

Bilateral pedicle stress fracture with adjacent old osteoporotic compression fractures that induced spondylolisthesis

Hyung-Jin Kang · Jae-Young Hong ·
Jong-Woong Park · Seung-Woo Suh

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Introduction

Osteoporotic spinal compression fracture is a common disease which induces disability and pain in the elderly. However, isolated pedicle fracture is a rare occurrence, even in the elderly, because of its higher mechanical strength [1, 2]. Most cases of pedicle fracture are because of post-surgical complications [1, 3–5] or stress-related activity [2, 6–8], for example in active athletes, irrespective of the trauma. However, reports on lumbar pedicle stress fractures without trauma or predisposing factors are limited in number [8–12], and such fractures in association with spondylolisthesis are quite rare [13]. However, disability and pain can develop after pedicle fractures, and there is no confirmed method of treatment because of its rarity. In this paper, we report a case of bilateral L3 pedicle stress fracture with anterior translation of the L3 vertebra body in a patient with adjacent L2 and L4 old osteoporotic compression fracture. In addition, we suggest an appropriate method of treatment for pedicle fracture with instability.

Our patient was informed and gave consent that data concerning the case would be submitted for publication.

Case report

A 76-year-old woman with osteoporosis (T -score = -4.1) presented with a 1-year history of severe back pain and radiculopathy of the right lower extremity. There was aggravation in pain while standing and walking, and improvement was observed while lying down. The patient had previously been treated with epidural steroid injection, painkillers, and physical therapy. However, symptoms progressed and the patient complained of muscle weakness in the right lower extremity. Physical examination revealed a marked reduction in the entire back movement and focal tenderness on the L3 spinous process. Neurological examination revealed motor grade IV muscle weakness in the right quadriceps, tibialis anterior, and extensor hallucis longus muscle. The patient had sensory disturbance at the L4 to L5 dermatome in her right lower extremity. Plain radiograph showed severe degenerative changes of the whole lumbar spine and compression fracture at L2 and L4, and bilateral pedicle fracture at L3 (Fig. 1a, b). However, a plain radiograph did not reveal any anomalies of the pars interarticularis of the L3 vertebra. In addition, the plain radiograph revealed anterior translation of the L3 vertebra body (spondylolisthesis, Meyerding grade I) with instability (Fig. 1c, d). Computed tomography (CT) scan revealed bilateral L3 pedicle fracture with blunt fracture margin (Fig. 2a, b, c), and magnetic resonance imaging (MRI) revealed minimal signal change on the L2 and L4 body and the L3 pedicle, which signified chronic lesion, and compression of both the nerve roots at the L3/4 level (Fig. 3a, b). The patient was treated with microscope-assisted decompressive laminectomy and foraminotomy of L3–4, and posterior lumbar interbody fusion was performed with auto and allo cancellous bone in the carbon cage after reduction of the translated L3 body with percutaneous reduction

H.-J. Kang · J.-Y. Hong (✉) · J.-W. Park
Department of Orthopaedic Surgery,
Korea University Ansan Hospital,
516, Gojan-Dong, Danwon-Gu, Ansan,
Kyeonggi-Do 425-707, South Korea
e-mail: osspine@korea.ac.kr

S.-W. Suh
Department of Orthopaedic Surgery,
Korea University Guro Hospital, Seoul, South Korea

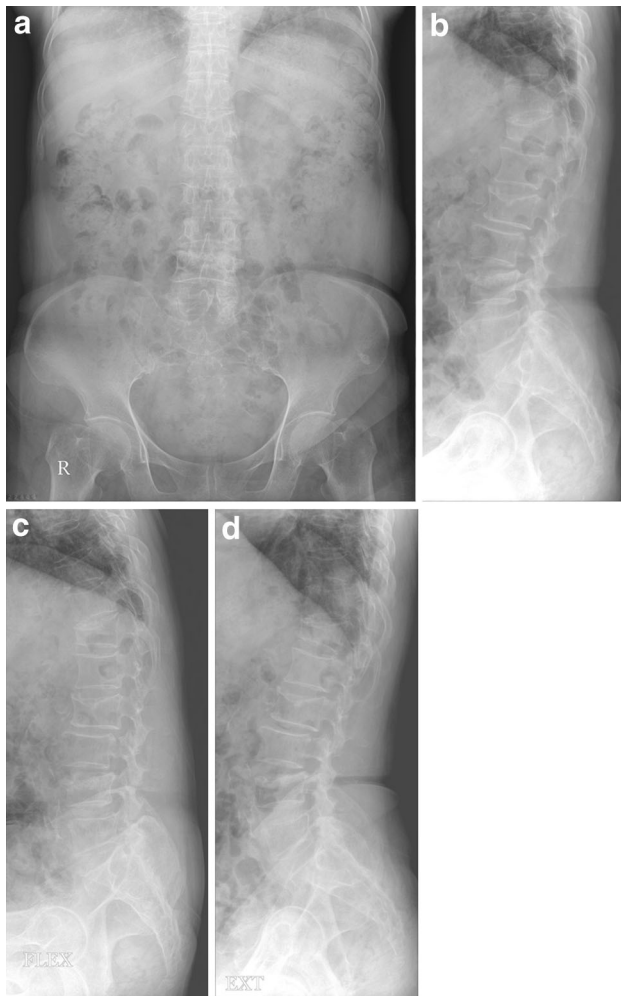


Fig. 1 Anteroposterior (a) and lateral (b) radiographs of the lumbar spine showing severe degenerative changes at the whole lumbar spine level, old compression fracture at the L2 and L4 level, and pedicle fracture at the L3 level. Flexion (c) and extension (d) lateral radiographs of the lumbar spine showing L3 vertebral body instability because of L3 pedicle fracture

pedicle screws (Fig. 4a, b). The patient received zonalendronic acid after the operation. In 1-year postoperative follow-up, the patient reported solid fusion of the L3/4 segment had resulted in pain relief (Fig. 5a, b, c), and she had returned to normal activity. Clinically, patient did not report pain at the final follow-up.

Discussion

Osteoporosis is an increasingly prevalent disease among the elderly, and osteoporosis-induced spinal compression fracture has become more common because of an increase in the aging population [14]. It commonly involves the vertebral body and induces loss of vertebral height with severe back pain. However, fracture of the lumbar pedicle is rare and only a few cases have been reported in the

literature [1, 4, 5, 8, 10–13, 15]. The load on the neural arch is abnormally distributed with resulting occurrence of pedicle fracture in several abnormal conditions. First, these fractures can occur because of surgically acquired disturbance of the neural arch [1, 3–5, 16, 17]. The pedicles associated with spinal fusion masses may experience abnormal repetitive shear forces because of continued motion through intervertebral discs, and the pars interarticularis [8]. Second, stress fractures of the pedicle can also occur as a result of non-surgically acquired structural abnormality of the neural arch. These fractures may occur on the contralateral side in patients with unilateral pars interarticularis spondylolysis [2, 9, 18, 19]. Unilateral spondylolysis can alter the normal biomechanics of the neural arch, resulting in increased stress on the contralateral pedicle, and “pediculolysis” can occur [2, 15, 18]. Third, pedicle stress fractures can also occur as a result of patient stress-related activities, e.g. athletes, and without iatrogenic and acquired structural abnormalities of the neural arch [6–9, 15, 20]. In short, in these three categories almost all reported cases are associated with specific underlying causative factors. However, to the best of our knowledge this is the first case of bilateral pedicle stress fracture with adjacent old osteoporotic compression fractures accompanying spondylolisthesis without any history of trauma, previous spine surgery, or stress-related activity. In this case, the predisposing factors for the pedicle fracture were osteoporosis (T -score = -4.1) and the change of motion of the L2–4 segment after L2 and L4 compression fracture. We consider that osteoporosis may induce the L2 and L4 compression fracture with chronic vertebral height loss, and incurrence of consequent abnormal mechanical force on the L3 pedicles for a long period. In addition, the abnormal repetitive mechanical force changes the cross sectional moment of inertia which induces the stress fracture of the L3 pedicles and gradual spondylolisthesis. Wiltse et al. differentiated several etiologies of spondylolisthesis as: congenital, isthmic, degenerative, traumatic, pathologic, and iatrogenic [21]. Among these, pars interarticularis defect is the most common cause of spondylolisthesis, because repetitive mechanical stress in the vertebral neural arch is usually located in the pars interarticularis [15, 22]. Moreover, the pedicle has a relatively shorter moment arm from the vertebral body and greater intrinsic strength than the pars interarticularis, as a result of which it can resist greater cyclic shear force [1, 2]. However, in our case, bilateral pedicle stress fracture was present and this induced muscle weakness and sensory disturbance of the right lower extremity. It seems that an adjacent old compression fracture can induce pediculolysis with unstable spondylolisthesis. In addition, surgical treatment that decompresses the impinged nerve and stabilizes the unstable segment is needed. Therefore, the

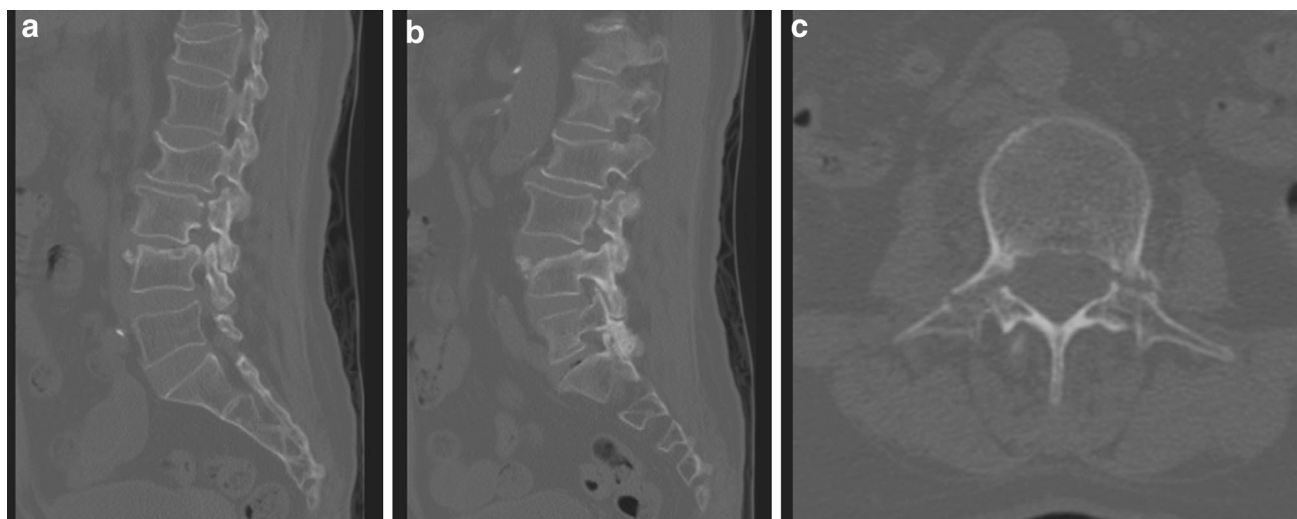


Fig. 2 Sagittal (a: right, b: left) and axial (c) computed tomographic (CT) scan revealing the bilateral L3 pedicle stress fracture with blunt fracture margin

Fig. 3 Magnetic resonance imaging (MRI) revealing a compression of both the nerve roots at the L3/4 level b without evident signal changes on the vertebral body

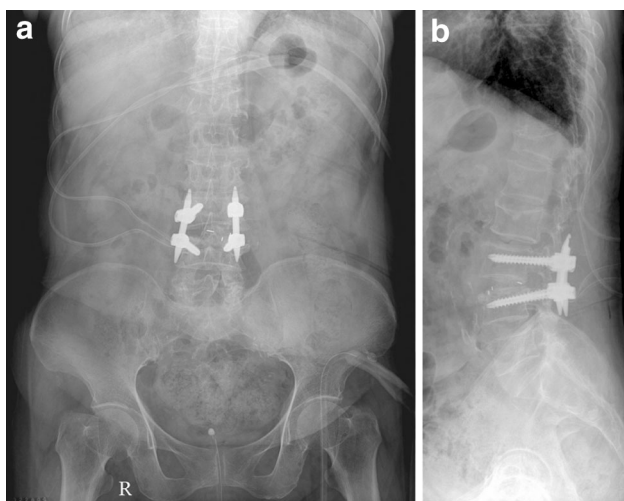
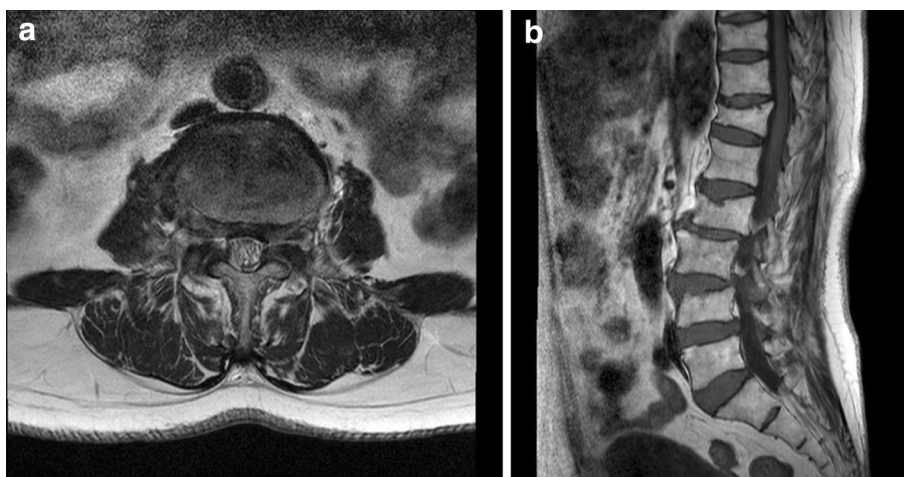


Fig. 4 Postoperative radiographs, anteroposterior a and lateral b views, showing decompressive laminectomies of L3 and posterior lumbar interbody fusion L3/4 with rigid pedicle screw fixation and autogenous bone graft

patient was treated with decompressive laminectomy and foraminectomy with posterior lumbar interbody fusion. We reduced the displacement of the pedicle and vertebral body by percutaneous insertion of large pedicle screws (reduction screw). We also fused the L3–4 segment to stabilize the unstable segment. Consequently, solid fusion resulted in pain relief for the patient, who was able to return to normal activity. We believe that appropriate reduction of the translated pedicle and body with large pedicle screws and decompression of the foramen should be carried out to resolve the radiculopathy and back pain. In addition, solid fusion of the unstable segment with autogenous bone graft can prevent further progression of the disease.

In conclusion, we report a rare case of lumbar bilateral pedicle stress fracture with adjacent levels of old osteoporotic compression fractures accompanying spondylolisthesis without a history of major trauma. We also report appropriate surgical treatment that can resolve the patient's

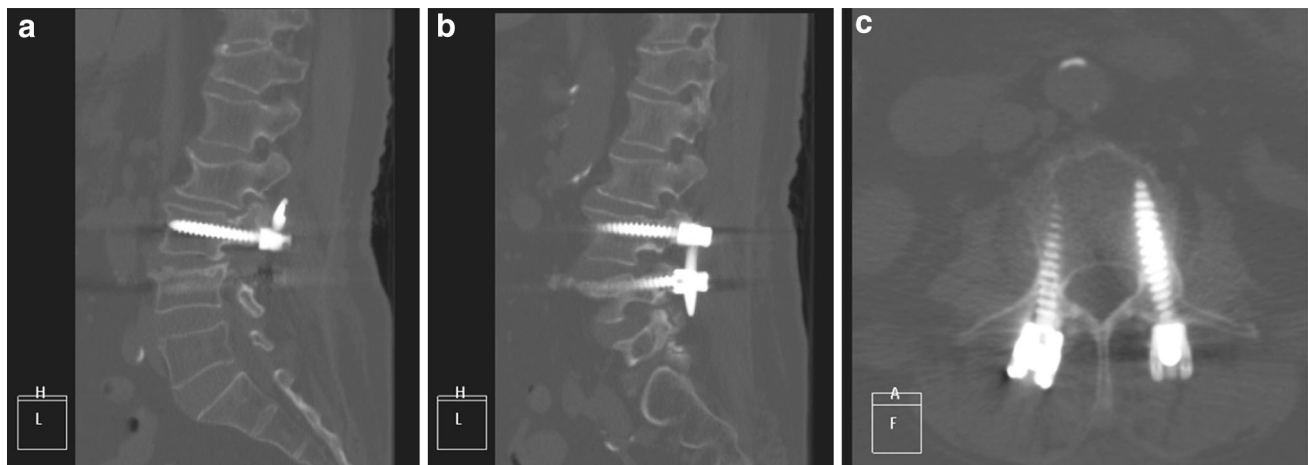


Fig. 5 1-year postoperative follow-up computed tomographic (CT) scan, sagittal (a: right, b: left) and axial (c), showing union of bilateral pedicle and appropriate screw placement

disability. Moreover, it will provide beneficial information to surgeons in the treatment and diagnosis of similar cases.

Conflict of interest The authors declare that they have no conflict of interest.

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