

Minimally invasive Posterior Stabilization of a Solitary Plasmacytoma of the Lumbar spine with Long-Term Follow-Up: A Case Report

ABSTRACT

BACKGROUND Minimally invasive posterior stabilization without fusion has recently been used with definitive radiation therapy to treat solitary plasmacytomas of the spine, but little long-term follow-up data have been reported.

METHODS We report a case of a 43-year-old man who presented with low back pain for 4 years, acutely worsening for 2 months. Imaging studies revealed a hypointense lesion on T1-weighted images and a hyperintense lesion on T2-weighted images involving the L3 vertebral body and pedicles with mild vertebral collapse.

RESULTS The patient underwent definitive radiation therapy to the lumbar spine and a minimally invasive posterior stabilization of L2 to L4 without fusion. After surgery, the patient's symptoms improved immediately, and he had no pain, no evidence of recurrence, no evidence of hardware failure, and excellent quality of life, as measured by EQ-5D and FACT-G, 5 years postoperatively.

CONCLUSION We report a case of solitary plasmacytoma of the lumbar spine stabilized percutaneously without formal fusion. The patient had no pain or evidence of hardware failure 5 years postoperatively. This case report suggests a role for minimally invasive posterior stabilization as a definitive procedure rather than temporary internal brace.

Solitary plasmacytomas of bone account for roughly 5% of plasma cell neoplasms, with the most common site of occurrence being the vertebral bodies.^{1,2} Radiation therapy is the mainstay of treatment for solitary plasmacytomas of the spine, but while highly effective for local disease control, radiation therapy does not afford structural stability to the diseased segment.³⁻⁵ Traditional open posterior spinal fusion involves significant muscle dissection, removal of facet capsules and other supportive structures, and can result in pain and impaired functional recovery.⁶ Minimally invasive posterior stabilization by percutaneously inserted instrumentation has been used for patients with plasmacytomas and metastatic diseases of the spine in the palliative setting with favorable short-term outcomes.⁷ Advances in minimally invasive surgery have allowed for posterior thoracic corpectomies for metastatic tumors with less blood loss and shorter hospital stay than conventional open surgery.⁸ We describe a case of solitary plasmacytoma of the lumbar spine treated definitively with radiation therapy and stabilized percutaneously with favorable long-term follow-up.

Dafang Zhang, MD¹
Kathryn Hess, BA¹
Gunnlaugur Petur Nielsen, MD²
Joseph H. Schwab, MD¹

AUTHOR AFFILIATIONS

¹Department of Orthopaedic Surgery, Massachusetts General Hospital, Harvard Medical School, Boston, MA, USA

²Department of Pathology, Massachusetts General Hospital, Harvard Medical School, Boston, MA, USA

CORRESPONDING AUTHOR

Dafang Zhang, MD
MGH Department of Orthopaedic Surgery
55 Fruit Street
Boston, MA 02114
Phone: (314) 600-8997
Fax: (617) 726-7587
dzhang9@partners.org

The authors report no conflict of interest related to this work.

©2016 by The Orthopaedic Journal at Harvard Medical School

CASE REPORT

A 43-year-old man presented to an outside hospital with a constant low-grade low back pain for about 4 years, acutely worsening over the past 2 months, failing to improve with conservative treatment. He denied fevers, constitutional symptoms, or neurological symptoms. Computed Tomography (CT) of the lumbar spine at the outside hospital showed a lytic lesion of the L3 vertebral body; he was given the radiographic diagnosis of an osseous epithelioid hemangioendothelioma. A transpedicular core biopsy of the L3 vertebral body was obtained, showing a monoclonal plasma cell infiltrate associated with abundant amyloid deposition, for which the differential diagnosis included plasma cell dyscrasias and B-cell non-Hodgkin's lymphoma with marked plasmacytic differentiation. The patient was referred to our hospital.

On examination, the patient had focal tenderness to palpation in the mid-lumbar region exacerbated by flexion. He had full ROM of the lumbar spine and was neurovascularly intact distally with a normal motor and sensory examination. His gait was normal. Laboratory results were notable for creatinine of 1.09 mg/dL (reference range 0.60 – 1.50 mg/dL), calcium of 9.4 mg/dL (reference range 8.5 – 10.5 mg/dL), hemoglobin of 13.5 g/dL (reference range 13.5 – 17.5 g/dL), and lactate dehydrogenase of 137 U/L (reference range 110 – 210 U/L). Serum IgG was elevated at 1539 mg/dL (reference range

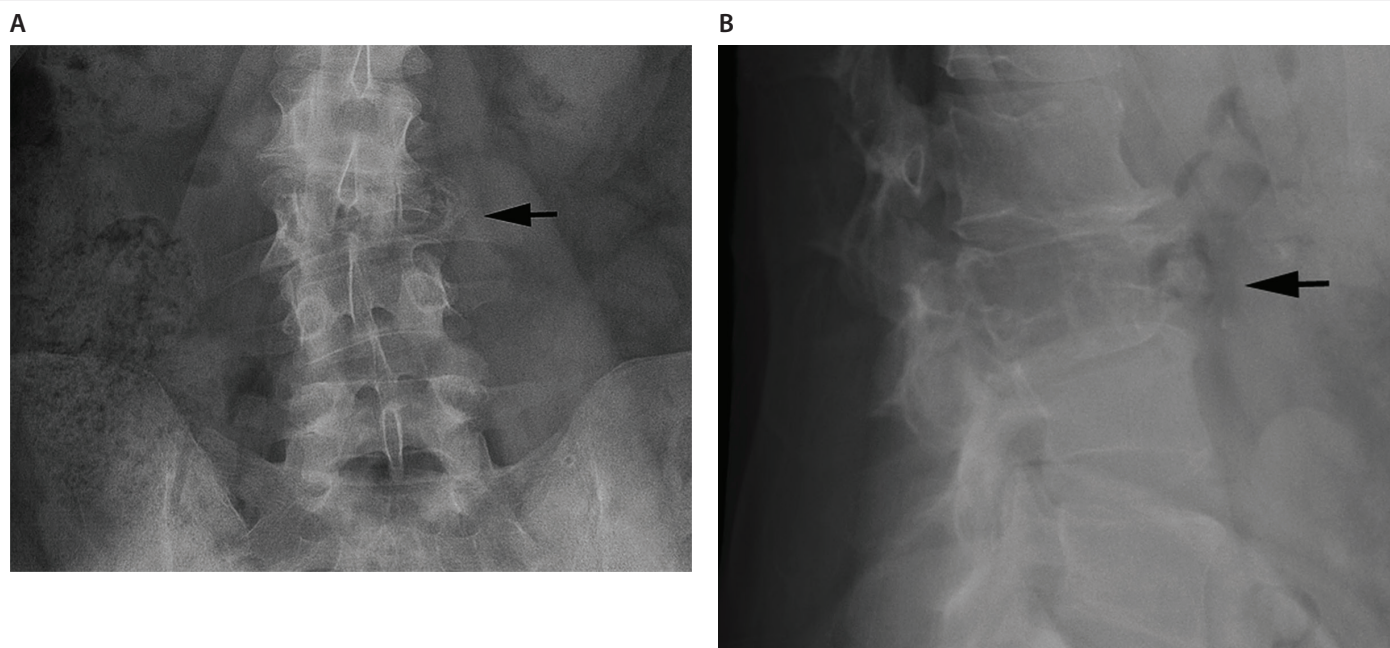
< 1295 mg/dL). Serum protein electrophoresis was abnormal with a 0.70 g/dL of IgG kappa M component on immunofixation. Serum free kappa light chain was 19.2 mg/L (reference range < 19.4 mg/L).

AP and lateral radiographs of the lumbar spine showed a lytic lesion of the body and pedicles of L3 with a mild pathologic compression fracture with mild dextroscoliosis of 28° (**Figure 1**). CT and MR imaging of the lumbar spine were obtained. The lesion was hypointense on T1-weighted Magnetic Resonance (MR) images, hyperintense on T2-weighted MR images, and heterogeneously contrast-enhancing throughout. Minimal central canal stenosis was appreciated; however, the lesion had eroded through the posterior wall of the vertebral body (**Figure 2**).

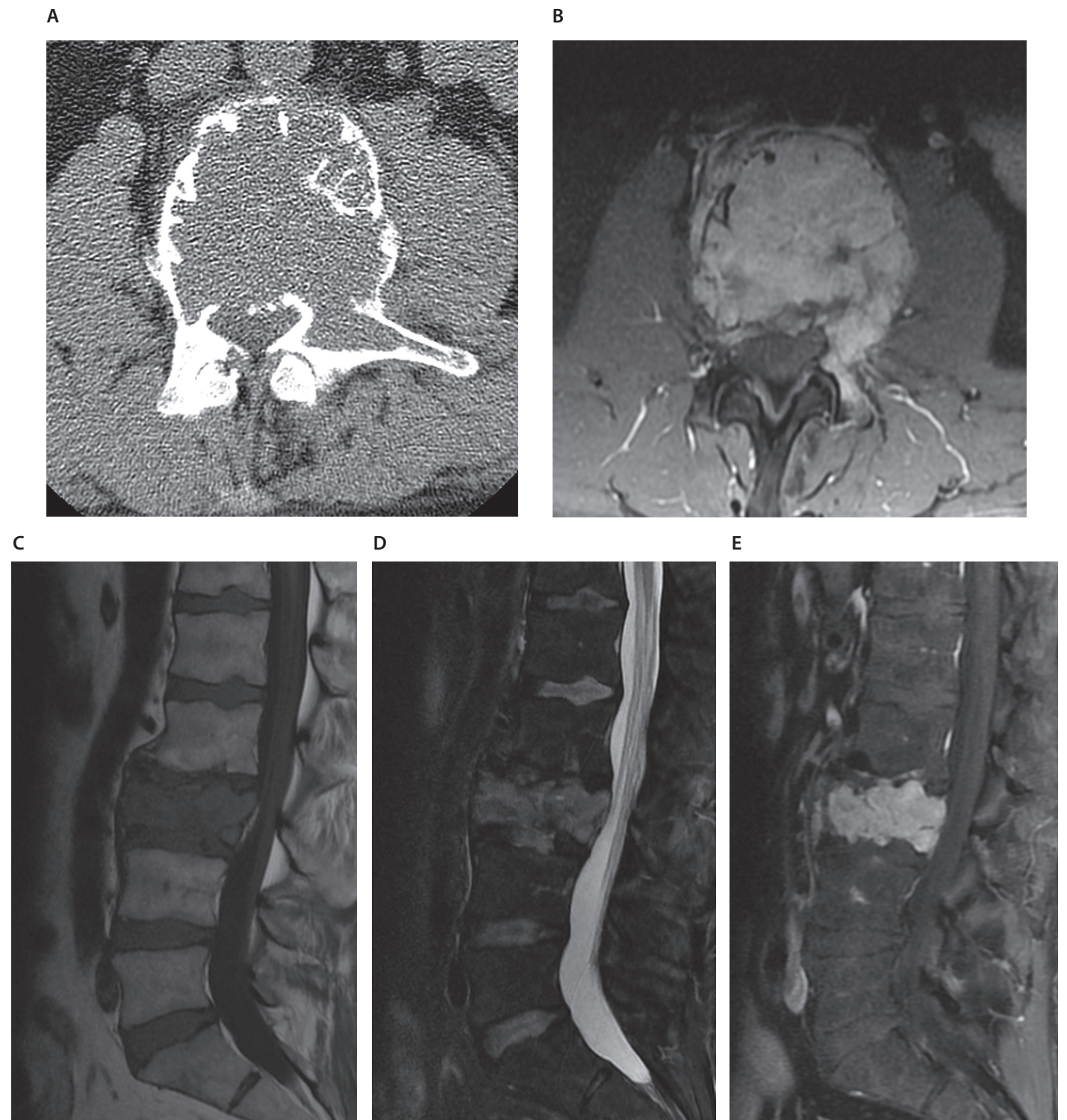
Histologic examination of the core biopsy tissue was consistent with osseous plasmacytoma with extensive amyloid deposition. Immunohistologic results were CD38 (+), CD79a (+), kappa light chain (+), lambda light chain (rare), and CD20 (rare). Bone marrow biopsy showed a 2% plasma cell population with no evidence of monoclonal plasma cells.

The L3 vertebral lesion was felt to be at risk for further collapse with radiation therapy given its involvement and lytic nature. The patient underwent a minimally invasive posterior stabilization from L2 to L4 with percutaneously inserted pedicle screws and rods using the Medtronic Sextant Spinal System (Medtronic, Minneapolis, MN, USA). The pathologic fracture was distracted intraoperatively to partially correct the

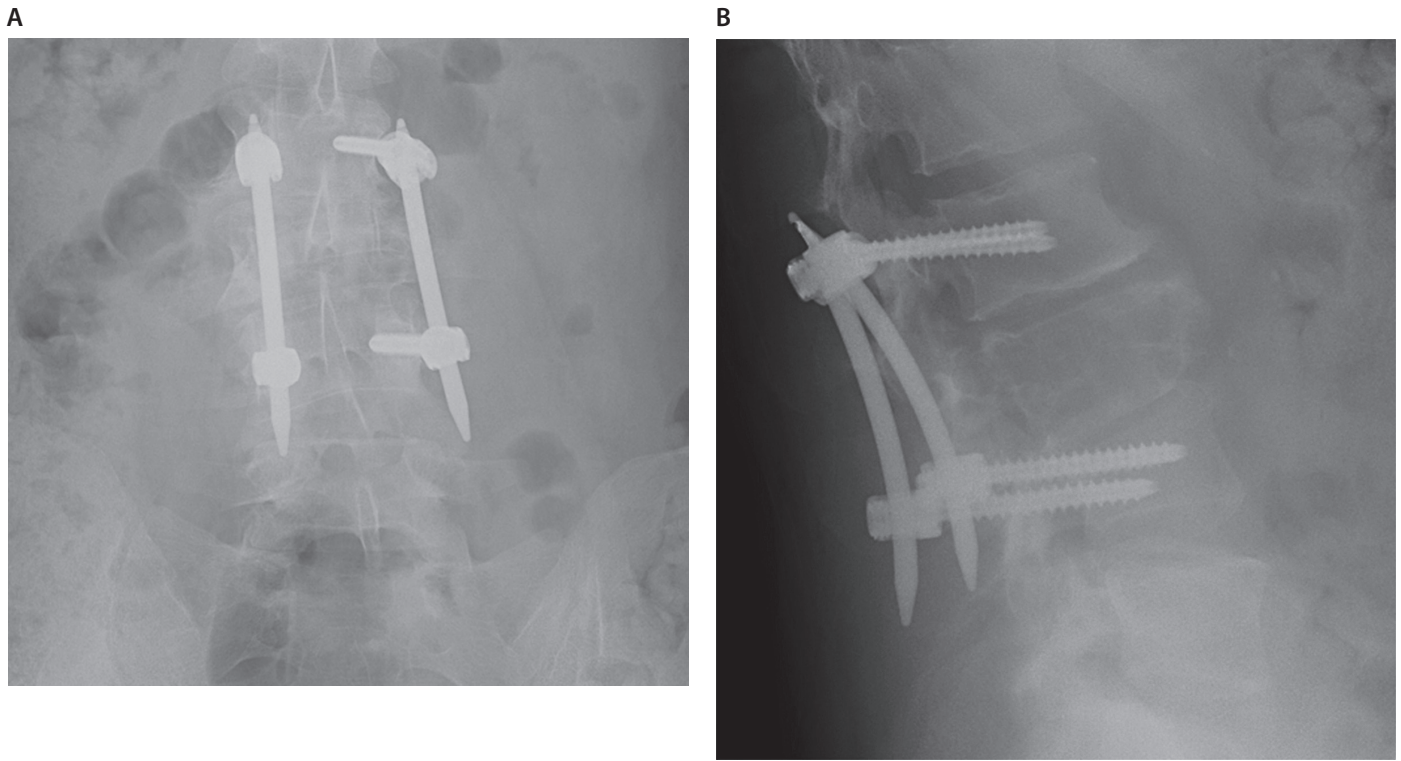
FIGURE 1 Radiographs



(A) AP and (B) lateral radiographs of the lumbar spine, 2x magnified, show a mild compression fracture of the L3 vertebra.

FIGURE 2 CT and MR images

(A) Axial CT and (B) T1-weighted gadolinium-enhanced MR images showing the L3 lesion involving the body and both pedicles, left greater than right. Minimal central canal stenosis is seen. On sagittal MR imaging, the lesion is (C) hypointense on T1-weighted imaging, (D) hyperintense on T2-weighted imaging, and (E) heterogeneously contrast-enhancing throughout on T1-weighted gadolinium-enhanced imaging.

FIGURE 3 Post-op radiographs

(A) AP and (B) lateral radiographs of the lumbar spine post-operatively, 2x magnified, showing posterior instrumentation.

dextroscoliosis to 17° (**Figure 3**). Three weeks after surgery, the patient underwent definitive radiation therapy consisting of 50 Gy to the lumbar spine over a 5-week period. His serum IgG and serum protein electrophoresis normalized at 5-month follow-up. The patient's low back symptoms immediately improved after surgery. He declined further surgical interventions as he was asymptomatic. We agreed to follow him clinically with no removal of instrumentation unless he became symptomatic. He had no pain with full activities, no evidence of recurrence, and no clinical or radiographic evidence of instrumentation motion or failure at his 5 year follow-up. Assessment of the patient's quality of life at his follow-up appointment with validated measures showed a EQ-5D index score of 1.00 (out of 1.00) and a Functional Assessment of Cancer Therapy – General (FACT-G) total score of 104 (out of 108).

DISCUSSION

Solitary plasmacytomas of bone are localized neoplasms within bone composed of a monoclonal population of plasma cells in the absence of overt signs of multiple myeloma. The spine is the most common location of occurrence, comprising 54% of all solitary plasmacytomas of bone. The most commonly involved segment is the thoracic spine, followed by the lumbar spine.^{1,2} Localized radiation therapy with a dose of 40 to 50 Gy to the tumor site with curative intent is the preferred treatment for solitary plasmacytoma of the spine. Rates of local recurrence have been cited to be

less than 10% in multiple studies; however, progression to multiple myeloma is more frequently observed, occurring in more than 50% of cases.^{4,5} The 5-year overall survival for patients with solitary plasmacytomas of bone is roughly 70% to 75%. Favorable prognostic factors include age less than 60, smaller tumor size, and tumor location in the spine. Progression to multiple myeloma is a negative prognostic factor for survival.^{3,9-11}

While radiation therapy is preferred as the curative treatment, it fails to confer structural stability to the diseased segment. Surgical stabilization of the diseased spine is indicated in cases of instability or impending collapse. Risk factors and probabilities for impending fractures of the thoracolumbar spine have been described for metastases¹² and plasmacytomas.¹³ Traditional techniques for spinal stabilization involve open posterior spinal fusion, which entails significant muscle dissection, removal of facet capsules and other supportive structures, and resultant pain and difficult functional recovery. The advantage of the traditional open method is a solid fusion mass across the unstable segment.

Minimally invasive percutaneous stabilization procedures are an alternative to traditional open posterior spinal fusions. Percutaneous stabilizations are performed by placing pedicle screws through small paraspinal incisions, preserving the paraspinal muscles, and then sliding contoured rods from one incision to another under the paraspinal muscles. These procedures have been performed in attempts to decrease muscle denervation and ischemia, blood loss and operative time, length of hospital stay and complications, and pain and functional impairment. In the management of traumatic single-level thoracolumbar

burst fractures, minimally invasive percutaneous stabilization has been shown to have less blood loss, earlier return to work and leisure, and improved Oswestry Disability Index scores compared with open spinal surgery.¹⁴ In minimally invasive posterior stabilizations of thoracic and lumbar spine tumors with average follow-up of 11 months, patients have been shown to have high satisfaction with low complication rates.¹⁵ Minimally invasive posterior stabilization has also been studied in patients with neurological symptoms secondary to metastasis to the thoracolumbar spine. In this population, minimally invasive decompression and percutaneous stabilization increased the Frankel grade by at least 1 in 80% of patients.¹⁶

We presented a patient with solitary plasmacytoma of the lumbar spine found to have a mild pathologic compression fracture. While radiation therapy with curative intent was the definitive treatment option, we elected to stabilize the spine given the extent and lytic nature of the tumor suggestive of impending further collapse. Following validation of the Spinal Instability Neoplastic Score (SINS),¹⁷ we retrospectively calculated the SINS for this lesion to be 14, consistent with instability. We elected to perform a percutaneous stabilization to avoid the soft tissue injuries of an open approach, and we deferred kyphoplasty given the breach of the posterior vertebral wall on initial CT imaging. As no formal fusion was performed, the instrumentation is akin to an internal brace and would in theory eventually fail, especially in a mobile spine segment. While we anticipated the possibility of instrumentation failure, the patient remained asymptomatic with full activities 5 years postoperatively. The option of hardware removal was discussed with the patient, which he declined in so far as he was asymptomatic. Excellent scores on the validated EQ-5D and FACT-G measures were consistent with a high quality of life.

From an oncologic perspective, in patients with spine metastases, percutaneous stabilizations are a definitive treatment for palliation. In patients with solitary plasmacytomas of the spine, percutaneous stabilizations have been viewed as a temporizing measure. Our case report demonstrates that percutaneously inserted instrumentation may be a reasonable option for definitive treatment in this patient population.

REFERENCES

1. Chang MY, Shih LY, Dunn P, Leung WM, Chen WJ. Solitary plasmacytoma of bone. *J Formos Med Assoc.* 1994 May;93(5):397-402.
2. Frassica DA, Frassica FJ, Schray MF, Sim FH, Kyle RA. Solitary plasmacytoma of bone: Mayo Clinic experience. *Int J Radiat Oncol Biol Phys.* 1989 Jan;16(1):43-8.
3. Dimopoulos MA, Goldstein J, Fuller L, Delasalle K, Alexanian R. Curability of solitary bone plasmacytoma. *J Clin Oncol.* 1992 Apr;10(4):587-90.
4. Liebross RH, Ha CS, Cox JD, Weber D, Delasalle K, Alexanian R. Solitary bone plasmacytoma: outcome and prognostic factors following radiotherapy. *Int J Radiat Oncol Biol Phys.* 1998 Jul 15;41(5):1063-7.
5. Reed V, Shah J, Medeiros LJ, Ha CS, Mazloom A, Weber DM, et al. Solitary plasmacytomas: outcome and prognostic factors after definitive radiation therapy. *Cancer.* 2011 Oct 1;117(19):4468-74. doi: 10.1002/cncr.26031. Epub 2011 Mar 22.
6. Lowery GL, Kulkarni SS. Posterior Percutaneous Spine Instrumentation. *Eur Spine J.* 2000 Feb;9 Suppl 1:S126-30.
7. Schwab JH, Gasbarrini A, Cappuccio M, Boriani L, De Iure F, Colangeli S. Minimally Invasive Posterior Stabilization Improved Ambulation and Pain Scores in Patients with Plasmacytomas and/or Metastases of the Spine. *Int J Surg Oncol.* 2011;2011:239230. doi: 10.1155/2011/239230. Epub 2011 Sep 5.
8. Lau D, Chou D. Posterior Thoracic Corpectomy with Cage Reconstruction for Metastatic Spinal Tumors: Comparing the Mini-Open Approach to the Open Approach. *J Neurosurg Spine.* 2015 Aug;23(2):217-27. doi: 10.3171/2014.12.SPINE14543. Epub 2015 May 1.
9. Dore GM, Landgren O, McGlynn KA, Curtis RE, Linet MS, Devesa SS. Plasmacytoma of bone, extramedullary plasmacytoma, and multiple myeloma: incidence and survival in the United States, 1992-2004. *Br J Haematol.* 2009 Jan;144(1):86-94. doi: 10.1111/j.1365-2141.2008.07421.x. Epub 2008 Nov 11.
10. Knobel D, Zouhair A, Tsang RW, Poortmans P, Belkacemi Y, Bolla M, et al. Prognostic factors in solitary plasmacytoma of the bone: a multicenter Rare Cancer Network study. *BMC Cancer.* 2006 May 5;6:118.
11. Ozsahin M, Tsang RW, Poortmans P, Belkacemi Y, Bolla M, Dincbas FO, et al. Outcomes and patterns of failure in solitary plasmacytoma: a multicenter Rare Cancer Network study of 258 patients. *Int J Radiat Oncol Biol Phys.* 2006 Jan 1;64(1):210-7. Epub 2005 Oct 17.
12. Taneichi H, Kaneda K, Takeda N, Abumi K, Satoh S. Risk factors and probability of vertebral body collapse in metastases of the thoracic and lumbar spine. *Spine (Phila Pa 1976).* 1997 Feb 1;22(3):239-45.
13. Mendoza S, Urrutia J, Fuentes D. Surgical treatment of solitary plasmacytoma of the spine: case series. *Iowa Orthop J.* 2004;24:86-94.
14. Kumar A, Aujla R, Lee C. The Management of Thoracolumbar Burst Fractures: A Prospective Study between Conservative Management, Traditional Open Spinal Surgery and Minimally Interventional Spinal Surgery. *Springerplus.* 2015 Apr 30;4:204. doi: 10.1186/s40064-015-0960-4. eCollection 2015.
15. Gasbarrini A, Cappuccio M, Colangeli S, Posadas MD, Ghermandi R, Amendola L. Complications in minimally invasive percutaneous fixation of thoracic and lumbar spine fractures and tumors. *Eur Spine J.* 2013 Nov;22 Suppl 6:S965-71. doi: 10.1007/s00586-013-3019-7. Epub 2013 Sep 21.
16. Zairi, F, Arikat A, Allaoui M, Marinho P, Assaker R. Minimally Invasive Decompression and Stabilization for the Management of Thoracolumbar Spine Metastasis. *J Neurosurg Spine.* 2012 Jul;17(1):19-23. doi: 10.3171/2012.4.SPINE111108. Epub 2012 May 18.
17. Fournay DR, Frangou EM, Ryken TC, Dipaola CP, Shaffrey CI, Berven SH, et al. Spinal instability neoplastic score: an analysis of reliability and validity from the spine oncology study group. *J Clin Oncol.* 2011 Aug 1;29(22):3072-7. doi: 10.1200/JCO.2010.34.3897. Epub 2011 Jun 27.