Minimal-invasive stabilization and circumferential spinal cord decompression in metastatic epidural spinal cord compression (MESCC)

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Introduction

Surgery with instrumentation to the spine has been shown to provide excellent pain relief, stabilization and quality of life in patients with spinal metastasis [1, 4, 12, 13, 15]. Surgery may also offer superior outcomes to other treatments, such as radiation in cases of acute spinal cord compression and neurological deficits [7, 11].

In comparison to degenerative spinal disorders [5], there is little data on the use of minimally invasive surgery (MIS) as an alternative to open approaches for spinal metastatic surgery [9].

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The benefits of MIS in spinal surgery compared to open approaches include reduction in muscular trauma, blood loss, cost and hospital stay [3, 6, 10, 14].

Here we present a surgical technique of posterior percutaneous instrumentation with minimal-invasive circumferential spinal cord decompression and subsequent thoroscopically reconstruction of the anterior vertebral column with an expandable titanium cage.

Case description

The patient is a 59-year-old male with back pain (NRS 6/10) of the lower thoracic spine, resulting in immobilization. The pain level increases during movement or axial load. No leg pain is present. The patient further reports night sweating without weight loss. Beside local tenderness to palpation from T8 to T10, the physical examination shows no abnormality. X-ray of the thoracic and lumbar spine and MRI of the whole spine show a pathologic T9 fracture with spinal cord compression. The staging with CT of the abdomen and thorax reveals an osteolytic destruction of the whole vertebral body and a tumor of the left lung with left sided and contralateral lymph node metastasis without further tumor manifestation. Furthermore a poststenotic pneumonia is diagnosed. After interdisciplinary consultation (oncology/radiotherapy/spine surgery) the patient is scheduled for spinal stabilization and spinal cord decompression. Thereafter chemotherapy and radiotherapy is planned.

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Surgical procedure

Surgery is planned as a two-step MIS procedure with posterior stabilization and decompression and thoracoscopic vertebral body replacement. Posterior instrumentation is partially done, using Iso-C-3D navigation and compared to conventional fluoroscopic controlled screw placement in order to demonstrate potential solutions for reduced intraoperative radiation exposure to the staff. The anterior procedure is planned from the right side, since the patient had a spontaneous pneumothorax with chest drain insertion on the left side some years ago.

The patient is placed prone. After skin disinfection and sterile draping, the fractured vertebral body is identified using lateral fluoroscopy. A midline longitudinal incision is made at the spinous process of T9. The patient tracker of the navigation system is mounted and a 3D scan (100 pictures/scan) is made. The entry points of the screws are marked, using the navigation system pointer. Stab incision is made and a Jamshidi needle is placed in the T11 pedicle using the navigation. Reaching the posterior wall, the placement is double checked by fluoroscopy. After verification of the correct placement, the needle is advanced further and a K-wire is placed through the needle.

Fluoroscopic controlled screw placement requires a slightly different approach. First the entry point for the pedicle screws is determined by positioning of spinal needles with a 20–30° convergence with the tip, lateral to pedicle oval in the true anterior–posterior fluoroscopic image, and parallel to the upper endplate in extension to the pedicle in the lateral fluoroscopic view.

After determination of the skin entry point, a 1.0–1.5 cm postero-lateral incision is made, followed by incision of fascia and blunt dissection of the muscles. The placement of the Jamshidi needle is performed according to the modified method described by Wiesner et al. [17]. Thereafter a K-wire is placed through the Jamshidi needle. The cannulated screws are positioned using the K-wire as a guide. The final screw position is controlled fluoroscopically.

Prior to the rod insertion, the decompression is made to allow easier subperiosteal dissection of the muscles, and to avoid disturbance of the lateral access to the vertebral body due to the rods. For the same reason, navigated placed caudal K-wires are bent and attached to the drape to ease the insertion of the distractor for decompression. The screw insertion is therefore done after the decompression and extension of the stab incision. For decompression, the midline incision is extended caudally exposing the spinous process and lamina of T9. After insertion of a wound distractor, the spinous process is removed and the lamina is thinned out, using a high-speed drill with subsequent laminectomy. Following the posterior decompression, the nerve roots are exposed with

resection of the facet joints, and the pedicle is removed bilaterally. The vertebral body is removed partially in peace-meal fashion, and the posterior wall is removed including the posterior ligament.

After the 360° decompression, the rod is bent, using rod contouring shafts, and insertion is performed in a cephalic to caudal direction through the most cranial incision, without needing an extra incision. After rod positioning, blocker nuts are inserted and reduction is performed with fluoroscopic controlled compression. Finally the blocker nuts are tightened and the retractor-blades of the screws are removed. Prior to the wound closure, a peridural catheter is placed for postoperative pain reduction. A drain is placed in site of the decompression and the wound closure is performed with reconstruction of fascia, subcutaneous tissue and skin closure.

The posterior procedure is followed by a thoracoscopic vertebral body replacement (VBR) to complete vertebral body resection and stabilization of the anterior column.

Postoperative information

The patient is monitored after operation on intermediate care facility. No blood transfusion is necessary. The posterior drain is removed 2 days after operation. The chest drains are removed 3 days after thoracoscopic VBR. The patient is mobilized 1 day after the first procedure. No neurological deterioration is observed (Frankel Grade E). The patient received antibiotic treatment (Piperacillin and Tazobactam) due to the preoperative diagnosed pneumonia.

In the postoperative course, the patient receives a local radiotherapy and systemic chemotherapy. In the follow up after 3 and 6 months, the patient reports a markedly decreased pain level NRS 0–2/10. Neither local tumor recurrence nor implant failure/loosening did occur, but the patient suffers from systemic progress of the disease.

Discussion and conclusion

This case demonstrates that MIS techniques in the treatment of spinal metastasis represent a valuable alternative to open procedures. While the life expectancy of patients with multiple spinal metastases is predominantly short [1, 7, 8, 12, 13, 15, 16, 18], the main benefit might not result from the long-term functional outcome due to decreased muscle dissection and denervation [2, 6]. Nevertheless short term benefits, like reduction in hospital stay, reduction of blood loss and decreased perioperative morbidity remain desirable achievements in the treatment of these patients and may allow earlier initiation of adjuvant therapy [5]. In particular since the MIS procedures offer equivalent

technical results and are safe procedures in the hand of experienced spine surgeons.

Conflict of interest N. Hansen-Algenstaedt is working as a consultant for Stryker, DepuySynthes and SpineArt. He receives royalties on implants from Stryker and Globus Medical.

References

1. Falicov A, Fisher CG, Sparkes J, Boyd MC, Wing PC, Dvorak MF (2006) Impact of surgical intervention on quality of life in patients with spinal metastases. *Spine* 31:2849–2856
2. Gejo R, Matsui H, Kawaguchi Y, Ishihara H, Tsuji H (1999) Serial changes in trunk muscle performance after posterior lumbar surgery. *Spine* 24:1023–1028
3. Hu SS (2004) Blood loss in adult spinal surgery. *Eur Spine J* 13(Suppl 1):S3–S5. doi:10.1007/s00586-004-0753-x
4. Jonsson B, Sjöström L, Olerud C, Andreasson I, Bring J, Rauschnig W (1996) Outcome after limited posterior surgery for thoracic and lumbar spine metastases. *Eur Spine J* 5:36–44
5. Karikari IO, Isaacs RE (2010) Minimally invasive transforaminal lumbar interbody fusion: a review of techniques and outcomes. *Spine* 35:S294–S301
6. Kim DY, Lee SH, Chung SK, Lee HY (2005) Comparison of multifidus muscle atrophy and trunk extension muscle strength: percutaneous versus open pedicle screw fixation. *Spine* 30:123–129
7. Klimo P Jr, Kestle JR, Schmidt MH (2003) Treatment of metastatic spinal epidural disease: a review of the literature. *Neurosurg Focus* 15(5):E1
8. Lee BH, Kim TH, Chong HS, Moon ES, Park JO, Kim HS, Kim SH, Lee HM, Cho YJ, Kim KN, Moon SH (2013) Prognostic factor analysis in patients with metastatic spine disease depending on surgery and conservative treatment: review of 577 cases. *Ann Surg Oncol* 20(1):40–46
9. Molina CA, Gokaslan ZL, Sciubba DM (2011) A systematic review of the current role of minimally invasive spine surgery in the management of metastatic spine disease. *Int J Surg Oncol*. doi:10.1155/2011/598148
10. Park Y, Ha JW (2007) Comparison of one-level posterior lumbar interbody fusion performed with a minimally invasive approach or a traditional open approach. *Spine* 32:537–543
11. Patchell RA, Tibbs PA, Regine WF, Payne R, Saris S, Kryscio RJ, Mohiuddin M, Young B (2005) Direct decompressive surgical resection in the treatment of spinal cord compression caused by metastatic cancer: a randomised trial. *Lancet* 366:643–648
12. Pointillart V, Vital JM, Salmi R, Diallo A, Quan GM (2011) Survival prognostic factors and clinical outcomes in patients with spinal metastases. *J Cancer Res Clin Oncol* 137:849–856
13. Quan GM, Vital JM, Auroeur N, Obeid I, Palussiere J, Diallo A, Pointillart V (2011) Surgery improves pain, function and quality of life in patients with spinal metastases: a prospective study on 118 patients. *Eur Spine J* 20:1970–1978
14. Wang MY, Cummock MD, Yu Y, Trivedi RA (2010) An analysis of the differences in the acute hospitalization charges following minimally invasive versus open posterior lumbar interbody fusion. *J Neurosurg Spine* 12:694–699
15. Weigel B, Maghsudi M, Neumann C, Kretschmer R, Müller FJ, Nerlich M (1999) Surgical management of symptomatic spinal metastases. Postoperative outcome and quality of life. *Spine* 24:2240–2246
16. Wibmer C, Leithner A, Hofmann G, Clar H, Kapitan M, Berg-hold A, Windhager R (2011) Survival analysis of 254 patients after manifestation of spinal metastases: evaluation of seven preoperative scoring systems. *Spine* 36:1977–1986
17. Wiesner L, Kothe R, Ruther W (1999) Anatomic evaluation of two different techniques for the percutaneous insertion of pedicle screws in the lumbar spine. *Spine* 24:1599–1603
18. Wise JJ, Fischgrund JS, Herkowitz HN, Montgomery D, Kurz LT (1999) Complication, survival rates, and risk factors of surgery for metastatic disease of the spine. *Spine* 24:1943–1951