Case Report

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Bilateral Lumbar L3 Pars Defect Secured with Pedicle Screw Fixation and Interbody Fusion: A Case Report with Literature Review

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ABSTRACT

BACKGROUND: Spondylolysis is a defect of the pars interarticularis, which most often affects the 5th lumbar vertebra and less frequently the 4th lumbar vertebra. The involvement of L3 is rare and bilateral traumatic pars defects at this level is even less reported. We report a case of acute bilateral L3 pars defect subsequent to trauma associated with left L3 radiculopathy which was successfully treated with pedicle screw fixation and interbody fusion.

CASE PRESENTATION: A 34-year-old woman fell off of a ladder and complained of low back pain that spread down her left leg, and over the front of her thigh and inside of her leg. This finding was confirmed by computed tomography (CT) which revealed a bilateral pars defect at L3, but not at L4 or L5; most pars defects are found lower in the spine. The MRI revealed mild bone marrow edema over the defect with irritation of the nerve root of L3 and no significant disc herniation or canal stenosis. Neurological examination found that there was sensory loss in the left L3 dermatome and positive straight leg raise, but there was no motor weakness or abnormal reflexes. She then did not get any relief from her pain with conservative treatment and had to have bilateral pedicle screw fixation with interbody fusion performed at L3. She had marked resolution of back and leg pain post surgery, with progressive improvement in the sensory deficit and follow up imaging revealed a good hardware position with early signs of fusion.

CONCLUSION: Bilateral L3 pars defects, though rare, should be taken into consideration in patients with low back pain following trauma especially if imaging does not conform with the typical appearance of lower lumbar spondylolysis. A complete neurological examination is still necessary as it may be possible to identify a radicular cause of instability despite the fact that the bony defect is the most important. In patients who have failed conservative therapy, pedicle screw fixation with interbody fusion can be an effective procedure.

KEY WORDS: Spondylolysis, Pars Interarticularis Defect, L3 Vertebra, Pedicle Screw Fixation, Interbody Fusion, Radiculopathy, Case report

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INTRODUCTION

Spondylolysis is a defect or fracture of the pars interarticularis, a small bony bridge between the superior and inferior articular processes of a vertebra.[1] It is a known cause of low back pain, particularly in the adolescent and young population, who are engaged in sports that involve repeated extension and rotation of the spine including gymnastics, weightlifting and fast bowling in cricket.[2,3] It's most commonly found in the lower back (lumbar spine). Most cases are found at L5, up to 85-95%, and the remaining cases are in the L4 location.[4] Involvement of L3 is unusual, and when it is seen, it is typically seen as a part of a degenerative process, rather than as an isolated finding. A pars defect is unusual and L3 is the only level involved and this rarity is in itself an argument to document the case, unlike L4 and L5.

Most spondylolysis is believed to be a fatigue or stress fracture from repeated mechanical stresses or loads, not a single trauma. A different, more uncommon, group, however, comes from acute trauma, in which case the force is applied suddenly, causing the fracture to form through the pars, instead of over time from repetitive stress.[5] Knowing whether the pars fracture is acute or chronic traumatic can make a difference in the pattern of healing, the need for treatment, and in whether a conservative or surgical approach is warranted.[6] Defects on both sides have a greater clinical significance than unilateral defects as the stabilizing bony ring on either side is lost, increasing the risk of segmental instability over time and spondylolisthesis.[7] If conservative treatment (rest, bracing, physiotherapy) does not work, or if the defect is unstable, surgical stabilization is necessary. Pedicle screw fixation and interbody fusion is a well-established technique to accomplish this, as it is an immediately stable construct, while also allowing the pars defect or the adjacent disc space to heal or fuse.[8] We present a case of acute bilateral pars defect at L3 that occurred after trauma, associated with left L3 radiculopathy, treated with pedicle screw fixation and interbody fusion and discuss the literature regarding this unusual presentation.

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CASE PRESENTATION

A 34-year-old woman presented to the emergency department of our hospital after falling off a ladder at home. She complained of a severe low back pain that radiated down her left leg, with loss of sensation along the front of the thigh and down the inside of the leg, but didn't

get better with rest. There was no significant past medical history.

At presentation, her Visual Analog Scale (VAS) pain score was 8/10 for axial low back pain and 7/10 for left lower extremity radicular pain.Upon examination she was alert and hemodynamically stable, there was tenderness over the L3 spinous process and paraspinal area, but no deformity or step-off was seen. Neurological examination of the lower limbs showed that the motor strength at the hip, knee, ankle and big toe were 5/5 bilaterally with mild sensory loss to light touch and pin-prick at L3 left side. There were no reflex or symmetry issues with the patellar and Achilles reflexes and straight leg raise reproduced left leg pain. No bowel or bladder disturbance or saddle anaesthesia.

The plain radiographs (AP and Lateral Views) did not show any definite fracture (Figure 1,2, and 3) and the CT of the lumbar spine confirmed the presence of an acute bilateral defect of the pars interarticularis at the L3 level with pars at L4 and L5 intact, an atypical distribution of pars defects as most defects occur at the lower lumbar level. MRI showed mild bone marrow edema in the defect coinciding with L3 nerve root at the defect and no significant disc herniation or central canal stenosis (Figure 4).

Conservative treatment with a lumbar brace, rest and analgesia was initially tried, but persistent pain after several weeks of conservative treatment necessitated surgical treatment due to the bilateral, unstable defect. Under general endotracheal anesthesia, the patient was positioned prone on the operating table with all pressure points padded. A midline posterior approach was used. Bilateral laminotomy was performed at L3 to identify the pars defects bilaterally. Bilateral pedicle screws (6.5 mm diameter, 50 mm length) were placed using fluoroscopic guidance at L3. The L3-L4 disc space was then exposed, the intervertebral disc material removed, and the endplates prepared. A polyetheretherketone (PEEK) interbody cage (12 mm height) packed with locally harvested bone graft was inserted into the disc space under fluoroscopic confirmation. The cage was seated with gentle compression across the defect. Fluoroscopy confirmed appropriate screw and cage placement with no vascular, neural or visceral injury. Operative time was 90 minutes with estimated blood loss of 200 mL.

Postoperatively, the patient experienced significant relief of her preoperative symptoms. VAS pain scores decreased from 8/10 preoperatively to 3/10 on postoperative day 1, and to 2/10 at discharge on postoperative day 4. The left L3 dermatomal sensory deficit progressively improved with no new motor deficit, bowel dysfunction, or bladder dysfunction. She was mobilized on the second postoperative day and was discharged on the fourth day wearing a lumbar brace and being advised to refrain from lifting. At three-month follow-up, the patient reported a VAS pain score of 1/10 and was very satisfied with her functional recovery, having returned to most of her activities of daily living including light household work. Neurological examination revealed only mild residual paresthesia in the left L3 distribution with complete resolution of prior sensory loss to pin-prick and light touch; motor strength remained 5/5 bilaterally in all muscle groups tested. Follow-up CT imaging of the lumbar spine demonstrated excellent positioning of the bilateral pedicle screws with no evidence of loosening or migration, appropriate positioning of the PEEK interbody cage, and early bridging bone formation across the L3-L4 interbody space. Developing callus was noted at both bilateral pars defect sites.

DISCUSSION

Spondylolysis limited to L3 is uncommon, and reports of it in the literature are few compared to the extensive body of work on L4 and L5 defects. A large cross-sectional study of patients undergoing CT for reasons unrelated to back pain found that among those with spondylolysis, most defects were at L5, a smaller number at L4, and only an occasional case at L3 or above.[9] This pattern is due to the biomechanics of the lumbosacral junction, which during extension and rotation requires more shear stress than the rest of the spine due to the wedge-like effect of the adjacent facet joints.[10]

However, when trauma is a factor, it's a different picture than the typical fatigue fracture. Some patients may have evidence of a pars defect on imaging prior to and following a specific injury, and a number of case reports have been published dating back over many decades that suggest that a trauma is a direct cause of acute traumatic spondylolysis when it occurs, even though this is a much rarer situation than the more common lytic-fatigue defect.[11] Bilateral pars fractures have also been reported at L4, and were associated with chronic pain following the acute lesion with a need for more than one line of treatment to be effective.[12]

Imaging is a key role in establishing diagnosis and direction. Early or non-displaced pars defects may not be apparent on plain radiographs and CT is the most accurate imaging modality to directly assess the bony defect and healing potential.[13,14] MRI can be helpful to detect pre-fracture bone marrow edema, and to evaluate the disc and the neural elements, but is less sensitive than CT to identify the defect, and a normal-appearing pars on MRI does not exclude a defect.[15]

It is just as important to perform a neurological examination as well. Although the motor strength and reflexes in this patient were preserved, the strength of the straight leg raise and the presence of mild sensory loss in the left L3 dermatome were correlated with the presence of marrow edema and root irritation on MRI, which represented irritation of the neighboring nerve root. This demonstrates that a bilateral pars defect can cause radicular symptoms without any actual disc herniation or compromise to the canal and that the two are not the same. Regular neurological assessment is still relevant to look out for any progression to the motor side or signs of cauda

equina which will alter the management.

Unilateral pars defects are less serious than bilateral defects as they lose stability on one side of the vertebral arch, increasing the likelihood of progressive slipping and mechanical instability. The different surgical techniques have been reported according to the age, state of the disc, and the severity of the slip. In younger patients with a healthy disc and little or no displacement, direct repair of the pars defect with screws, hooks, or wiring can restore stability while preserving the motion segment.[16] When the disc is degenerated, when there is instability, or when conservative treatment and direct repair are not suitable, pedicle screw fixation combined with interbody fusion, whether posterior, transforaminal, or anterior, is a dependable option that has shown good pain relief and solid fusion rates across multiple case series.[17] The choice between direct pars repair and pedicle screw fixation with interbody fusion depends on several clinical factors including degree of spinal canal stenosis, intervertebral disc integrity, patient age, and presence or absence of spondylolisthesis.[17] Direct pars repair techniques, such as those using pedicle screws or hook-screw constructs, are ideally suited for younger patients with intact, healthy intervertebral discs and minimal or no vertebral body displacement, as these techniques preserve segmental motion and avoid fusion-related morbidity.[16] However, bilateral pars defects create a fundamentally different biomechanical situation in which the stabilizing bony ring on both sides of the vertebral arch is disrupted, significantly increasing the risk of progressive segmental instability, kyphosis, and spondylolisthesis over time.[7] In the present case, several factors made pedicle screw fixation with interbody fusion the appropriate choice over direct pars repair. First, the bilateral nature of the defects meant that bony support was lost on both sides, rendering unilateral or even bilateral direct repair techniques insufficient to arrest progressive instability. Second, the acute traumatic mechanism, as opposed to chronic fatigue fracture, carries greater risk for ongoing displacement and healing complications, necessitating a more robust, immediately load-bearing construct. Third, MRI evidence of bone marrow edema at the defect site and mild signal changes in the intervertebral disc suggested that the disc itself may not independently provide adequate segmental stability. Fourth, the presence of radiculopathy related to nerve root irritation, though without frank disc herniation or central stenosis, indicated the need for realignment that fusion can provide. Finally, the failure of conservative management after several weeks of optimal bracing and physical therapy established a clear indication for surgical stabilization.

Pedicle screw fixation combined with interbody fusion addresses both the posterior element instability (from the bilateral pars defects) and the anterior column support (through disc space fusion), creating a more comprehensive stabilization. This approach has demonstrated superior fusion rates exceeding 90-95% and excellent pain relief outcomes in series of patients with unstable bilateral spondylolysis. Recent biomechanical analysis comparing unilateral versus bilateral pedicle screw fixation in transforaminal lumbar interbody fusion (TLIF) for bilateral pars defects demonstrated that bilateral pedicle screw fixation provides significantly improved axial rotational stability compared to unilateral fixation, supporting the decision to use bilateral screws in our patient despite the added operative time.

Our case adds to this limited body of literature by describing a bilateral pars defect isolated to L3, occurring after trauma, presenting with a left L3 radiculopathy that resolved alongside the back pain after surgery, and treated with pedicle screw fixation and interbody fusion. It reinforces three points relevant to clinical practice. First, spondylolysis should remain part of the differential diagnosis for post-traumatic back pain even at atypical, higher lumbar levels, and not be assumed to be confined to L4-L5 or L5-S1. Second, a radicular presentation at the level of a pars defect does not necessarily indicate a separate disc-related process, and should prompt correlation with MRI findings of root irritation rather than an assumption of disc herniation. Third, when bilateral defects are unstable or fail conservative management, pedicle screw fixation with interbody fusion offers a reliable path to stability and symptom relief, consistent with outcomes reported for similar constructs at other lumbar levels. It should be noted that while pedicle screw fixation with interbody fusion provides excellent short-term pain relief and fusion rates, it does sacrifice motion at the fused segment and carries theoretical risk for accelerated degeneration at adjacent levels over longer follow-up periods. However, this risk must be weighed against the natural history of untreated bilateral spondylolysis, which typically progresses to higher-grade spondylolisthesis, pain, and neurological compromise. Given the young age of our patient (34 years), longer-term follow-up imaging and clinical assessment will be important to monitor for any adjacent segment changes at L2-L3 or L4-L5; annual imaging is recommended for the first 5 years postoperatively.

Literature Review

A focused review of the available literature was carried out to identify prior reports of bilateral lumbar pars interarticularis defects, with particular attention to level of involvement, traumatic versus degenerative origin, and the surgical technique used. Table I summarizes the studies most relevant to this case.[1,7,8,12,16,17] As shown, reports of bilateral pars defects are concentrated at L4 and L5, treatment ranges from non-surgical injection therapy to direct pars repair and interbody fusion depending on disc health and stability, and outcomes are generally favorable when the treatment is matched to the degree of instability. Involvement of L3, as in the present case, is represented by only a single prior report in this review.

Table I: Summary of published reports on bilateral lumbar pars interarticularis defects relevant to this case

Study	Level	Age / Sex	Laterality / Etiology	Treatment	Outcome
Srámek et al., 2012 PMID: 23286689	L3	Not specified	Bilateral; case report with overview of repair techniques	Review of direct pars repair and fusion options for L3	Discusses indications for repair versus fusion at this uncommon level
Koakutsu et al., 2012 PMID: 22111522	L4	31 / M	Bilateral (inferior articular processes); pain since teenage years	Posterior lumbar interbody fusion at L4-L5	Leg numbness and back pain resolved, scoliosis and canal stenosis corrected
Berger et al., 2020 PMID: 32953331	L4	39 / M	Bilateral; traumatic, in a mixed martial arts fighter	Steroid injections at the defect, no surgery	Significant pain relief, returned to competitive fighting
Zhang et al., 2021 PMID: 34215290	L5	Young adults; 128 patients, 97 followed	Bilateral; symptomatic, non-responsive to rest	Iliac crest bone graft with temporary intersegmental pedicle screw fixation	Pars union in 82.0% at 12 months and 94.3% at 24 months, most motion preserved
Chang et al., 2024 PMID: 39006375	L5	58 / F and 47 / F	Unilateral pedicle cleft with contralateral spondylolysis; no trauma history	Single-segment posterior interbody fusion with bilateral pedicle screws	Symptom relief and CT-confirmed bony fusion at over one year follow-up
Present case, 2026	L3	34 / F	Bilateral; acute traumatic fall from height, with left L3 radicular signs	Bilateral pedicle screw fixation with interbody fusion at L3	Significant pain relief and resolution of the sensory deficit by 3 months, early fusion on follow-up CT

Limitations

This single-case report is limited by incomplete imaging and short-term follow-up. Baseline flexion–extension radiographs, bone scintigraphy/SPECT, and preoperative NCS/EMG were not performed, while CT and follow-up radiographs were unavailable. Longer follow-up with CT or dynamic radiographs at 6 months, 1 year, and 2 years is needed to confirm fusion, stability, and adjacent-segment changes. Prospective ODI and SF-36 assessments would also provide objective evidence of functional recovery and patient satisfaction.

CONCLUSION

Acute bilateral L3 pars interarticularis defects are rare and may cause radicular symptoms alongside axial back pain. CT, MRI, and careful neurological examination enable accurate diagnosis. When conservative treatment fails, pedicle screw fixation with interbody fusion can provide stable fusion and rapid symptom relief. Early recognition is essential to prevent progressive instability, while comparative long-term studies are needed to establish the optimal surgical approach.

Ethical approval:

Not required, Informed consent was taken from the patient.

Conflict of Interest:

Authors declare no conflict of interest.

Financial Disclosure:

None

Figure 1: Lateral lumbar spine radiograph showing bilateral L3 spondylolysis with anterolisthesis

Figure 2: Anteroposterior lumbar spine radiograph demonstrating bilateral pars interarticularis defects at L3 with segmental instability

Figure 3: Lateral lumbar spine radiograph demonstrating bilateral spondylolytic defects at L3 with Grade I anterolisthesis of L3 on L4 and associated disc space narrowing.

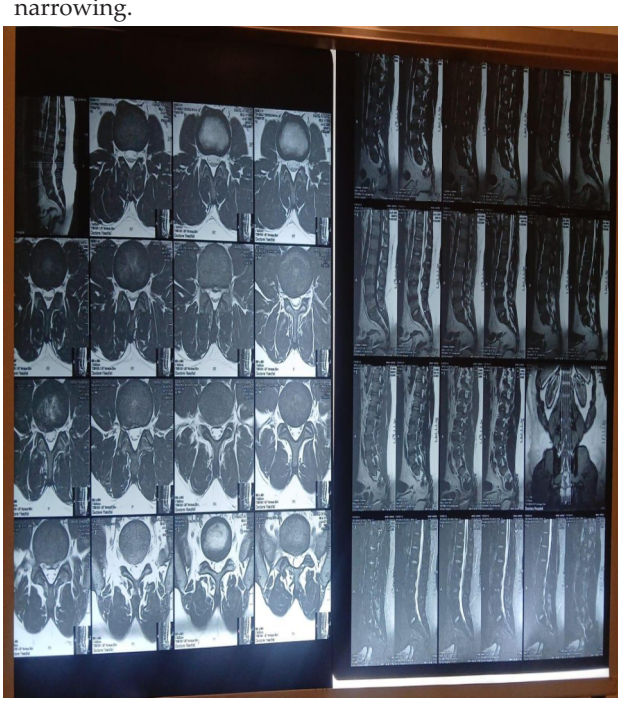

Figure 4: Multiplanar MRI of the lumbar spine showing bilateral L3 pars interarticularis defects. (A–D) Axial T2-weighted MRI slices demonstrating symmetric bilateral defects with spinal canal involvement. (E–H) Sagittal T2-weighted reconstructions showing Grade I anterolisthesis and disc signal changes.

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