

Bilateral Pedicle Stress Fractures in a Female Athlete

Case Report and Review of the Literature

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Study Design. Clinical case report of bilateral stress fractures of the pedicle in a female athlete presenting with back pain

Objectives. To report this unusual case and surgical treatment and to review the relevant literature.

Summary of Background Data. Low back pain is a frequent complaint in athletes, with the majority of cases being related to muscular or soft tissue etiology. Spondylolysis, or pars fracture, is the most common injury of the neural arch. Stress fracture of the pedicle is a much less common occurrence. Bilateral pedicle fractures in an otherwise healthy athlete has not been previously reported in the orthopedic literature.

Methods. A 19-year-old female athlete presented with low back pain limiting sports and daily activities. Radiographic workup revealed bilateral stress fractures of the pedicles of the L5 vertebra. Circumferential fusion of the L5–S1 segment was performed after failure of conservative treatment. Anterior interbody structural allograft and a vertical mesh cage were combined with instrumented posterolateral fusion using segmental pedicle screws and autogenous iliac crest bone graft.

Results. The patient achieved complete pain relief, solid fusion, and return to normal function.

Conclusions. In this uncommon case of bilateral stress fractures of the pedicle, circumferential fusion assures full immobilization of the injured motion segment and assures a high probability of successful healing. [Key words: pedicle, stress fracture, neural arch, spondylolysis] **Spine** 2004;29:E19–E21

Low back pain is a relatively common complaint in young athletes. The majority of cases are related to muscular or soft tissue injury. Bony injuries often involve the neural arch, with spondylolysis being the most commonly encountered injury. There have been several reports of unilateral pedicle stress fractures associated with contralateral spondylolysis^{1–8} as well as of laminar stress fractures.^{9,10} Stress fractures of the pedicle (“pediculolysis”) are less common occurrences, especially bilateral. Most reports are of pedicle stress fractures as postsurgical complications.^{11–15} There have been few reports of bilateral stress fractures of the pedicle without other injuries or predisposing factors^{9,16} and none in the ortho-

pedic literature. We report an uncommon case of a female athlete with bilateral pedicle stress fractures.

■ Case Report

A 19-year-old female college Lacrosse player presented with a 6-month history of persistent and severe low back pain. The pain was mechanical in nature, exacerbated by movement, and significantly limiting in all athletic activities. There were no associated radicular symptoms, and no specific injury or predisposing factors could be identified.

Physical examination was notable for tenderness to palpation over the lumbosacral spine and increased pain with lumbar extension or rotational movements.

Plain radiographs suggested bilateral L5 pedicle fractures (Figure 1) which was confirmed by computed tomographic (CT) scan (Figure 2). Magnetic resonance imaging (MRI) indicated normal disc architecture and no other soft tissue injury (Figure 3), and nuclear bone scan revealed increased activity in the posterior elements of L5 in the region of the pedicles (Figure 4).

Nonoperative treatment was initiated, with restriction from sports, full-time bracing, and analgesics. There was no change in the symptoms and no radiographic evidence of fracture healing after 3 months.

Because of the failure of nonoperative treatment, the patient underwent a single-stage circumferential fusion of the L5–S1 segment. An anterior interbody fusion procedure was performed, using a vertical mesh cage filled with morselized allograft, and also structural tricortical allograft. This was followed by an instrumented posterolateral fusion with autogenous iliac crest bone graft and segmental pedicle fixation. During drilling of the pedicles for screw placement, sclerotic bone was encountered. The displaced fracture line could be palpated with a ball-tipped probe within the pedicles.

In postoperative follow-up, the patient reported complete pain relief and return to collegiate level Lacrosse after 5 months. There was radiographic evidence of fusion by 5 months after surgery (Figure 5) and at the 1-year follow-up.

■ Discussion

Cyron *et al*^{17,18} have reported on the biomechanical characteristics of the lumbosacral spine in relation to stress injury patterns, and they found that L5 was the most common level of injury. This was reported to result from increased forces at the lumbosacral junction secondary to the steeply inclined sacral table, and an abrupt transition from the flexible lumbar spine to the stable pelvis. The neural arch was found to be most vulnerable to the typical impact or cyclic loading forces encountered in many sporting activities. In their study, isthmic fractures occurred with much greater frequency than isolated pedicle fractures. Pedicle fractures also occurred following contralateral isthmic fractures, secondary to a weakening of the neural arch with resulting increased stress across the contralateral pedicle. They proposed several

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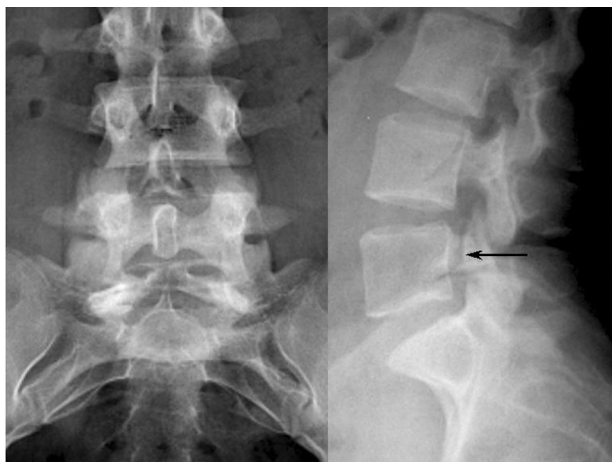


Figure 1. Preoperative plain radiographs are suggestive of L5 pedicle fractures (arrow).

risk factors for these injuries in young individuals, including strenuous activity, greater shear forces secondary to increased elasticity and mobility of the intervertebral disc, and incomplete ossification of the neural arch. Additionally, the importance of adequate extensor musculature for control of the stresses on the neural arch was noted.

Stress fractures of the neural arch should be considered in any young athlete with persistent back pain. Non-operative treatment should be the first option, and most neural arch injuries can be successfully treated in this fashion.

Stress fractures of the pedicle are much less common than those of the pars interarticularis. The pedicle has greater intrinsic strength and a shorter moment arm from the vertebral body and therefore can resist greater cyclic shear forces.¹³ The pedicle may experience increased forces after spine surgery, especially after spinal fusion.^{11–15} Junctional pedicles, and even pedicles within

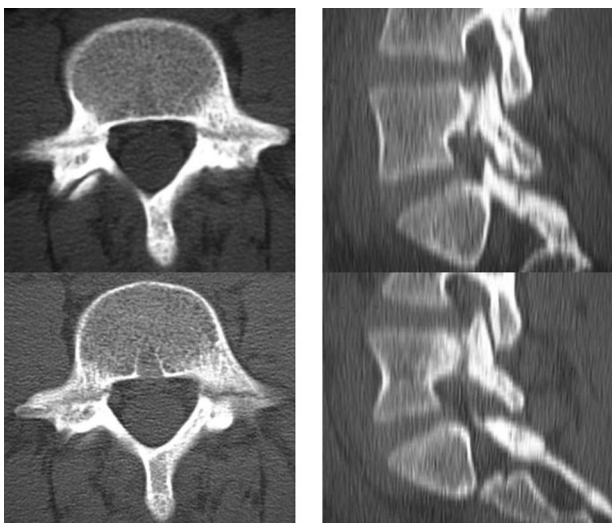


Figure 2. Axial CT sections (left) and sagittal reconstructions (right) confirm bilateral L5 pedicle fractures.

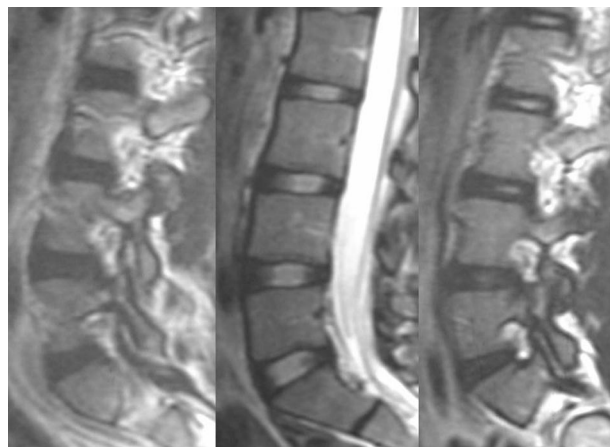


Figure 3. MRI demonstrates normal disc architecture and no soft tissue abnormalities.

a fused spinal level, experience repetitive shear forces secondary to continued motion through the intervertebral disc after posterolateral fusion. The pars interarticularis, which normally shares these forces, is incorporated into the fusion mass.

There have been several publications focusing on the reaction of the pedicle to increased stress. Reactive sclerosis and hypertrophy occur when increased forces are transmitted through the pedicle, as is often seen with weakening of the neural arch from a contralateral spondylolysis. Up to 40% of pedicles with a contralateral spondylolysis will have reactive changes on MRI.¹⁹

Altered biomechanics of the neural arch following spondylolysis are more likely to cause a contralateral spondylolysis than a stress fractures of the pedicle, but the occurrence of “pediculolysis” secondary to a contralateral spondylolysis can occur.^{1–8} Indeed, this phenomenon is more commonly reported than isolated stress fractures of the pedicle. There are two reports of bilateral pedicle fractures in the radiology literature,^{9,16} and the role of multiplanar single photon emission com-



Figure 4. Nuclear bone scan reveals significantly increased activity in the region of both pedicles of L5.

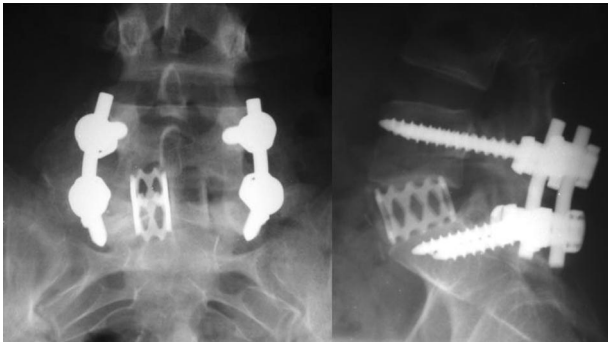


Figure 5. Postoperative plain radiographs indicate fusion by 5 months postsurgery.

puted tomography to more closely localize the area of fracture has been described.

In the case reported here, the patient presented with bilateral pedicle fractures that failed nonoperative treatment. Surgical options include direct curettage and grafting of the pedicles combined with a posterior “lag screw” across the pedicle, posterolateral fusion of L5–S1, or a combined anteroposterior approach. In the case of a pedicle fracture, direct exposure and fixation of the fracture site are not readily achieved. Anterior fusion with structural support is the only approach that neutralizes the anterior flexion and shear forces that occur across the intervertebral disc. These forces can be potentially problematic with regard to continued shear forces across the pedicle during healing. Anterior fusion also increases the chance for immobilization and solid fusion of the injured motion segment.

In the case presented, a combined anteroposterior fusion was performed to assure maximal healing potential of the injured motion segment. The patient experienced complete pain relief and full return to normal function. Anteroposterior fusion should be considered as a treatment option for this unusual injury.

■ Key Points

- Isolated stress fracture of the pedicle is uncommon and bilateral stress fracture of the pedicle in a healthy athlete has not been previously reported in the orthopedic literature.

- An unusual case of bilateral stress fractures of the pedicle in a female athlete is presented. Relevant literature is reviewed.
- Anteroposterior fusion is an effective surgical approach to this unusual injury.

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