

# A limited unilateral transpedicular approach for anterior decompression of the thoracolumbar spinal cord in elderly and high-risk patients

## ABSTRACT

**Background:** Surgical treatment for elderly patients with thoracolumbar (TL) kyphosis and spinal cord (SC) compression presents significant challenges due to compression location, the amount of deformity, and patient's medical status might not permit full correction of the deformity. In this series, we present a surgical approach that provides adequate decompression without the risks associated with a pedicle subtraction osteotomy/posterior vertebral column resection or an anterior corpectomy.

**Methods:** Three patients presented with TL kyphosis and progressive neurologic symptoms. All had acute weakness; none were ambulatory. SC was compressed over the apex of kyphosis, and for some, there was spinal stenosis at the proximal junction of the TL spine. The surgical technique involved unilateral resection of the pars, pedicles, the posterior one-third of the lateral wall of the vertebral body, decancellation of the impinging kyphus, and finally resection of the posterior vertebral body wall compressing the SC followed by instrumentation and fusion two levels above and below the fused segments.

**Results:** All patients survived the procedure and left the hospital after 10–22 days. Estimated blood loss was 653 ml. No deep infections occurred. One patient developed acute tubular necrosis but recovered fully. The other two showed improvement of one Frankel grade and were independent in the final follow-up. One patient developed acute tubular necrosis but recovered fully yet his neurologic status was unchanged. The other two showed improvement of one Frankel grade and were independent in the final follow-up.

**Conclusion:** The procedure described presents a compromise that fits the more elderly patient that might not be able to tolerate major deformity correction and at the same time provides similar results in the short and medium term to more extensive procedures.

**Keywords:** Kyphosis, spinal cord, spinal fusion

## INTRODUCTION

Many elderly patients are treated conservatively for thoracolumbar (TL) fracture or tuberculosis and end up with a painless TL kyphosis. Some present later with acute neurologic compromise caused by stretching of the spinal cord (SC) over the kyphus. Management of TL fractures of the elderly in underdeveloped countries poses significant challenges. In some cases, these patients are treated conservatively and not followed up properly. In others, a clear indication for surgery is there but is not followed due to lack of access to surgical facilities or refusal of the patient. In some cases, it is the referring physician who, unfortunately, places the more elderly patient in least priority. In many of


these cases, conservative treatment is successful and few complications are encountered.

When the patient starts to develop late neurological deficit, months and sometimes years later, both patient and physician are more inclined to refer the patient for surgical care. At

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this stage, the deformity has progressed and the fracture, or in some cases, tuberculous spondylitis-healed causing ventral compression of the SC over a hard bony ridge.<sup>[1,2]</sup> Standard surgical management at this stage involves either a two-stage anterior followed by posterior procedure for decompression and instrumented fusion or a single-stage pedicle subtraction osteotomy (PSO) or posterior vertebral column resection (PVCR) done through a posterior approach. Anterior thoracotomy or a thoracoabdominal approach can jeopardize the already reduced pulmonary reserve (wong). In addition to that, it is a major undertaking and, in this age group, is associated with high morbidity and mortality (up to 11%).<sup>[2]</sup> PSO and PVCR also have high complication rates and should only be done by experienced hands and in high-volume institutions.<sup>[3]</sup>

Here, we present a surgical technique that achieves anterior decompression of the SC, without correction of the deformity, preserving the posterior elements and including a long posterior fusion for prevention of progression of the deformity in selected patients.

## METHODS

Over a period of 4 years (2010–2014), 3 patients, above the age of 60, presented to our institution with TL junctional kyphosis and late-onset weakness. In two patients, the original pathology was a burst fracture, while in the third, the pathology was an unconfirmed healed tuberculous spondylitis. The average age of the patients was 66 years. The time from fracture to presentation was 3 and 8 months in two patients who had a clear history of a preceding traumatic event. The neurologic assessment was done on admission and graded using the Frankel grading system.<sup>[4]</sup> Each patient's pathology was evaluated radiologically by means of plain radiographs, computerized tomography (CT), and magnetic resonance imaging (MRI). Table 1 shows summary of patients' condition.

### Patient 1

A 63-year-old presented with back pain, inability to walk without assistance for 3 months. His initial traumatic event was a fall from 2 m height. Physical examination revealed bilateral lower limb weakness, motor scores of 4/5 L2 to L5, and was such was graded as Frankel D. Bowel and bladder function was normal. Long tract sign was absent. X-rays, CT, and MRI showed a burst fracture of L1 with cord compression and myelomalacia. Postoperatively, the patient recovered 1 Frankel (Grade E) but continued to complain of plantar paresthesia. In the latest follow-up at 2 years, the patient was pain free, ambulatory without assistive devices and his neurological symptoms have not progressed since surgery.

### Patient 2

A 74-year-old male presented with back pain and inability to walk since a fall from one flight of stairs 8 months ago. He admits that for the first 6 weeks he was able to extend his hip joint and both flex and extend his knee joint but that gradually got weaker with time. He was managed in the community hospital with a TL brace, but his compliance was minimal. Neurological examination showed weakness in hip flexors, knee extensors with intact ankle motor control (2–3/5 L2–L3, Frankel C). Bowel control was intact, but he had occasional urinary retention. Long tract sign was absent. Imaging shows L1 complete collapse and 45° kyphosis causing anterior compression of the SC. CT and MRI confirmed cord compression and complete vertebral collapse of L1. Bone density, as measured by a dual-energy X-ray absorptiometry, shows a T-score of –2.6 in the lumbar spine. Postoperatively, the patient recovered 1 Frankel grade (now Frankel D) and eventually admitted to a rehabilitation facility. At final follow-up 18 months later, the patient is independent with two canes or a walker and his neurological symptoms have not progressed since surgery.

### Patient 3

A 61-year-old male, with no previous history of trauma, presented with a 2 months history of progressive walking imbalance followed shortly by bilateral foot drop. He denied any previous traumatic event, and when asked about the history of treatment for tuberculosis of the spine, he denied such treatment. On examination, there was a clear kyphus at the TL junction. Cranial nerve and upper limb neurologic examination were unremarkable. Long tract signs were absent. Neurologic examination of the lower limbs revealed 2–3/5 motor score for hip flexion and knee extension while ankle dorsiflexion was 1/5. Plain radiographs and CT showed a 90°-kyphosis and complete fusion of five vertebrae from T11 to L3 [Figure 1]. MRI shows compression of the SC at two levels: the middle of the kyphus anteriorly as well as just proximal to the fused segments [Figure 2]. Postoperatively, the patient did not recover neurologically, but neither did he progress. Five days from surgery, he developed acute renal impairment due to urinary retention and severe hydronephrosis. This was managed conservatively with hydration, careful monitoring of his fluid intake, and recovered from it completely within 24 h. The urinary symptoms were found to be due to a combination of neurogenic bladder and benign prostatic hyperplasia. He later underwent elective prostatectomy and his symptoms resolved completely shortly afterward. Final follow-up was at 4 years. The patient improved functionally and was able to walk independently using a walker [Figures 3-5].

**Table 1: A summary of the three patients' presentation, investigation and outcomes**

	Patient 1	Patient 2	Patient 3
Age (years)	63	74	61
Presentation	Back pain, inability to walk without assistance for 3 months	Back pain and inability to walk for 8 months	2 months history of progressive walking imbalance followed shortly by bilateral foot drop
Traumatic event	Fall from 2-m height	Fall from one flight of stairs	No previous history of trauma
Physical examination	Bilateral lower limb weakness <sup>a</sup>  Long tract signs were absent	Weakness in hip flexors, knee extensors with intact ankle motor control <sup>b</sup>	Kyphus at the TL junction <sup>c</sup>
Bowel and bladder function	Normal	Bowel control was intact, but he had occasional urinary retention	Normal
Imaging	Burst fracture of L1 with cord compression and myelomalacia	L1 complete collapse and 45° kyphosis causing anterior compression of SC CT and MRI confirmed cord compression and complete vertebral collapse of L1 Bone density (DEXA) shows a T-score of -2.6 in the lumbar spine	90° kyphosis and complete fusion of 5 vertebrae from T11 to L3 MRI shows compression of the SC at 2 levels: The middle of the kyphus anteriorly as well as just proximal to the fused segments
Postoperation	Recovered 1 Frankel (Grade E) but continued to complain of plantar paresthesia	Recovered 1 Frankel grade (now Frankel D) and eventually admitted to a rehabilitation facility	Did not recover neurologically but neither did he progress
Follow-up	In the latest follow-up at 2 years, the patient was pain free, ambulatory without assistive devices and his neurological symptoms have not progressed since surgery	At final follow-up 18 months later, the patient is independent with two canes or a walker and his neurological symptoms have not progressed since surgery	Final follow-up was at 4 years. The patient improved functionally and was able to walk independently using a walker

<sup>a</sup>Motor scores of 4/5 L2-L5- and was such was graded as Frankel D, <sup>b</sup>2-3/5 L2-L3, Frankel C, <sup>c</sup>2-3/5 motor score for hip flexion and knee extension while ankle dorsiflexion was 1/5. SC - Spinal cord; MRI - Magnetic resonance imaging; CT - Computerized tomography; DEXA: Dual-energy X-ray absorptiometry; TL - Thoracolumbar

### Surgical technique

The patient was placed in the prone position with adequate protective padding of his face, chest, iliac crest, and knees. The levels were confirmed using fluoroscopy. A midline posterior approach was utilized. Pedicle screw instrumentation was placed two levels above and two levels below the level of the decompression. The supraspinous ligaments, spinous processes, and lamina were left intact.

The decompression started with dissection of the transverse processes, cost-transverse junction, and pars interarticularis of the level of the compression. The transverse process, rib head, and pedicle were resected in that order leaving the medial and inferior wall of the pedicle intact. The lateral wall of the vertebral body was further exposed by subperiosteal dissection, but only one-third to one-half of it is resected. At this stage, the medial and inferior wall of the pedicle is resected, and the nerve root is identified. It is used as a guide to the spinal canal. Decancellation of posterior vertebral body, supporting the hard cortical bony ridge causing the compression, is now performed. This was done with straight and angled curettes. Once that is carried out, the posterior vertebral body wall above and below the stenosis, roughly above and below the pedicle in most cases, is resected by collapsing it into the void left by the decancellation. Finally, any adhesions between the dura and the posterior longitudinal ligament are released. The bony ridge causing the compression is now free from all its connections, except

its connection to the lateral vertebral wall on the contralateral side, and can also be collapsed into the void in the vertebral body. A unilateral approach usually provides enough space for full central decompression and the dissector will be able to pass to the contralateral side [Figure 6]. Intraoperative imaging can confirm that. Decortication of the contralateral laminae and transverse processes and bone grafting is performed. The wound is then closed in layers over a closed suction drain. Postoperatively, the patient is permitted activity as tolerated without a brace.

### DISCUSSION

Delayed decompression of the SC, although not ideal, has been shown to improve neurologic outcome in SC injured patients.<sup>[5-7]</sup> Little is available in the literature that addresses this issue in the thoracic spine in the subacute setting.<sup>[8]</sup>

Much of the literature regarding late paraplegia for TL kyphosis comes from cases of tuberculosis of the spine.<sup>[1,2,9,10]</sup> In this population, there has been a gradual move away from anterior procedures toward posterolateral procedures. Some of the reports, however, address similar clinical scenarios but in the posttraumatic population with residual deformity and late-onset SC compression.<sup>[11-14]</sup> These reports present outcomes of such procedures using anterior, posterior, and combinations of both. The same can be said here; as there is a move toward single-stage



Figure 1: Three-dimensional computerized tomography of kyphotic segments

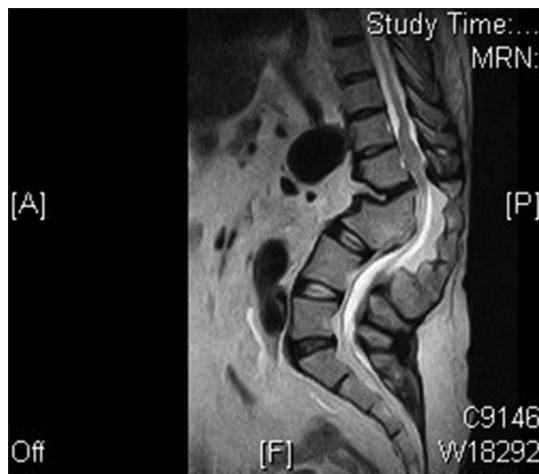


Figure 2: Magnetic resonance imaging of kyphosis showing cord compression



Figure 3: Postoperative computerized tomography scan showing internal resection of the kyphus



Figure 4: Postoperative X-rays showing spinal alignment



Figure 5: Postoperative posteroanterior radiographs

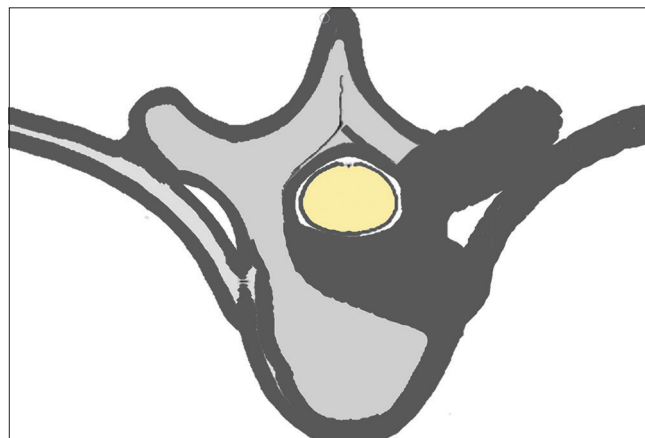


Figure 6: The transverse process, rib head and pedicle were resected in that order leaving the medial and inferior wall of the pedicle intact (resected area in dark grey)

posterior only correction which provides equal clinical and radiologic outcomes with less complication rates compared with open techniques.<sup>[13]</sup>

Very few series focus on the middle-aged and elderly patient, especially those with extensive medical comorbidities. In fact, in over a century of medical research of TL fracture



classification only in this decade was a classification system proposed that addresses the patient's medical status as a factor to be taken into consideration in managing such an injury.<sup>[15]</sup> Surgical management of the disease in this age group is often fraught with issues of patient's ability to tolerate the procedure medically and the uncertainty of neurologic recovery postdecompression. Issues of global sagittal balance, although relevant to any procedure for kyphosis in the TL spine, had less significance in this series as the patients all had a balanced spine with normal sagittal-vertical axis due to compensatory mechanisms.

Posttubercular kyphosis correction through anterior and anterolateral approaches are effective in improving neurological deficit but less so in correcting kyphosis.<sup>[13]</sup> Surgery is indicated in patients with progressive neurological deficit, progressive spinal deformity, failed conservative treatment, pain caused by abscess or instability, and uncertain diagnosis. Neurological sequelae of kyphosis include paraplegia or quadriplegia secondary to cord compression, whereas physiological and anatomic sequelae include cardiorespiratory compromise and impingement of the costal margins over the iliac crest.<sup>[3]</sup> Early-onset paraplegia is usually caused by active tuberculosis within 2 years, while late-onset paraplegia is usually caused by healed tuberculosis after 2 years.<sup>[9]</sup>

In the late setting, spinal surgery is less effective because patients tend to be older and compromised neurologically and physiologically, and all three columns tend to be affected. The posterior approach is technically more challenging and requires intraoperative neuromonitoring and pedicle screw spinal instrumentation.<sup>[8]</sup> The risk of neurological complications after the posterior approach is higher in older patients, particularly in those with a severe deformity, a vascularly compromised atrophic cord, and long-standing cord compression.

In PVCR, both the SC and the bone/disc wedge fragment compressing it are identified under direct vision. Complete decompression can then be safely accomplished, as well as full deformity correction. PVCR is safe when performed at cord level and more than one vertebrae can be excised, enabling translation and shortening if necessary to correct rigid deformities.<sup>[10]</sup> On the other hand, the disadvantage of PVCR is that there is no clear visualization of ventral SC. Some might argue that there is no need for that as adequacy of decompression can be assessed both by tactile feedback and through use of intraoperative CT, if available. In addition to that, it is an extensive procedure with significant blood loss the risk of neurologic compromise due to the acute correction of long-standing spinal deformity.

The proposed technique in this series combines anterior decompression, through a unilateral posterolateral approach, with contralateral posterior instrumentation and fusion. It achieves the objectives of decompression and stabilization without performing dual approaches, anterior and posterior, and without the extensive dissection and aggressive deformity correction in PVCR. We have found that unilateral posterolateral approaches provide adequate visualization of the posterior vertebral body and anterior cord. In patients where the sagittal alignment is maintained or there is minimal sagittal imbalance, this approach is a good compromise that provides excellent outcomes and a quick recovery.

## CONCLUSION

In this patient population, there has been a gradual move away from anterior procedures toward posterior procedures. Very few series focus on the middle-aged and elderly patient. Surgical management of the disease in this age group is often fraught with issues of patient's ability to tolerate the procedure medically and the uncertainty of neurologic recovery postdecompression.

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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