

Mini-open transpedicular lumbar vertebrectomy reconstructed with double cages and short segment fixation

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Abstract

Background: The purpose of this study was to assess the feasibility of using dual expandable cages plus short segment posterior fixation for reconstruction of vertebral bodies following a mini-open transpedicular approach.

Methods: A single posterior incision was used to perform a laminectomy of L2, a partial laminectomy of L1 and bilateral transpedicular approaches for a piecemeal vertebrectomy in a patient with spinal compression secondary to metastatic cancer. Subsequently, bilateral cages were placed through the transpedicular corridors and percutaneous pedicle screws were inserted a single level above and below the level of the vertebral column resection.

Results: The bilateral transpedicular approach facilitated the use of a mini-open incision (6.0 cm) compared with the extensive dissection normally employed for a lateral extracavitary type approach in the lumbar region. The bilateral transpedicular approach at L2 allowed for a vertebrectomy and complete decompression of neurological elements. The use of expandable cages allowed the nerve roots to be preserved. Placement of the cages in the lateral position was straightforward despite minimal exposure. The reconstruction with double expandable cages appeared robust.

Conclusions: In select patients requiring circumferential decompression of the lumbar spine, dual cage reconstruction decreases the technical difficulty of the operation and facilitates a mini-open approach. The durability of this construct will need biomechanical assessment and long-term clinical follow-up.

Key Words: Expandable cage, lumbar metastases, minimally invasive surgery, vertebrectomy

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INTRODUCTION

The posterior only approaches for anterior vertebral pathology are being used more frequently due to advances in technique and instrumentation. In particular, in the thoracic spine, the classic lateral extracavitary approach provides a generous corridor for vertebral tumor resection

and subsequent central cage placement once nerve roots are sacrificed.^[3,4] However, despite certain advantages, few surgeons perform the lateral extracavitary approach. It is generally time consuming, technically difficult and entails significant risks.

A similar approach can be used in the lumbar spine; however, this region presents unique challenges that

magnify the difficulty of the posterior only approach. Because of the more robust paraspinal musculature and anterior location of the lumbar spine, the length of incision and paraspinal dissection in the lumbar spine need to be very extensive in order to achieve the appropriate oblique trajectory for placement of a central cage. Further, nerve roots cannot be sacrificed and must be circumnavigated during the placement of anterior instrumentation from the posterior only approach.

Despite the difficulties associated with a posterior only approach, there remains a significant appeal, especially so in the oncologic setting. The posterior approach is the most familiar, and most patients who really need surgery require a posterior approach to decompress the spinal canal regardless of whether an anterior approach is performed.

The goal of this study was to optimize the lumbar posterior only approach, balancing invasiveness and technical difficulty with aggressive anterior decompression. We hypothesized that these aims could be achieved with a bilateral transpedicular approach through a limited incision with reconstruction using double cages and short segment posterior fixation.

MATERIALS AND METHODS

Patient selection

The patient was a bedridden 52-year-old male with widespread metastatic sarcoma involving the lumbar spine. Because of his poor prognosis, radiation and salvage chemotherapy were initially used to treat his spinal metastasis. However, despite aggressive nonsurgical management, the patient remained bedridden with intractable lumbar pain. Seven days after completing maximal spinal radiation, the patient developed further bilateral leg weakness and urinary incontinence. Magnetic resonance imaging of the spine revealed an anterior compression of the spinal cord from a pathological L2 fracture [Figure 1]. Due to the patient's relative youth,

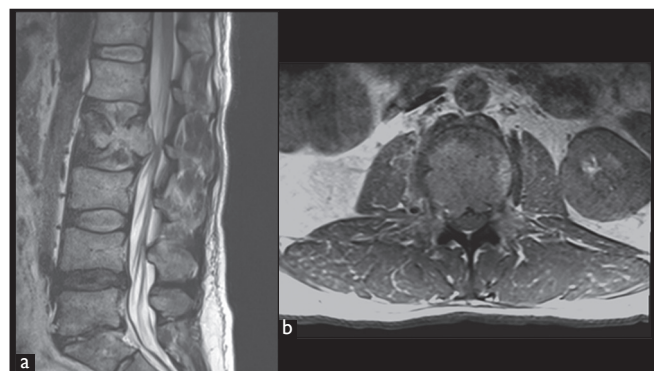


Figure 1: Preoperative imaging. (a) T2-weighted sagittal magnetic resonance imaging (MRI) showing a L2 pathological fracture. (b) T1-weighted axial MRI revealing degree of spinal canal compromise

terrible prognosis, cachexia and recent radiation, we offered the patient a novel construct that could be inserted through an incision sparing approach.

Surgical decompression

A 6 cm midline incision was centered on the vertebral body of L2. The dissection exposed the inferior lamina of L1, lamina of L2 and transverse processes of L2. A McCullough retractor was used for retraction. The inferior facet of L1 and the superior and inferior facets of L2 were removed, fully exposing the relevant nerve roots, disc spaces and the L2 pedicles.

Next, a bilateral transpedicular approach was used to remove the L2 pedicles, exposing the lateral aspects of the spinal cord and the L1 and L2 nerve roots bilaterally, which were preserved and marked with vessel loops. Subsequently, the lateral L2 vertebral body was resected using the established transpedicular corridors. At this point, using bilateral manipulation of the remaining anterior tumor, a plane was identified between the tumor and the anterior thecal sac. The previous lateral resection of the vertebral body then facilitated a medially directed approach to remove the central tumor and vertebral body. An angled mirror was used to confirm resection of the posterior longitudinal ligament and tumor under the anterior thecal sac. To complete the resection, the L1/L2 and L2/L3 discs were removed with preparation of the inferior end plate of L1 and superior endplate of L3 for subsequent anterior instrumentation and arthrodesis.

Surgical reconstruction

Given the small and relatively deep operative field, there was limited obliquity, preventing the insertion of a single, robust, centrally located anterior cage. Therefore, we exploited the wide rectangular space on each side of the thecal sac placing two small expandable titanium cages (Globus Medical, Audubon, PA, USA) [Figure 2].

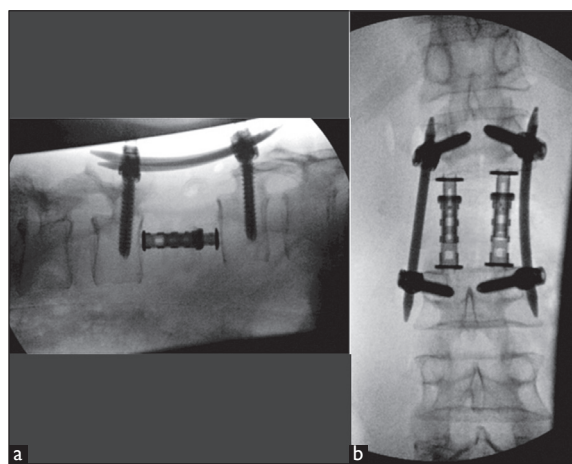


Figure 2: Intraoperative fluoroscopy. (a) Lateral and (b) anterior-posterior views of double cage placement after *in situ* expansion. Note that there is a small amount of iatrogenic scoliosis that could have been prevented with placement of temporary rods

The two cages, spanning from L1 to L3, and partially situated on the cortical rim of the endplate, were expanded to the same degree and evaluated manually and fluoroscopically [Figure 3a]. Subsequently, percutaneous pedicle screws were placed at L1 and L3 and connected with rods under mild compression [Figure 3b]. Neuro-monitoring remained stable throughout the operation. The patient was placed in a thoracolumbar brace postoperatively.

RESULTS

With two attending surgeons, the operative time was 3.5 h, with an estimated blood loss of 400 cc. The patient had immediate improvement in leg strength and was able to ambulate limited distances with a walker, although he was mostly bedridden due to his poor overall condition. Additionally, the patient's pain was significantly improved 1 week following surgery. Postoperative films, both immediately and at 3 months postoperatively, showed that the construct remained intact.

DISCUSSION

Patients with spinal oncologic pathology offer a challenging treatment paradigm because of the aggregate risks inherent in their systemic disease. Most have had several rounds of chemotherapy and/or radiation as part of their systemic management; often, they are immune-compromised and have nutritional deficiencies, and, most importantly, the surgical interventions that can be offered necessarily must include consideration of their prognosis, physical independence and tumor pathology.^[2,5] As such, the perpetual goal remains to offer them improved or maintained quality of life with a surgical strategy that is effective and durable, and, if possible, the least disruptive, to minimize postoperative pain and morbidity.

The technique of using percutaneous posterior fixation combined with the anterior or lateral approach is the most accepted option when surgically treating lumbar metastasis. However, there are limitations to these

approaches. For instance, it is extremely difficult to perform minimally invasive lateral corpectomies at L4 and L5. In this study, our aim is not to supplant accepted techniques but to offer another option that may be favorable in certain situations.

Typically, we employ a posterior only approach for patients with anterior spinal cord compression from metastatic tumors, followed with central single cage placement with posterior fusion two levels above and below. Regrettably, this approach necessitates a long incision and extensive muscular dissection, which are hazards when wound healing is tenuous. Our patient's circumstances, end-stage metastatic sarcoma, recent exposure to radiation, cachexia and intractable pain, favored an unconventional approach to managing the surgical treatment of his metastatic spine tumor.

Here, we describe a modified approach for piecemeal lumbar vertebrectomy through a bilateral transpedicular approach followed by double cage reconstruction and short segment fusion. This technique affords several advantages, the most obvious of which is that it allowed the use of a significantly smaller midline incision (6 cm). This smaller exposure did not compromise our ability to perform a vertebrectomy. Although our tumor was soft and had eroded much of the bone, our opinion is that a sclerotic lesion can also be removed using the same approach, although more time and patience would be required. This incision could have also been lengthened to place the pedicle screws. Instead, we chose a percutaneous approach with four smaller incisions, reasoning that in the setting of preoperative radiation, the mini-open approach with multiple smaller incisions may help reduce postoperative discomfort and the incidence of wound complications. Another significant advantage is the ease of cage placement through the transpedicular corridors. By creating rectangular spaces in line with and adjacent to the spinal cord, minimal manipulation of the thecal sac is necessary, obviating the usual struggle with trying to get a robust cage in the midline. When compared with cages placed through an anterior approach, the criticism for posteriorly placed *in situ* expandable cages has been the inferior contact with endplates and potentially increased subsidence.^[1] The use of double cages potentially creates a more robust endplate to cage interface by placing the load on the stronger bone of the apophyseal ring, which may resist subsidence better.

The disadvantages of the mini-open, transpedicular, double barreled cage approach are presently unclear. The contact area of two small Xpand cages (306 mm², Globus Medical) is slightly less than that of a single medium cage (379 mm²) and significantly less than that of a large cage (588 mm²). The decrease in contact area increases the potential for biomechanical instability, particularly

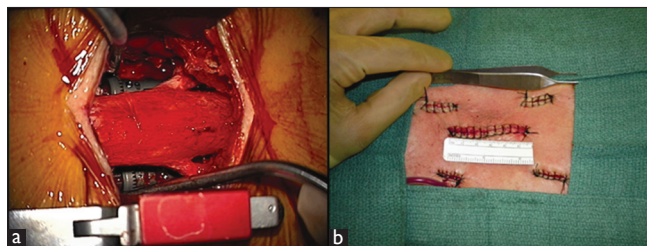


Figure 3: Photos of operative field. (a) Using McCullough retractors, the thecal sac, nerve roots and two expanded vertebral cages are visualized. (b) One 6 cm midline incision and four smaller incisions were used to decrease the invasiveness of the recently radiated skin

in the setting of short segment posterior fixation. A parallelogram type effect could occur. To prevent that situation from arising, the construct was reinforced with external bracing. Furthermore, we reasoned that instability was unlikely to occur as the patient's overall condition precluded any strenuous load bearing activity. If significant load bearing was anticipated, long segment posterior fixation is probably needed. The stability of the construct will need to be assessed using biomechanical testing in cadavers, which is currently ongoing. Nevertheless, the use of double expandable cages through corridors created by the bilateral transpedicular approach offers a potential alternative to single central cage techniques.

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