CASE REPORT

Parapedicular vertebral augmentation with polymethylmethacrylate for pedicle screw loosening

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SUMMARY

A 71-year-old man who had a L1/S1 posterior fusion revision surgery complained of increasing back pain 5 weeks after the open surgical procedure. The pain was initially estimated at 9/10 on the visual analog scale (VAS) and thought to be related to a right-sided L2 screw loosening. A right parapedicular vertebroplasty was performed and polymethylmethacrylate cement was instilled around the right pedicle screw, filling the anterior two-thirds of the vertebral body. On postvertebroplasty day 1, the patient had significant improvement in his low back pain. The pain further decreased at 1 and 3 months after the intervention (2/10 on the VAS). Vertebroplasty is a minimally invasive, accessible, effective, and long lasting treatment for compression fractures. We believe that this technique could also be indicated to treat pain related to low grade screw loosening in properly selected patients.

BACKGROUND

Most cases of pedicle screw loosening are surgically revised. Our patient with complex spinal reconstruction surgery developed symptomatic low grade screw loosening early after lumbar hardware revision. Because of the reluctance of the patient and surgeon for a third open surgery, a minimally invasive parapedicular vertebroplasty with polymethylmethacrylate (PMMA) was performed. Clinical success was evidenced by a significant and sustained decrease in pain and increased activities of daily living, as well as improvements in his range of motion. Given the remarkable improvement in quality of life for our patient, we would like to share this procedural technique.

CASE PRESENTATION

A man aged 71 years presented with severe lumbar pain status, postrevision and extension of an L1/S1 fusion and reconstruction surgery 5 weeks earlier. The patient was initially diagnosed 3 years prior with an L4 chordoma and treated with radiation therapy and surgery, including an L4 corpectomy, interbody fusion cage, pedicle screws, and four rod construct spanning from L2 to the pelvis.

Three months prior to the current presentation, the patient fell while gardening, heard a snapping sound, and immediately had severe right-sided

sciatic pain. Lumbar spine radiograph demonstrated cage subsidence, loosening of the bilateral L2 pedicle screws with disconnection of a left-sided vertical rod from the left L2 screw, a fracture of the left L3 pedicle screw, and a fracture of a right-sided rod.

Surgical removal of the broken rods as well as the pedicle screws at L2 and L3 was performed. Also, an extension of the instrumentation (L1 to the pelvis) was achieved with positioning of new larger diameter pedicle screws at L2 and L3 ([figure 1A](#)). The patient did well after this surgery but gradually developed back pain over the following 5 weeks. His symptoms were exacerbated with activity (9/10 on a visual analog scale (VAS)) and only mildly relieved with immobilization. The patient was admitted for pain management and denied new onset of weakness, numbness, or acute changes in bowel or bladder habits.

CT scan of the lumbar spine demonstrated intact surgical hardware with the exception of a new right-sided L2 screw loosening, measuring up to 3 mm ([figure 1B, C](#)). Because of the recent and complex surgery, both the patient and surgeon were reluctant to proceed with a new open surgical intervention. Our service was consulted to evaluate the possibility of stabilizing the screw loosening by injecting PMMA into the L2 vertebral body.

TREATMENT

According to the normal protocol, the patient was placed prone and the appropriate spine region was prepped and draped in a sterile fashion. Intravenous antibiotics and conscious sedation were administered. The correct level was verified by continuous fluoroscopy and referenced to the original imaging. The needle insertion site and periosteum above the right pedicle of the L2 vertebral body was anesthetized by lidocaine injection. A 10 gauge diamond stylet vertebral augmentation needle was used and advanced in the L2 vertebra with a right parapedicular approach to avoid the vertical rods. Once the needle tip was positioned in the posterior third of the vertebral body, a curved needle was inserted. The tip of the curved needle was positioned anteriorly and medially to the right L2 screw ([figure 2A, B](#)). PMMA was injected around the right pedicle screw, filling the anterior two-thirds of the vertebral body ([figure 2C, D](#)) and interdigitating with the screw.

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Figure 1 (A) Anteroposterior radiograph shows L1/S1 hardware. (B, C) Sagittal and axial CT images demonstrate loosening of the right L2 pedicle screw (white arrows).

The curved needle and working cannula were removed and the patient was transported to the recovery area in a stable condition.

OUTCOME AND FOLLOW-UP

On postoperative day 1, the patient had significantly decreased back pain (9/10 preoperatively compared with 4/10 postoperatively on the VAS).

Longitudinal follow-up at 1 month and 3 months demonstrated further interval decrease in pain, estimated at 2/10. Qualitative assessment of activities of daily living indicated that the patient was able to perform an increased number and variety of tasks independently. Feedback regarding range of motion indicated that the patient was able to gain range of motion with flexion, extension, and the rotational range of his lumbar spine.

DISCUSSION

Pedicle screws loosening is a major cause of morbidity in patients who undergo spinal fusion surgery. The underlying reasons for

screw loosening include initial poor bone density/quality, instrumentation induced stress shielding and subsequent disuse osteopenia, plastic deformation at the bone–screw interface, or high static stress in combination with cyclic loading.¹ Several options have been proposed to avoid such complications, including the use of hydroxyapatite coated screws, expandable screws, bicortical screws, larger diameter screws, and cannulated and fenestrated screws. However, when loosening occurs, few options exist and open surgery with hardware revision is typical. An alternative treatment method has recently been described using a modified pedicle screw technique with PMMA. However, this technique still requires open surgery and insertion of new screws.²

To our knowledge, vertebroplasty has not been evaluated as a method to treat pain related to low grade screw loosening. In patients with spinal fusion, vertical rods and pedicle screws can limit access to the vertebral body by a conventional transpedicular approach. Parapedicular or extrapedicular approaches offer a favourable route to the center of the vertebral body in this circumstance.^{3,4} Once the vertebral body is reached, a curved needle can be used to orient the needle tip near the target (distal loosened screw). This promotes circumferential cement instillation around the screw. In this patient, PMMA augmentation significantly reduced the pain related to that loosening.

Using the technique described above, this procedure can be attempted and promotes an expedited recovery of function when compared with traditional approaches. Although longitudinal and biomechanical studies are required to demonstrate the clinical indications for this intervention, we believe that this technique can be safely attempted in selected patients with symptomatic low grade screw loosening affecting one vertebral level. For patients with pronounced screw loosening, multilevel loosening, or spinal instability, open surgical intervention with spinal fusion revision should continue to be performed in the absence of further data supporting this technique.

Learning points

- ▶ Pedicle screw loosening is a major cause of morbidity status postinterbody fusion for chronic back pain and oncologic spinal surgery.
- ▶ Vertebroplasty, a minimally invasive technique, might be useful in reducing pain related to screw loosening in patients with comorbidities who are ill suited for open surgery.
- ▶ Both parapedicular and extrapedicular approaches can be safely used to avoid spinal hardware and optimize access to the vertebral body.
- ▶ Polymethylmethacrylate instillation around a loose screw may stabilize hardware and prevent further loosening; however, more data from longitudinal and biomechanical studies are needed.

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Figure 2 (A, B) Fluoroscopic images demonstrating the curved needle positioned anteriorly and medially to the right L2 pedicle screw (white arrows). (C, D) Postprocedure radiographs show adequate cement instillation and polymethylmethacrylate interdigitation (white arrow).

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