions utilizing in-line proximal SLB connectors.[8] An average of 10 months postoperatively, all three patients presented with acute myelopathy requiring urgent revision surgery and removal of their SLBs. The presentation, indications for revision, and clinical course of these patients are summarized in [Table 1].

Patient #1

Our first patient, a 57-year-old female with a history of multiple spine surgeries and a spinal cord stimulator had preoperative imaging that demonstrated a local lumbar lordotic deformity with a pelvic incidence-lumbar lordosis (PI-LL) mismatch of −14° and a C7 sagittal vertical axis (SVA) of 92.3 mm. Further, there was pseudoarthrosis with a mobile spondylolisthesis at L4-5 with neural foraminal stenosis bilaterally at L2-L3 and L5-S1. She underwent T8 to pelvis fusion with a T7 SLB. Two months later, she acutely presented to the emergency department with sudden onset bilateral lower extremity paraparesis. CT showed thoracic canal stenosis and a fracture at T7, the level of the SLBs. Revision with removal of the SLB and extension of her construct to T4 was performed and she improved postoperatively.

Patient #2

Our second patient, a 77-year-old male, initially presented with worsening low back and right leg pain. Imaging demonstrated global kyphotic sagittal deformity with a PI-LL mismatch of 18° and a C7 SVA of 10.2 mm [Figure 1a]. He was treated with decompression and fusion to T10 with a T9 SLB [Figure 1b]. Sixteen months after surgery, he presented with the acute onset of fecal incontinence and bilateral lower extremity paresis. The MRI demonstrated severe spinal canal stenosis at T9-T10 [Figures 2a-d]. Urgent revision with extension to T4 and removal of the SLB was performed. Following his revision, the patient's lower extremity strength improved, from 0/5 to 2/5, and his fecal incontinence resolved.

Patient #3

Our third patient, a 74-year-old male presented with intractable back and leg pain requiring revision of his prior L4-S1 construction. X-ray imaging demonstrated a local lordotic sagittal deformity with a PI-LL mismatch of 13° and C7 SVA -27.6 mm. He underwent revision and extension to T10 with a T9 SLB. Eleven months later, he presented to the ED paralyzed and insensate in both of his lower extremities.

Table 1: Case presentations of potential complications associated with sublaminar bands.

Patient	Sex	Age	Initial Surgery	Revision Signs and Symptoms	Imaging Findings	Interval Until Revision	Revision Surgery	Post-revision Outcomes
1	F	57	T8 to pelvis with T7 SLB for lumbar lordotic deformity and mobile spondylolisthesis	BLE paresis	CT confirmed canal stenosis and T7 fracture	2 months	Removal of SLB and extension to T4	Complete resolution of paresis
2	M	77	T10 to pelvis with T9 SLB for global kyphotic sagittal deformity	Acute onset fecal incontinence and BLE paresis	MRI confirmed severe T9-T10 canal stenosis	16 months	Removal of SLB and extension to T4	Complete resolution of fecal incontinence, improvements in BLE strength from 0/5 to 2/5
3	M	74	Revision of L4-S1 fusion, with correction of local lordotic deformity and extension to T10 with a T9 SLB	BLE paralysis with complete loss of lower extremity sensation	MRI confirmed severe T9-T10 canal stenosis	11 months	Removal of SLB and extension to T4	Complete resolution of sensation, ability to ambulate with minimal assistance

F: Female, SLB: Sublaminar Band, BLE: Bilateral Lower Extremity, CT: Computed Topography

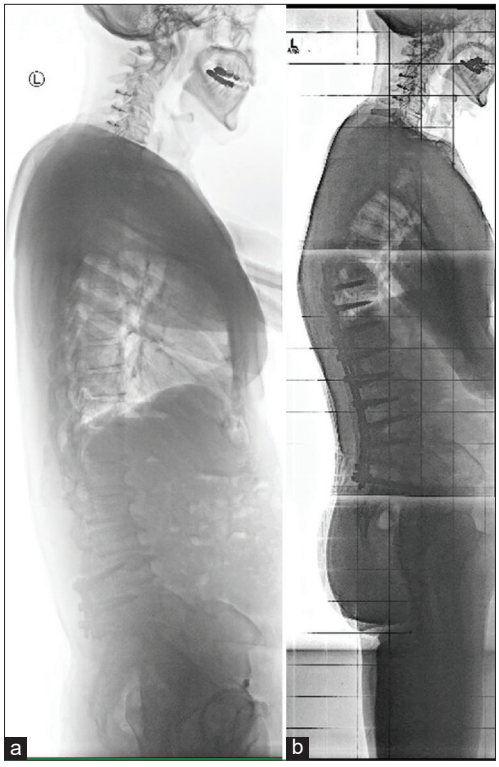

Figure 1: Case example showing X-ray imaging preoperatively (a) and postoperatively (b) at time of urgent myelopathic symptoms following sublaminar band placement.

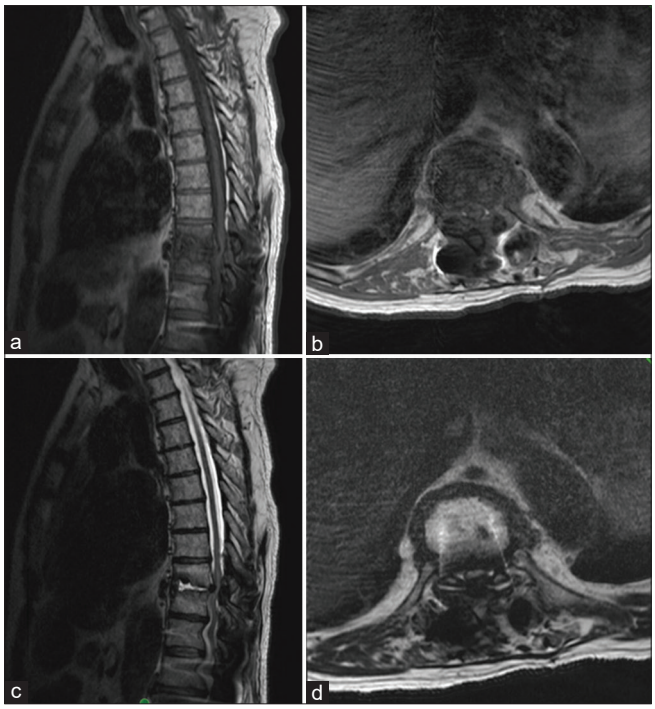

Figure 2: Case example showing T1 (a and b) and T2 (c and d) MRI at time of urgent myelopathic symptoms following sublaminar band placement.

The MRI revealed severe T9-T10 canal stenosis that prompted urgent revision and extension to T4 with removal of his T9 SLB. Postoperatively, he was able to ambulate with minimal assistance and had completely recovered sensation.

DISCUSSION

Here, we presented three patients who had SLBs placed one level above the proximal end of long-segment thoracolumbar constructs (decompressions/fusions) to mitigate the risk of PJK/PJF. All three developed acute postoperative myelopathies due to SLB-related significant inflammation and tissue hypertrophy resulting in severe spinal cord compression. At revision surgery, the vertebrae where the SLBs were placed formed what appeared to be "Charcot-Joint" like tissue hypertrophy. While the *in vivo* characteristics of SLBs remain unstudied, we hypothesize that micromotion against the band within the sublaminar joint space may lead to chronic inflammation and the subsequent development of the observed canal stenosis and myelopathy. Viswanathan *et al*. were the first to prospectively assess the potential role for SLBs in preventing PJK/PJF at 1 year among 40 ASD patients.[7] Other authors have investigated proximal tethers/bands as PJK/PJF prevention techniques, but Viswanathan *et al*. are the primary contributors studying the safety and efficacy of SLBs among adult patients. There is one current prospective clinical trial investigating the long-term safety and efficacy of thoracic and lumbar SLBs (Clinical trial registration no.: NCT02411799 [clinicaltrials.gov]), yet aside from this pending study, there are currently scarce data regarding complications associated with SLB placement in the thoracic spine. While there are reports of proximal tethers and PJK/PJF prevention devices, we turn our focus on the sublaminar aspect of these bands.[6] As a result of observing these complications, until SLBs are better characterized, we call into question the safety and efficacy of placing SLB's proximal to extensive thoracolumbar fusions.

CONCLUSION

SLBs may be effective in preventing PJK/PJF following extensive thoracolumbar fusions, but their long-term safety, as documented in the three patients presented above, remains questionable.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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