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Pedicle Insufficiency Fracture Following Decompressive Laminectomy in Patients Receiving Hemodialysis: A Report of Two Cases

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Study Design: Case report.
Objectives: To report our experiences of patients receiving hemodialysis who had pedicle stress fractures after decompressive laminectomy.

Summary of Literature Review: The junction between the pedicle and vertebra body is a weak point in biomechanical testing. When partial laminectomy is performed in an abnormal bone condition, stress may be more concentrated around the pedicle. There are rare reports of pedicle stress fractures after spinal surgery.

Materials and Methods: Two elderly patients were admitted to our hospital due to newly developed pain after they underwent partial decompressive laminectomy. They presented with severe back pain during motion that was relieved by rest. There was no trauma history or event they remembered that could evoke such severe pain. In addition, there were no notable events during the previous surgery. Plain radiographs and computed tomography (CT) revealed pedicle insufficiency fractures at the previous decompressive laminectomy segment.

Results: Both patients revealed bony union at the previous fracture site on follow-up CT. Their pain improved and their clinical results were favorable.

Conclusions: Bone quality may be poor in patients with a long history of dialysis, and decompressive laminectomy should be performed carefully. If notable pain during motion newly develops after successful spinal surgery in these patients, pedicle stress fracture should be suspected as a possible cause.

Key words: Insufficiency pedicle fracture, Hemodialysis, End-stage renal disease, Spine

In rare cases, pedicle fracture is associated with spinal surgery, spondylolysis, or stress fractures, and patients usually report lower back pain (LBP). The biomechanical background of the pedicles, with an increased strength and shorter moment arm than the pars, enables these structures to resist greater cyclic stress when force is transmitted through the vertebra. These rare lesions can be related to trauma, activity-related mechanical stress, altered bone biology, or commonly, post-operative complications of spine instrumentation, mainly at the upper level of posterior fusion. Furthermore, there are reports of bilateral pedicle stress fractures in patients with osteoporotic conditions. We present an uncommon cases of hemodialysis patients who sustained bilateral vertebral insufficiency stress fracture around pedicle of after decompressive laminectomy.
disease who had received hemodialysis for 2 years visited our out-patient clinic for postoperative follow-up due to progressive motion back pain. Five months ago, she underwent right-side hemi-laminectomy at the L4–5 level and a right-side discectomy under a diagnosis of spinal stenosis with intervertebral disc herniation. She did not present any back pain, either before surgery or immediately after surgery, and there were no signs or symptoms to suggest a fracture at the spine (Fig. 1A). The lowest T-score by dual-energy X-ray absorptiometry (DXA) bone mineral densitometry (BMD) was −2.2, and she had no treatment for osteoporosis. The patient’s back pain started 2 months after the surgery without any traumatic event. A physical examination revealed that neurologically intact, but moderate to severe pain was present around in the lower back area; her LBP was worse with motion but relieved by sitting or lying down. Plain radiographs showed no significant alterations compared to the previous radiograph images. However, computed tomography revealed bilateral pedicle fractures through the L4 level (Fig. 1B). The patients treated with conservative management. After 1 year of initial surgery, she had no motion pain and the Computed Tomography (CT) revealed signs of bony unions on the previous fracture site (Fig. 1C).

Case 2.
A 77-year old woman with history of end-stage renal disease who had received hemodialysis for 4 years was admitted to our institution due to LBP which was aggravated 3 months prior without any history of trauma. The patient underwent L4–L5 and L5–S1 left side laminotomy 8 years ago, under a diagnosis of spinal stenosis. She was pain–free for 6 years, but back pain with radiating pain and intermittent claudication recurred. Plain radiographs showed vertebral endplate erosion with disc space narrowing and anterior slippage on L5–S1. Computed tomography revealed a bilateral pedicle fracture on L4 and L5 where previous surgery had done (Fig. 2). The lowest T-score by dual-energy X-ray absorptiometry (DXA) bone mineral densitometry was −4.1, and she had a 3 years history of zoledronate injections. The patient was treated with oblique lateral interbody fusion (OLIF) and posterior pedicle screw fixation at L4–L5–S1 due to associated spinal stenosis. After surgery, back pain and radiating pain much improved.

Discussion
Spontaneous bilateral pedicle fracture of the lumbar spine
without trauma is rare. Its etiology is unknown but may be related to stress fracture. There are two types of stress fractures: (1) fatigue fractures which occur in normal bone that is subjected to repetitive abnormal stress and (2) insufficiency fractures which are due to normal stress on a structurally defective bone. Cadaver studies revealed that the pars interarticularis is most prone to stress fracture in the vertebral bone and that the pedicle is the second–weakest vertebral area. The exact cause for stress fracture of neural arch after lumbar surgery has not been established.

Patients with bilateral pedicle stress fractures often had bone fragility, including rheumatoid arthritis, osteoporosis and ankylosing spondylitis. Previous spinal surgery also causes bilateral pedicle fracture. Because some motion in the anterior disc portion after lumbar posterior fusion has been demonstrated, stress fracture would be the hypothesized result of this cantilever motion. Also previous study demonstrated a high level of equivalent stress in the pars interarticularis and pedicle of L5 in low–grade isthmic spondylolisthesis using a personalized finite element model. The reported cases were happened after posterior decompressive laminotomy or partial laminectomy (Table 1). We could assume that because of the lamina excisional procedure, mechanical load on posterior neural arch would have been altered, so it may cause more stress in the transitional portion such as pedicle, base of vertebral body. Its effect may contribute to fracture on bilateral pedicle.

Also, all patients were on end–stage renal disease with hemodialysis. Even though, the association between bone density and fracture in dialysis patients is not clear. But patients under hemodialysis often have underlying metabolic bone diseases such as osteomalacia, adynamic bone, hyperparathyroidism, or a combination of these, which may be associated with increased risk of fractures without changes in BMD. Also long–term hemodialysis contributes to alteration of bone mineral metabolism which may cause destructive spondyloarthropathy in lumbar spine. This induces adynamic bone disease and generates loss of bone viability, and non–viable bones are vulnerable to repetitive stress.

### Conclusions

Bone quality may be poor in patients with a long history of dialysis, and decompressive laminectomy should be performed carefully. If notable motional pain newly happens after successful spinal surgery in these patients, we have a suspicion of a pedicle stress fracture that is one of the causes.

### Conflict of Interest

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article. The authors have no potential conflicts of interest to disclose.

### Table 1. Summary of cases.

| Case 1 | Case 2 |
|--------|--------|
| Preoperative diagnosis | Spinal stenosis c HIVD L4-5 Rt. | Spinal stenosis L4-5, L5-S1 |
| Initial surgery | Hemi-laminectomy L4-5 Rt. | Laminotomy L4-5, L5-S1 Lt. |
| Duration of hemodialysis | 2 years | 4 years |
| BMD (T-score) | -2.2 | -4.1 |
| Treatment for osteoporosis | None | Zoledronate injection for 3 years |
| Symptom onset (after initial surgery) | 2 month | 6 years |
| Fracture site | Rt. Pedicle, Lt. pedicle | L4: Rt. Pedicle, Lt. pedicle L5: Rt. Pedicle & Lt. Pedicle-body junction |
| Fracture healing | Union | Non-union |
| Clinical result | Improved | Improved |

BMD: Bone Mineral Density, Rt=Right, Lt=Left.
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혈액투석환자의 감압 후궁절제술 후 척추경 부전 골절: 증례 보고 2예
최성우 • 이재철 • 김태욱 • 신병준
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연구계획: 증례 보고
목적: 장기간 혈액투석 환자에서 요추 수술 후 척추경 부전 골절이 발생한 증례를 체험하여 이를 보고하고자 한다.

선형 연구문헌의 요약: 생역학 분석에서 척추경과 척추체 사이의 접합부는 취약한 부분 중 하나이다. 비정상적인 뼈 상태에서 부분 후궁 절제술을 시행하면 척추경 주위에 스트레스가 더 집중될 수 있다. 척추 수술 후 척추경 부전 골절에 대한 보고는 많지 않다.

대상 및 방법: 2명의 고령 환자에서 감압 부분 후궁 절제술 후 새로 발생한 통증으로 내원하였다. 통증은 움직임에 더 심해지고, 휴식을 취하면 희미되는 양상이었다. 심한 통증을 일으킬 만한 외상의 병력은 없었다. 또한, 이전 수술중에 특별한 이벤트는 없었다. 단순 방사선 사진과 컴퓨터 단층 활영에서, 이전 감압 후궁 절제술한 부위에서 척추경 부전 골절이 확인되었다.

결과: 2명의 환자 모두 추적 전산화 단층촬영 검사에서 척추경 부전골절 부위의 골유합을 보였다. 그리고 2명 모두 동통이 완화되었고 임상적으로 좋은 결과를 보였다.

결론: 오랜 혈액투석 병력이 있는 환자의 골질은 좋지 않을 수 있으므로 감압 후궁 절제술을 주의 깊게 시행해야 한다. 이런 환자들에게서 성공적인 척추 수술 후에, 지명한 운동성 통증이 새로 발생한다면 척추경 주위 부전 골절의 가능성을 염두에 두어야 한다.

색인 단어: 척추경 부전골절, 혈액투석, 말기신장질환, 척추
약칭 제목: 혈액투석환자에서 요추수술 후 발생한 척추경 부전골절