Eur Spine J (2012) 21 (Suppl 4):S549–S553
DOI 10.1007/s00586-012-2204-4

CASE REPORT

Minimally invasive lumbopelvic instrumentation for traumatic sacrolisthesis in an elderly patient

Joshua J. Wind · Lauren M. Burke · Khalid H. Kurtom · Fabio Roberti · Joseph R. O'Brien

Received: 4 April 2011 / Revised: 14 January 2012 / Accepted: 11 February 2012 / Published online: 22 February 2012

Abstract
Purpose We present a novel minimally invasive technique for lumbopelvic instrumentation in selected elderly patients suffering from traumatic sacrolisthesis. An 82-year-old female suffered from sacrolisthesis after a fall. She developed significant low back pain and bilateral lower extremity radiculopathy. Preoperative radiographs and magnetic resonance imaging sequences demonstrated the fracture dislocation between S1 and S2 with compromise of the spinal canal. Lumbopelvic instrumentation was sought to offer fixation and allow mobilization; however, open lumbopelvic instrumentation techniques have significant morbidity, especially in this patient population of elderly patients with medical comorbidities.
Methods A minimally invasive technique employing percutaneous pedicle screws at L5 and S1 coupled with percutaneous S2 iliac screws was employed.
Results and conclusions The patient tolerated the procedure well without any complications or morbidity. At the last follow-up of 14 months, she was ambulating without assistance with near total resolution of back pain and radicular pain. Radiographs obtained at 8 months' follow-up demonstrated fusion across the fracture line. Although further follow-up data is still needed to establish the durability of this technique in the long-term, this minimally invasive technique for lumbopelvic instrumentation can be considered as an option in elderly patients with traumatic sacrolisthesis, whose need for early mobilization and medical comorbidities preclude the use of an open lumbopelvic fixation procedure.

Keywords Sacrolisthesis · Lumbopelvic instrumentation · Minimally invasive

Abbreviations

CT	Computed tomography
MRI	Magnetic resonance imaging
EMG	Electromyography
AP	Anteroposterior
MIS	Minimally invasive surgery

Introduction

Traumatic sacrolisthesis is an uncommon entity, usually encountered in high-energy trauma accompanied by pelvic fractures. Only 3–5% of sacral fractures are transverse in nature, representing a unique situation, where the pelvis and spine are no longer in stable union [1]. While most of these types of fractures are associated with high-energy trauma, there are several reported cases in the literature of low-energy falls in elderly patients presenting with traumatic sacrolisthesis [2, 3]. Diagnosis can often be missed as these patients are frequently neurologically intact, and standard radiographic studies may not demonstrate the injury readily.

Electronic supplementary material The online version of this article (doi:10.1007/s00586-012-2204-4) contains supplementary material, which is available to authorized users.

J. J. Wind (✉) · K. H. Kurtom · F. Roberti
Department of Neurologic Surgery, The George Washington University Medical Center, The George Washington University School of Medicine, 2150 Pennsylvania Avenue, NW, Suite 7420, Washington, DC 20037, USA
e-mail: jwind@gwu.edu

L. M. Burke · J. R. O'Brien
Department of Orthopedic Surgery, The George Washington University School of Medicine, Washington, DC, USA

When traumatic sacrolisthesis is discovered, it presents a challenge for the treating physician. Lumbopelvic dislocation due to these injuries is frequently incapacitating, and neurologic deficits may be delayed in presentation [3]. Treatment is complicated by the fact that many of these patients are elderly and oftentimes debilitated, frequently by low-energy falls. Furthermore, elderly, bedridden patients are at increased risk of sacral decubiti, wound breakdown, deep vein thrombosis, and pulmonary emboli.

The advent of minimally invasive spine surgery (MIS) has been well applied to instrumentation constructs through most of the spinal axis with good results, allowing patients to have smaller incisions, less blood loss, shorter hospital stays, decreased rates of infections, and subsequent cost benefits [4–6]. Advocates of these techniques suggest that these factors lead to earlier mobilization and rehabilitation and decreased morbidity from being immobilized. We present a case of MIS applied to traumatic sacrolisthesis in an elderly patient—a novel technique for treating these rare injuries.

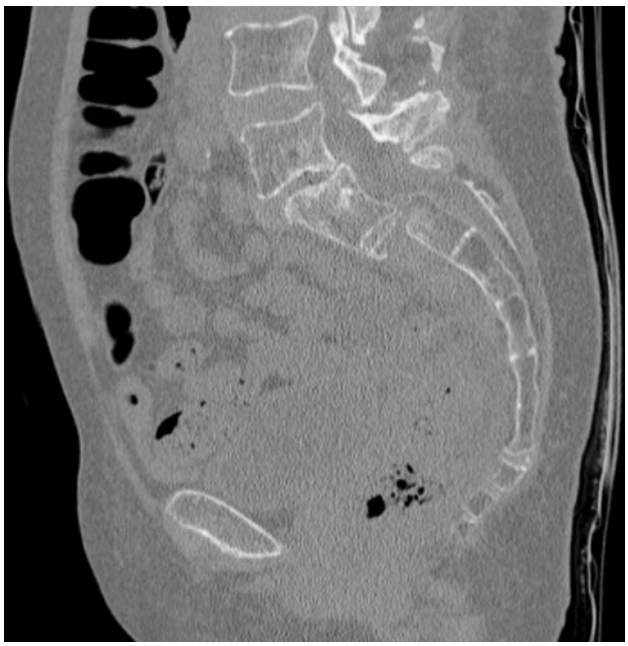

Fig. 1 Sagittal CT scan of the lumbosacral spine demonstrating sacrolisthesis

Case report

An 82-year-old woman with a past medical history of spinal stenosis, hypertension, hypothyroidism, and osteoporosis fell from standing, landing on her back. Immediately, she complained of low back pain and pain radiating down the lower legs, which was worse on the right side. On physical examination she was full strength in the lower extremities, with trace deep tendon reflexes and a normal rectal exam. Radiographs of the lumbar spine revealed a fracture dislocation with grade 2 spondylolisthesis between S1 and S2. CT and MRI scans of the lumbosacral spine were obtained as well (Figs. 1, 2).

Given the incapacitating nature of the pain associated with this fracture, and significant compromise of the spinal canal secondary to the sacrolisthesis, as well as lumbopelvic dislocation, an operative intervention was sought to provide stability to aid in pain control and allow early mobilization. Due to the significant medical comorbidities of this patient, as well as the wound issues associated with large midline incisions in the lumbosacral region, a novel minimally invasive technique was employed to treat this unique fracture dislocation.

The patient was placed prone on a radiolucent Jackson table in a neutral position. Attempts were made under fluoroscopic guidance to reduce the sacrolisthesis through positioning maneuvers and gentle traction; however, this was unsuccessful.

Under C-arm fluoroscopy, incisions were localized and planned. The back was prepped and draped in sterile fashion. Prophylactic antibiotics were administered. The

Fig. 2 Sagittal T2 MRI of the lumbosacral spine demonstrating sacrolisthesis

decision was made to incorporate L5 into the instrumentation construct in order to offer additional fixation points due to the high mechanical demand at S1 [7]. Stab incisions were made over the bilateral L5 and S1 pedicles using AP fluoroscopy. A percutaneous technique was used to place bilateral L5 and S1 pedicle screws using Jamshidi needles and K-wires to cannulate the pedicles. Tissue dilaters were then inserted, and then the pedicle screws were inserted through the percutaneous dilator system (Depuy Viper, Depuy Spine, Raynham, Massachusetts).

Intraoperative fluoroscopy was used to successfully place these screws using the posterior vertebral body line rule as well as the medial pedicle line to ensure extracanal placement. Instrumentation was stimulated with electromyography (EMG) neuromonitoring probes, and no nerve root stimulation was obtained below 10 mA.

Next, attention was directed at placing pelvic fixation via minimally invasive S2-iliac screw placement, as previously described in the literature [8]. Stab incisions were made just inferior and lateral to the S1 dorsal foramen, and Jamshidi needles were then advanced through the sacral ala toward and passed the sacroiliac joint. The trajectory of the Jamshidi needle course was 30° caudally, and 10° anteriorly, from the surface of the sacral lamina (or 40° from a horizontal line connecting the posterior superior iliac spines) [8]. K-wires were then advanced through the Jamshidi needles into the ilia. These were then used to insert 7 mm × 55 mm titanium screws bilaterally. Again this positioning was verified with fluoroscopy and EMG stimulation.

Titanium rods were curved manually to match the difficult anatomy of her pelvis and curvature of screw alignment. They were then passed successfully through each titanium screw and secured.

After the percutaneous screw insertion system was removed, the use of handheld retractors permitted visualization medial and lateral to the screw and rod construct at L5 and S1. The bone in this region was decorticated with the use of a high-speed pneumatic drill, and a mixture of cancellous bone and demineralized bone matrix was placed over the decorticated bone in order to promote fusion. Closure was then completed with fascia, dermis, and subcutaneous absorbable sutures. The final AP and lateral fluoroscopic images are seen in Figs. 3 and 4, and the postoperative skin incisions are seen in Fig. 5. Operative blood loss was minimal, and total operative time was 241 min.

The patient tolerated the procedure well, and remained neurologically intact. She was transferred to a rehabilitation facility for generalized deconditioning and had improvement in her radicular and back pain. At 14 months' follow-up, the patient had near total resolution of her back pain and radicular pain; she was ambulating without need of any assistance, and she had been discharged home in good condition. Lateral radiographs were obtained at 8 months' follow-up, which demonstrated stability of construct as well as bony fusion occurring across the fracture line (Fig. 6).

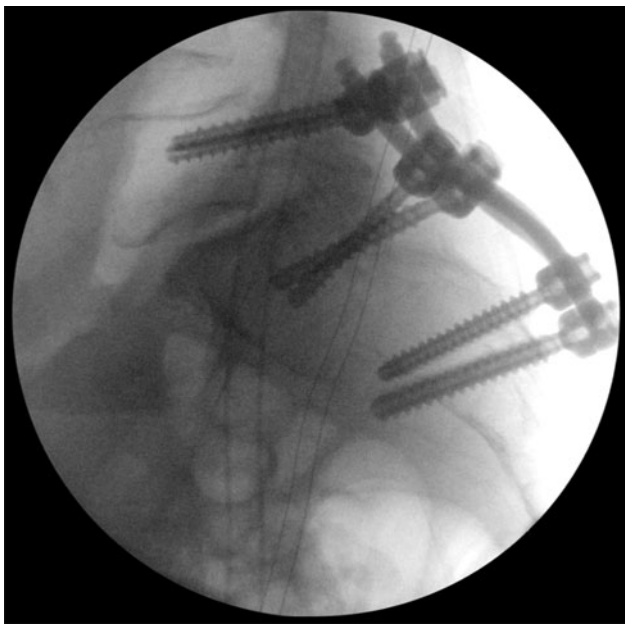

Fig. 3 Lateral intraoperative fluoroscopic images demonstrating instrumentation

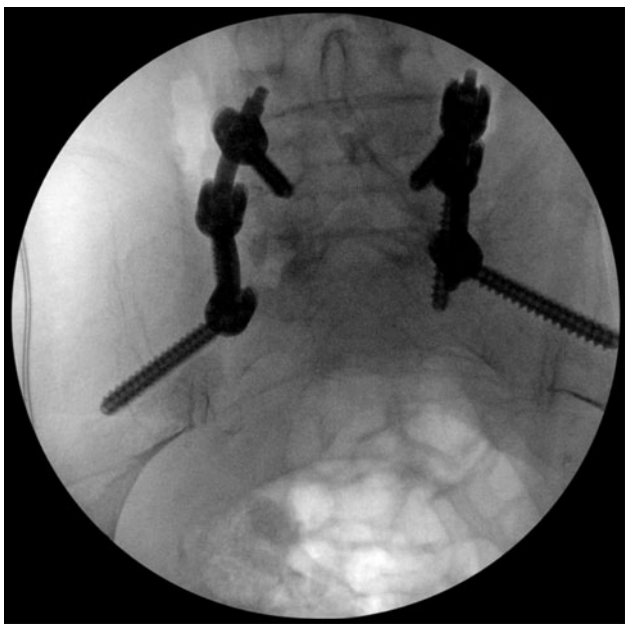

Fig. 4 AP intraoperative fluoroscopic images demonstrating instrumentation

Discussion and conclusion

Traumatic sacrolisthesis represents a rarely encountered clinicopathologic entity; however, it presents significant challenges in its management, both from the standpoint of anatomical and surgical technique as well as the patient population and subsequent comorbidities. Prior to minimally invasive techniques, these rare fracture dislocations required open treatment with instrumentation constructs bridging the sacrolisthesis or conservative management with prolonged immobilization. Open operative constructs included transiliac bars, iliac post bolts, and iliosacral

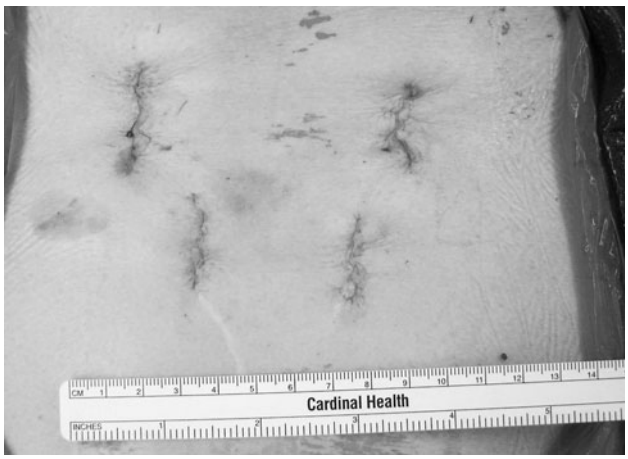

Fig. 5 Postoperative photograph of skin incisions

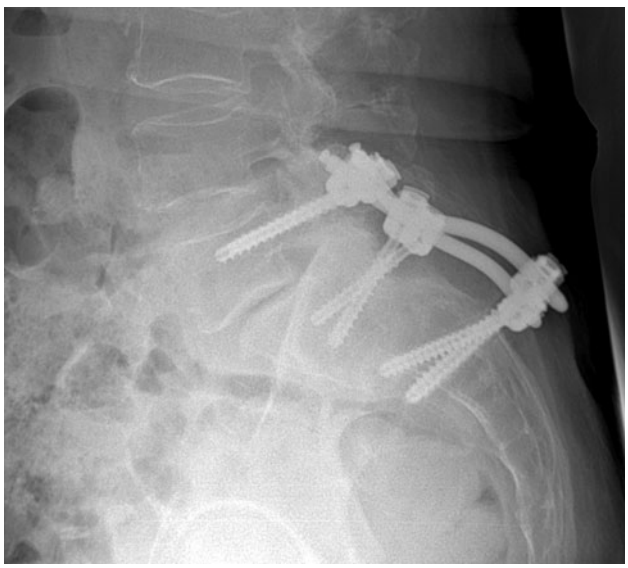

Fig. 6 Lateral X-ray at 8 months' follow-up demonstrating stability of the construct and fusion across the fracture line

screws [7, 9]. The location of the required skin incision for these large open procedures and elderly patient population made these surgical options especially prone to wound healing issues, sacral decubiti, and other postoperative morbidities secondary to prolonged immobilization.

There are disadvantages of using this minimally invasive approach for treating traumatic sacrolisthesis. First, the percutaneous iliac screws currently available through many minimally invasive surgical systems are shorter than those available in open surgical systems. This limitation of hardware will undoubtedly be corrected in the future, but currently it may lead to an increased risk of hardware failure and pseudoarthrosis in long-term follow-up. Second, the small incision size associated with the minimally invasive technique does limit the amount of bone available for decortication and placement of a bony fusion. This also may lead to higher pseudoarthrosis rates in long-term follow-up. Bony decompression may also be limited by the small incision size as well. Further research will be needed to determine whether adjuvant osteobiologics such as bone morphogenic protein would be beneficial to the fusion rates in these patients. Further research is also needed to determine the long-term fusion and pseudoarthrosis rates in these patients. In addition, there is a learning curve to minimally invasive techniques for spinal surgery that requires training in order to optimize patient outcomes and minimize procedure time.

This technique for the minimally invasive treatment of traumatic sacrolisthesis in elderly patients may offer many of the benefits of minimally invasive surgery employed elsewhere in the spinal axis, namely smaller incisions, decreased postoperative pain, and earlier mobilization. This minimally invasive technique may be a welcome addition to the surgical options for this specific subset of patients, as a mechanism for palliation of fracture related pain and disability, allowing for earlier mobilization. Despite the lack of long-term follow-up data for this technique, it may be a viable option for those patients whose comorbidities preclude their undergoing an open surgical procedure.

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

References

1. Bucknill TM, Blackburne JS (1976) Fracture-dislocations of the sacrum. Report of three cases. J Bone Joint Surg Br 58-B:467–470
2. Fountain SS, Hamilton RD, Jameson RM (1977) Transverse fractures of the sacrum. A report of six cases. J Bone Joint Surg Am 59:486–489
3. Thumbikat P, Abdlslam KM, Howard AC (2002) Atypical traumatic sacrolisthesis following minimal trauma. Injury 33:371–373
4. Parker SL, Adogwa O, Witham TF, Aaronson OS, Cheng J, McGirt MJ (2011) Post-operative infection after minimally invasive versus open transforaminal lumbar interbody fusion (TLIF): literature review and cost analysis. Minim Invasive Neurosurg 54:33–37. doi:10.1055/s-0030-1269904
5. McGirt MJ, Parker SL, Lerner J, Engelhart L, Knight T, Wang MY (2011) Comparative analysis of perioperative surgical site infection after minimally invasive versus open posterior/transforaminal lumbar interbody fusion: analysis of hospital billing and discharge data from 5170 patients. J Neurosurg Spine 14:771–778. doi:10.3171/2011.1.SPINE10571
6. Peng CW, Yue WM, Poh SY, Yeo W, Tan SB (2009) Clinical and radiological outcomes of minimally invasive versus open transforaminal lumbar interbody fusion. Spine (Phila Pa 1976) 34:1385–1389. doi:10.1097/BRS.0b013e3181a4e3be
7. Tsuchiya K, Bridwell KH, Kuklo TR, Lenke LG, Baldus C (2006) Minimum 5-year analysis of L5–S1 fusion using sacropelvic fixation (bilateral S1 and iliac screws) for spinal deformity. Spine (Phila Pa 1976) 31:303–308. doi:10.1097/01.brs.0000197193.81296.f1

8. O'Brien JR, Yu WD, Bhatnagar R, Sponseller P, Kebaish KM (2009) An anatomic study of the S2 iliac technique for lumbo-pelvic screw placement. Spine (Phila Pa 1976) 34:E439–E442. doi:10.1097/BRS.0b013e3181a4e3e4

9. Emami A, Deviren V, Berven S, Smith JA, Hu SS, Bradford DS (2002) Outcome and complications of long fusions to the sacrum in adult spine deformity: luque-galveston, combined iliac and sacral screws, and sacral fixation. Spine (Phila Pa 1976) 27:776–786