

## Bilateral pedicle stress fracture in a patient with osteoporotic compression fracture

Minoru Doita · Yoshihiro Ando · Soichiro Hirata ·  
Hitoshi Ishikawa · Masahiro Kurosaka

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**Abstract** A case of bilateral pedicle stress fracture of L4 in a patient with osteoporotic compression fracture of L5 and without a history of major trauma or surgery is reported, and the literature is reviewed. Bilateral pedicle fracture is a rare entity and few cases have been reported in the literature. All reported cases had some underlying causative factors like previous spine surgery or stress related activities. To the best of the authors' knowledge, only one case of bilateral pedicle stress fracture without a history of trauma, previous spine surgery, or stress-related activities has been reported. A 77-year-old woman presented with severe low back pain and radiating pain in the right leg that was exacerbated after standing and walking. Plain radiograph showed pathological fracture at L5 level. Magnetic resonance imaging (MRI) revealed the compression of dural sac at L5 level. CT scan taken 3 months after admission revealed bilateral pedicle fractures through L4. The patient was treated with decompressive laminectomies of L4, followed by posterior spinal fusion with rigid pedicle screw fixation and autogenous bone graft mixed with hydroxyapatite. The patient achieved pain relief and returned to normal activity. Stress fracture of the pedicle within the proximal vertebra of an osteoporotic compression fracture of lumbar spine is an uncommon entity. It

may, however, be an additional source of symptoms in patients with osteoporosis who present with further back pain. Surgeons caring for this group of patients should be aware of this condition.

**Keywords** Pedicle fracture · Stress fracture · Osteoporosis · Low back pain · Lumbar spine

### Introduction

Osteoporosis is the most common cause of spinal compression fracture, but most of these fractures are stable and can be managed conservatively. Progressive collapse of the vertebral body and late kyphosis can be associated with complications possibly causing neurological deficits and chronic back pain necessitating surgical correction. However, stress fractures of the pedicle in the osteoporotic spine are uncommon. Most pedicle stress fractures have been reported in association with previous spine surgery [9, 11, 14] or stress-related activities [8, 13, 16, 18] such as in highly active athletes. However, there have been few reports of bilateral stress fractures of the pedicle without other injuries or predisposing factors [15]. We report an uncommon case of bilateral pedicle stress fracture of L4 in a patient with L5 osteoporotic compression fracture without the history of trauma.

### Case report

A 77-year-old woman presented with severe low back pain and radiating pain in the right leg that was exacerbated after standing and walking. The patient was admitted to the second author's hospital in February 2007. A needle biopsy

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M. Doita · S. Hirata · M. Kurosaka  
Department of Orthopaedic Surgery,  
Kobe University Graduate School of Medicine, Kobe, Japan

Y. Ando · H. Ishikawa  
Department of Orthopedic Surgery,  
Ishikawa Hospital, Himeji, Japan

M. Doita (✉)  
7-5-1 Kusunoki-cho, Chuo-ku, Kobe 650-0017, Japan  
e-mail: doita@med.kobe-u.ac.jp

was performed to make differential diagnosis of pathological fracture of metastatic bone tumor through posterolateral approach without disturbing the posterior elements. A diagnosis of osteoporotic compression fracture of the fifth lumbar vertebral body was made, and the patient was conservatively treated with the administration of painkillers and frame corset. The patient joined rehabilitation exercises and started walking gradually with the corset. However, symptoms progressed and the patient complained of muscle weakness in the right leg.

Physical examination revealed a marked reduction in all back movement and tenderness on L5 spinous process. The patient had a straight-leg-raise restriction of 30° in her right lower limb and 85° in her left lower limb. Neurological examination revealed slight muscle weakness with 4 out of 5 strength in right anterior tibial muscle and extensor hallucis longus muscle. The patient had sensory disturbance at the L4 to S1 area in her right leg. Usual blood and urine examinations showed no abnormal findings.

Plain radiographs showed the L5 compression fracture (Fig. 1a, b) and a computed tomographic (CT) scan taken on Jan 31 at the outpatient clinic showed no L4 pedicle fractures (Fig. 2a, b). Magnetic resonance imaging (MRI) revealed the compression of dural sac at L5 level. A CT scan taken on April 6 before operation revealed bilateral pedicle fractures through L4 (Fig. 3a, b).

The patient was treated with decompressive laminectomies of L4, followed by posterior spinal fusion with rigid pedicle screw fixation at L3–S1 and autogenous bone graft mixed with hydroxyapatite (Fig. 4a, b). We could not find any anomalies in the pars region of L4 vertebra.

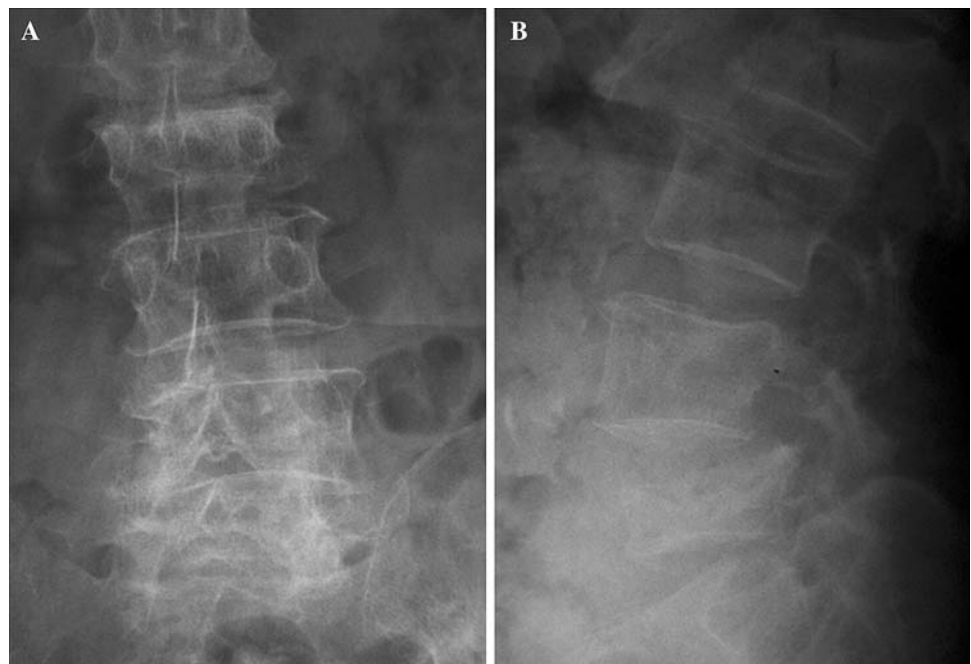
At the follow-up assessment at 5 months, the patient had no residual low back pain or lower extremity pain.

## Discussion

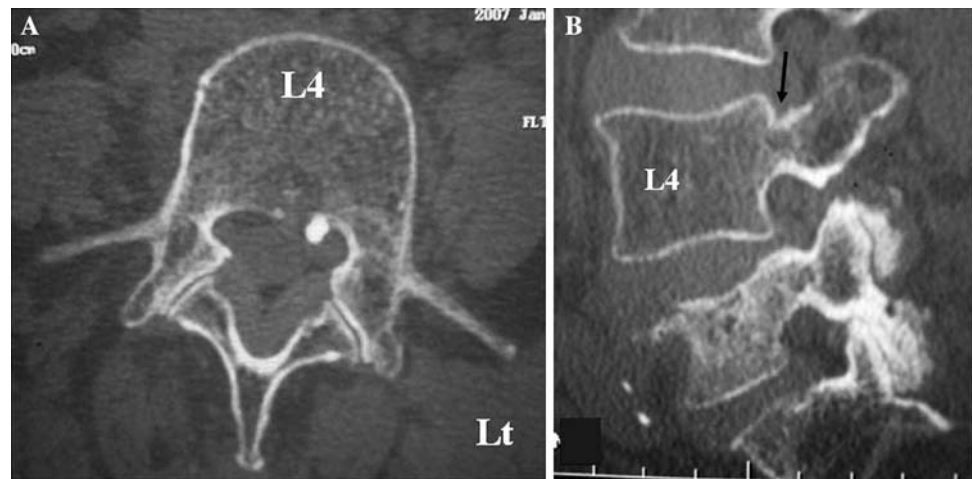
Stress fractures occur in normal or abnormal bone that is subjected to prolonged and repetitive loading and has not accommodated itself to that action. Depending on the amount of stress applied to bone and on the elastic properties of bone tissue, they are classified as fatigue or insufficiency fractures. Fatigue fractures occur when abnormal muscular stress or torque is applied to bone with normal elastic resistance. Insufficiency fractures occur when normal physiological muscular stress is applied to bone with deficient elastic resistance or mineral content. The spine and the hip are the most common fracture sites secondary to osteoporosis. However, stress fractures of the pedicle are much less common [8, 9, 11, 13–16, 18]. In the present case, postmenopausal osteoporosis is a predisposing factor for the bilateral pedicle fracture because an osteoporotic compression fracture had occurred before this fracture. Furthermore, the change of motion of the L4–5 segment after the compression fracture might be another reason for the stress fracture. Therefore, it is supposed that abnormal muscular stress was applied to the pedicles of osteoporotic bone with deficient elastic resistance and mineral content after an adjacent vertebral body fracture.

It has been shown that the pedicle is the second weakest part of the vertebrae after the pars interarticularis [3–5, 14]. These fractures may occur bilaterally or on the contralateral

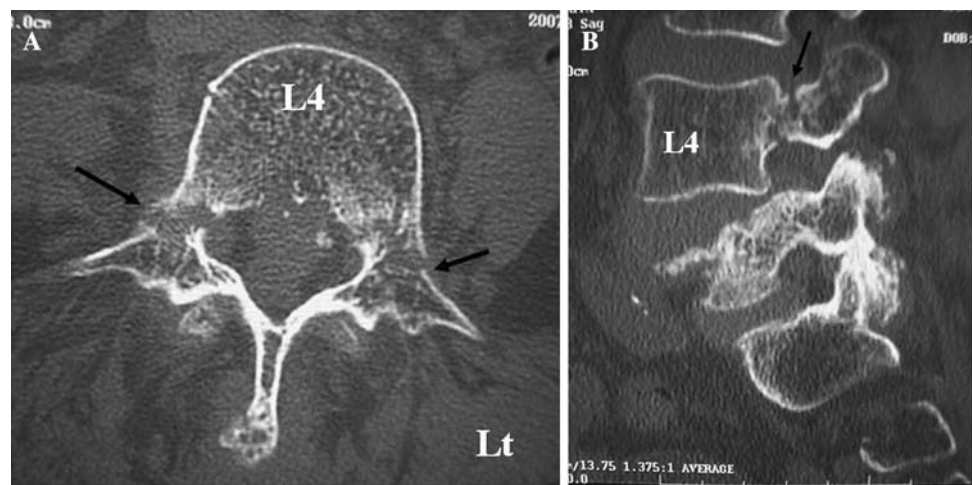
**Fig. 1** Anteroposterior (a) and lateral (b) radiographs of the lumbar spine showing osteoporotic burst fracture of L5



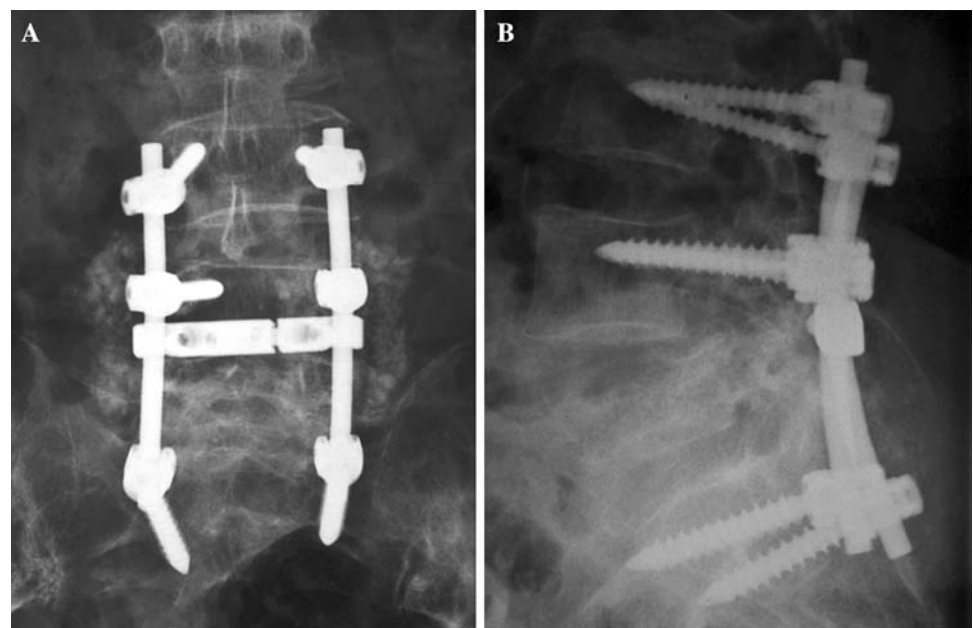
**Fig. 2** Axial (a) and parasagittal computed tomographic (CT) scan taken Jan 31 showing no L4 pedicle fractures



**Fig. 3** a Computed tomographic (CT) scan demonstrating the bilateral pedicle fracture through L4 (arrows). b Parasagittal reconstructions confirm L4 pedicle fractures (arrow)



**Fig. 4** Anteroposterior (a) and lateral (b) postoperative plain radiographs of the lumbar spine showing decompressive laminectomies of L4, followed by posterior spinal fusion with rigid pedicle screw fixation at L3–S1 and autogenous bone graft mixed with hydroxyapatite



side in patients with unilateral spondylolysis [1, 2, 6, 7, 12]. Bilateral pedicle fracture is a rare entity. Few cases have been reported in the English literature. Almost all reported cases have had some underlying causative factors like previous spine surgery [9, 11, 14] or have occurred as a result of stress-related activities, such as in athletes [8, 13, 16, 18]. To our knowledge, only one case has been previously reported of bilateral pedicle fracture in the absence of previous spinal surgery or stress-related activities [15].

The pedicle has greater intrinsic strength and a shorter moment arm from the vertebral body and therefore can resist greater cyclic shear forces [14]. The pedicle may experience increased forces after spine surgery, especially after spinal fusion [10, 11, 14, 17, 19]. Junctional pedicles, even pedicles within a fused spinal level, experience repetitive shear forces secondary to continued motion through the intervertebral disc after posterolateral fusion. The pedicle stress fracture in the previous two reported cases after surgery occurred at the most proximal level of the fusion. Three cases of bilateral pedicle stress fracture without a history of lumbar spine surgery have also been reported [8, 13, 18]. These cases suggest the patient's activity as a cause of fracture. In the present case, the proximal junctional pedicles to the L5 compression fracture were involved in the absence of fracture of the L4 vertebral body. The pedicles of L4 would have received abnormal repetitive shear stress, because both the anterior and posterior columns of the L5 vertebral body were destroyed and the patient had been encouraged to perform a walking exercise after a diagnosis of osteoporotic compression fracture was made. Furthermore, the fractures appeared to be fresh, because no sclerotic change was shown at the fracture margins and they were not observed 3 months before surgery.

The patient presented with muscle weakness of the lower extremities combined with L5 burst fracture and L4 bilateral pedicle fractures. Thus, the patient was treated with decompressive laminectomies of L4, followed by posterior spinal fusion with rigid pedicle screw fixation at L3-S1.

Stress fracture of the pedicle within the proximal vertebra of osteoporotic compression fracture at lower lumbar spine is an uncommon entity. It may, however, be an additional source of symptoms in patients with osteoporotic spine who present with further back pain. Surgeons caring for this group of patients should be aware of this condition.

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**Conflict of interest statement** None of the author has any potential conflict of interest.

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