Eur Spine J (2012) 21:1804–1806
DOI 10.1007/s00586-012-2247-6

GRAND ROUNDS

Expert's comment concerning Grand Rounds case entitled "A novel 'Pelvic Ring Augmentation Construct' for Lumbo-Pelvic Reconstruction in Tumor Surgery" (by Sathya Thambiraj, Daren Forward, James Thomas and Bronek Boszczyk)

Rahul Vaidya

Received: 23 October 2011 / Accepted: 20 February 2012 / Published online: 4 April 2012

Abstract
Introduction Historically, metastatic spine tumor surgery has been palliative for pain control, to maintain neurologic and ambulatory function. The thought of curing cancer with limited metastatic disease by resecting the primary and the metastatic lesions is becoming more common. Multilevel spondylectomy for resection of metastatic disease has been reported in the literature, mostly at the thoracic or lumbar level with some success. Reconstruction of the lumbosacral junction after tumor resection is a difficult endeavor and several techniques have been utilized. Subcutaneous anterior pelvic fixation has been described for the treatment of unstable pelvic fractures.
Materials and methods Review of the Grand Rounds case "A novel Pelvic Ring Augmentation Construct for Lumbo-Pelvic Reconstruction in Tumour Surgery" by Sathya Thambiraj, Daren Forward, James Thomas, Bronek Boszczyk and review of the pertinent literature.
Conclusion The authors describe a novel percutaneous rod technique and construct for buttressing a posterior spinal construct to a subcutaneous anterior pelvic fixator after tumor resection of the lumbo-pelvic junction. They manage to salvage a difficult situation for which they should be commended. This technique may be useful in situations where instrumentation has to be preformed to the pelvis: i.e., in tumor reconstruction, fusions such as neuromuscular scoliotic disease to the pelvis, to augment a lumbo-pelvic construct when a nonunion occurs or in osteoporotic patients as a salvage procedure.

Keywords Metastatic spine tumor · Multilevel spondylectomy · Complex lumbosacral reconstruction

Original procedure

The authors [1] describe a case of a 69-year-old female with a history of renal cell cancer with metastatic disease limited to the spine but to three adjacent vertebrae; L4, L5 and S1. Her findings included a 6-month history of back pain with a normal neurological exam. She was treated with a nephrectomy removing the primary tumor. The authors then chose to do a multilevel spondylectomy and a complex reconstruction.

Indications for surgery in spinal metastatic disease include:

1. Intractable pain unresponsive to non-operative measures;
2. Existence of a growing tumor that is resistant to radiation, chemotherapy, or hormonal therapy;

R. Vaidya (✉)
Department of Orthopaedic Surgery, Detroit Receiving Hospital, Detroit Medical Center, 4201 St. Antoine Blvd, Detroit, MI 48201, USA
e-mail: rahvaidya@hotmail.com; rahvaidya2012@gmail.com

3. Patients who have reached spinal cord tolerance after prior radiation therapy;
4. Spinal instability manifested as pathologic fracture, progressive deformity, or neurologic deficit;
5. Clinically significant neural compression.

In this case, a renal cell cancer, which responds poorly to radiation and chemotherapy, surgical intervention could be considered. The reason for surgery and the type of surgery preformed spondylectomy is an attempt to cure the disease, control local recurrence, and to prolong survival.

Spondylectomy for spinal tumors was originally described for giant cell tumors and malignant primary spine tumors in the 1960s and 1970s [2, 3] in an effort to cure the disease. In 1994, Tomita et al. [4] described an en bloc spondylectomy technique for solitary metastatic disease and several authors have reported their experience since [4–9]. It has usually been employed when the primary has been completely resected and there is a single bone met. Tomita et al. [10] have tried to stratify patients with respect to grade of malignancy, visceral mets and solitary versus multiple bone mets as candidates for spondylectomy. They use aggressive resection in patients with slow growing (breast, prostate, thyroid) or moderate growing (kidney, uterine) tumors with treatable or no visceral mets and solitary bone mets. Their and others' results indicate that they may be able to achieve an increased survival in selected patients, decrease local recurrence rates, improve patients' quality of life and increased overall survival rates with this procedure [9–11].

In this case, we have a patient with a moderate growing tumor with multiple bone mets who undergoes a multilevel spondylectomy at the lowest lumbar level including the sacrum for control of metastatic disease. Multilevel spondylectomy for resection of metastatic disease has been reported on a few occasions in the literature mostly at the thoracic or lumbar level with some success [12–15]. Reconstruction has been achieved with vertebral body replacement (VBR) systems with either bone graft or cement. The choice of going for a wide resection in this patient seems aggressive to me as the tumor involves multiple vertebrae and is at the lumbosacral junction. My preference would still be to consider radiation for pain control unless there was a pathological fracture, or neurologic compromise.

First surgery

Cement augmentation in and around your cage as well as an anterior plate would have helped the original anterior construct in stability from dislodging and perhaps could have even been performed at the first revision. Although plates often cause stress shielding of graft material in VBR a small plate at the inferior aspect of the construct could have been a buttress for the cage.

First revision

Cement augmentation and a plate buttress may have been able to be done at your first revision as well unless tumor had further destroyed the sacrum. The anterior construct was converted into a trans-iliac bar with anterior rod and cement. The reconstruction of an L4/L5 spondylectomy is easier when the sacrum is not involved and in this case as more sacrum seems to be destroyed it turns into a procedure that needs to reconstruct the lumbosacral junction as one would do for sacral resection. This is a difficult endeavor and requires inventive ways of transferring the patient's body weight held by the spine to the pelvis [16–21]. Some authors use a VBR with this construct as well and multiple iliac bars.

Second revision

The posterior rod construct broke at 9 months postop. and was converted to a four rod system as described by Shen et al. [19]. This construct was still inadequate as the anterior trans-sacral rod had broken again.

Augmentation procedure

The augmentation procedure was performed and led to no further structural trouble until the patient died 15 months later from her disease. This is an innovative procedure which was involved minimal dissection, little blood loss (250cc) and connected the instrumentation to an anterior pelvic frame described by our group at Detroit Receiving Hospital for anterior pelvic fixation in pelvic fractures [22, 23]. This subcutaneous frame Internal Fixator (InFix) is good for anterior pelvic compression and distraction. It sits in an area that we call the "bikini area". It is biomechanically stronger than an anterior external fixator. Patients are not hindered by its presence and are able to sit, stand and ambulate without difficulty. We have used it with a posterior rod and screw construct in pathologic pelvic fractures as well. To use this as an anchor for posterior fixation in a tripod design is ingenious and worked for this individual for more than a year. The biomechanics of this construct need to be worked out to assess its real stabilizing ability, and I encourage the authors to do that as most such constructs are tested before applied. The authors have developed a method that may be useful in situations where instrumentation has to be performed to the pelvis, i.e., in tumor reconstruction, fusions such as neuromuscular scoliotic disease to the pelvis, to augment a lumbo-pelvic

construct when a nonunion occurs or in osteoporotic patients as a salvage procedure.

Historically metastatic spine tumor surgery has been palliative for pain control, to maintain neurologic and ambulatory function. Modern medicine is challenging this premise. The thought of curing cancer with limited metastatic disease by resecting the primary, and the metastatic lesions has been reported for lung mets, liver mets, and bone mets. The challenge is minimizing the harm to these patients who often have a limited life span. Patients and surgeons are eager to attempt treatment, which may lead to cure with radical surgery. It is hard not to say that this patient may have benefitted from less aggressive surgery, radiation and pain management but maybe she would have had a shorter survival as well. In this report the authors describe a very original solution for buttressing a posterior construct after tumor resection of the lumbo-pelvic junction for which they should be commended.

Conflict of interest None of the authors has any potential conflict of interest.

References

1. Thambiraj S, Forward D, Thomas J, Boszczyk B (2012) A novel "Pelvic Ring Augmentation Construct" for lumbo-pelvic reconstruction in tumour surgery. Eur Spine J [Epub ahead of print]
2. Lièvre JA, Darcy M, Pradat P, Camus JP, Bénichou C, Attali P, Joublin M (1968) Giant cell tumor of the lumbar spine; total spondylectomy in 2 states. Rev Rhum Mal Osteoartic 35(3):125–130
3. Stener B (1971) Total spondylectomy in chondrosarcoma arising from the seventh thoracic vertebra. J Bone Joint Surg Br 53(2):288–295
4. Tomita K, Toribatake Y, Kawahara N, Ohnari H, Kose H (1994) Total en bloc spondylectomy and circumspinal decompression for solitary spinal metastasis. Paraplegia 32(1):36–46
5. Tomita K, Kawahara N, Baba H et al (1997) Total en bloc spondylectomy: a new surgical technique for primary malignant vertebral tumors. Spine 22(3):324–333
6. Heary RF, Vaccaro AR, Benevenia J et al (1998) ''En-bloc'' vertebrectomy in the mobile lumbar spine. Surg Neurol 50(6):548–556
7. Abe E, Kobayashi T, Murai H et al (2001) Total spondylectomy for primary malignant, aggressive benign, and solitary metastatic bone tumors of the thoracolumbar spine. J Spinal Disord 148(3):237–246
8. Yao KC, Boriani S, Gokaslan ZL et al (2003) En bloc spondylectomy for spinal metastases: a review of techniques. Neurosurg Focus 15(5):E6
9. Sakaura H, Hosono N, Mukai Y et al (2004) Outcome of total en bloc spondylectomy for solitary metastasis of the thoracolumbar spine. J Spinal Disord Tech 17(4):297–300
10. Tomita K, Kawahara N, Kobayashi T, Yoshida A, Murakami H, Akamaru T (2001) Surgical strategy for spinal metastases. Spine 26(3):298–306
11. Melcher I, Disch AC, Khodadadyan-Klostermann C et al (2007) Primary malignant bone tumors and solitary metastases of the thoracolumbar spine: results by management with total en bloc spondylectomy. Eur Spine J 16(8):1193–1202
12. Aryan HE, Acosta FL, Ames CP (2008) Two-level total en bloc lumbar spondylectomy with dural resection for metastatic renal cell carcinoma. J Clin Neurosci 15(1):70–72
13. Hardes J, Gosheger G, Halm H et al (2003) Three-level en bloc spondylectomy for desmoplastic fibroma of the thoracic spine: a case report. Spine 28(9):E169–E172
14. Samartzis D, Marco RA, Benjamin R et al (2005) Multilevel en bloc spondylectomy and chest wall excision via a simultaneous anterior and posterior approach for Ewing sarcoma. Spine 30(7):831–837
15. Disch AC, Schaser KD, Melcher I, Feraboli F, Schmoelz W, Druschel C, Luzzati A (2011) Oncosurgical results of multilevel thoracolumbar en-bloc spondylectomy and reconstruction with a carbon composite vertebral body replacement system. Spine 36(10):E647–E655
16. Gokaslan ZL, Romsdahl MM, Kroll SS et al (1997) Total sacrectomy and Galveston L-rod reconstruction for malignant neoplasms. J Neurosurg 87(5):781–787
17. Widmann RF, Hresko MT, Hall JE (1999) Lumbosacral fusion in children and adolescents using the modified sacral bar technique. Clin Orthop Relat Res 364:85–91
18. Farcy JP, Rawlings BA, Glassman SD (1992) Technique and results of fixation to the sacrum with iliosacral screws. Spine 17(Suppl 6):S190–S195
19. Shen FH, Harper M, Foster WC et al (2006) A novel "Four-Rod Technique" for lumbo-pelvic reconstruction: theory and technical considerations. Spine 31(12):1395–1401
20. Wuisman P, Lieshout O, Dijk MV et al (2001) Reconstruction after total en bloc sacrectomy for osteosarcoma using a custom-made prosthesis. A technical note. Spine 26(4):431–439
21. Gallia GL, Suk I, Witham TF et al (2010) Lumbopelvic reconstruction after combined l5 spondylectomy and total sacrectomy for en bloc resection of a malignant fibrous histiocytoma. Neurosurgery 67(2):E498–E502
22. Vaidya R, Colen R, Vigdorchik J, Tonnos F, Sethi A (2012) Treatment of unstable pelvic ring injuries with an internal anterior fixator and posterior fixation: initial clinical series. J Orthop Trauma 26(1):1–8
23. Vaidya R, Kubiak EN, Bergin PF, Dombroski DG, Critchlow RJ, Sethi A, Starr AJ (2012) Complications of anterior subcutaneous internal fixation for unstable pelvis fractures: a multicenter study. Clin Orthop Relat Res [Epub ahead of print]