



Case Report

Surgical treatment of complete fifth lumbar osteoporotic vertebral burst fracture: A retrospective case report of three patients

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ABSTRACT

Background: Due to its rarity, surgical treatments for a complete fifth lumbar osteoporotic vertebral burst fracture (L5 OVBF) have yet to be well documented as compared to that for osteoporotic vertebral fractures of the thoracolumbar spine. The current case report discusses details of the surgical outcomes following posterior decompression and fusion for a complete L5 OVBF.

Case Description: Three women, ranging in age from 69 years to 82 years, were surgically treated for a complete L5 OVBF. Two of these patients were being treated for rheumatoid arthritis. Surgery was performed using the L5 shortening osteotomy or vertebroplasty, with one- or two-level posterior lumbar interbody fusion, and posterior spinal fixation for the L2 or L3 to the pelvis. Although the spinal alignment parameters, which included lumbar lordosis (LL), pelvic incidence-lumbar lordosis, T1 pelvic angle, and sagittal vertical axis, were better as compared to that observed before the surgery, these worsened at the final follow-up due to clinical fractures that occurred at the adjacent vertebral body and proximal junctional kyphosis. Compared to preoperative Japanese Orthopaedic Association (JOA) scores, postoperative JOA scores were improved and maintained at the final follow-up.

Conclusion: Posterior surgery of a complete L5 OVBF led to improvement of both the JOA score and spinal alignment after the surgery. Despite a worsening of the spinal alignment parameters, the JOA score was maintained at the final follow-up.

Keywords: Fifth lumbar vertebral fracture, Osteoporotic vertebral burst fracture, Posterior lumbar interbody fusion, Posterior spinal fixation, Vertebroplasty

INTRODUCTION

Although osteoporotic vertebral fracture (OVF) commonly occurs in the thoracolumbar spine, occurrence in the lower lumbar spine, especially the fifth lumbar (L5) OVF, is relatively rare.^[3] Even though OVF of the lower lumbar spine is not common, it can cause severe impairment of both the quality of life and the activity of daily living (ADL) in elderly osteoporotic patients.^[2] It has also been reported that OVF in the lower lumbar spine, including L5, frequently causes pseudoarthrosis of vertebral fracture, spinal deformity, and spinal or foraminal stenosis.^[4,6,8]

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Thus, surgical treatments are required in patients with L5 OVF who complain of a neurological deficit or deformity of the spinal alignment.^[4,6,8] However, surgical treatments of an osteoporotic spine are often challenging, especially in patients with a highly collapsed vertebra. Although there are reports on anterior surgery in the literature, such as corpectomy and vertebral column reconstruction, this is associated with a high complication rate.^[7] Here, we describe three cases of a complete L5 osteoporotic vertebral burst fracture (OVBF) with vertebral collapse that was treated by posterior interbody fusion with vertebroplasty. This case report presents details on the surgical outcomes in the patients after undergoing posterior decompression and fusion for a complete L5 OVBF, which until now has not been previously reported.

CASE PRESENTATION

Case 1

A 69-year-old female presented with low back pain, right leg pain, and numbness without any identifiable cause for 8 months. She had been treated with methotrexate (4–8 mg/week) and prednisolone (PSL) (7–9.5 mg/day) for rheumatoid arthritis (RA) for 27 years. She also had been prescribed a bisphosphonate (risedronate, 75 mg/month) for 3.5 years and had no history of any previous fractures. Magnetic resonance imaging (MRI) was performed, with T2-weighted images (T2WI) showing a low signal intensity in L5 with canal stenosis [Figure 1a]. Computed tomography (CT) after myelography demonstrated the presence of pseudoarthrosis, canal stenosis, and right foraminal stenosis caused by a retropulsed bony fragment at L5 due to an osteoporotic split burst fracture (Magerl classification Type A3.2) [Figure 1b]. Total spinal X-ray showed spinal deformity with 26° of lumbar lordosis (LL), 18° of pelvic incidence (PI)-LL, 27° of T1 pelvic angle (TPA), and 151 mm of sagittal vertical axis (SVA) [Figure 1c].

The preoperative (preop) Japanese Orthopaedic Association (JOA) score was 8 points. We performed an L5 vertebroplasty with hydroxyapatite (Apaceram HA block U4-004-BA, Hoya Pentax, Tokyo, Japan), decompression at L4-5, posterior lumbar interbody fusion (PLIF) at L5-S1, and posterior spinal fusion from L2 to the pelvis [Figure 1d and e]. Operation time was 6 h 27 min, with an estimated blood loss of 223 cc. Her right leg pain improved after surgery and there was a gradual reduction in her lower back pain. Spinal alignment after the surgery, which included LL, PI-LL, TPA, and SVA, improved to 41°, 7°, 17°, and 101 mm, respectively [Figure 1f]. Values at 20 months after the surgery were 6°, 43°, 34°, and 143 mm [Figure 1g]. Bony fusion was observed at the L5-S1 PLIF level at the final follow-up [Figure 1g]. The postoperative (postop) and final follow-up JOA scores were 23 and 20 points, respectively. The recovery rate for the JOA score at the final follow-up (20 months after the surgery) was 57%. Three months before the surgery, her osteoporosis treatment was switched from bisphosphonate to teriparatide (20 µg/day). However, due to complaints of nausea caused by the teriparatide, at 7 months after the surgery, her treatment was changed to denosumab (60 mg/6 months) with a daily oral intake of 2 tablets of Denotas® chewable combination tablets (a tablet form mixture of calcium carbonate 762.5 mg, cholecalciferol 0.005 mg, and magnesium carbonate 59.2 mg) (Daiichi Sankyo, Co., Ltd., Tokyo, Japan). At the final follow-up, bony fusion of the L5-S1 level of PLIF was observed.

Case 2

An 82-year-old female presented with bilateral leg pain and numbness without any identifiable cause for 4 months. She had an asymptomatic L3 vertebral fracture but had not been previously treated for osteoporosis. The sagittal T2WI of the MRI indicated a low signal intensity in the L5 [Figure 2a]. CT after myelography showed a complete burst fracture and collapse of the L5 (Magerl classification Type A3.3)

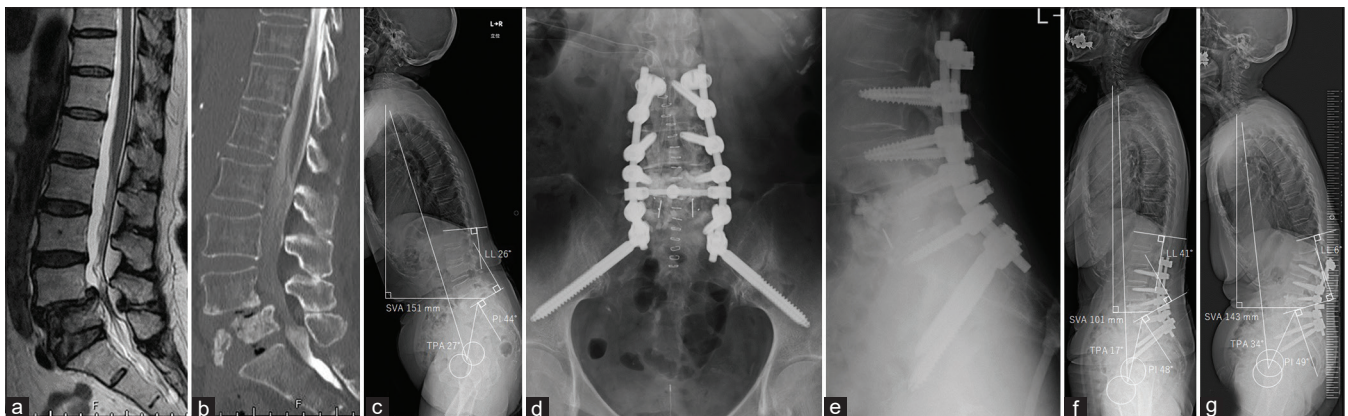


Figure 1: Case 1. A sagittal T2-weighted image of magnetic resonance imaging (a). A sagittal image of computed tomography after myelography (b). Preoperative lateral plain radiograph of the total spine (c). Postoperative anteroposterior (d) and lateral (e) plain radiograph of the lumbar spine. Lateral plain radiograph of the total spine after surgery (f) and at the final follow-up (g).

[Figure 2b]. Total spinal X-ray demonstrated that there was a spinal deformity with 7° of LL, 38° of PI-LL, 33° of TPA, and 198 mm of SVA [Figure 2c]. Preop JOA score was 11 points. We performed L5 vertebral column replacement using the NOVEC VC cage (Alphatec Spine, Inc., CA, USA) and posterior instrumentation from L3 to the pelvis [Figure 2d and e]. Operation time was 5 h 23 min, with an estimated blood loss of 1975 cc. The patient complained of transient numbness of her right leg, with the numbness improving at 3 months after the surgery. Spinal alignment after the surgery, which included LL, PI-LL, TPA, and SVA, improved to 13°, 25°, 22°, and 103 mm, respectively [Figure 2f]. After the surgery, she was started on eldecalcitol (0.75 µg/day) for the treatment of her osteoporosis. However, at 2 months after the surgery, she had an L2 vertebral fracture. At 3 years after the surgery, these spinal alignment parameters worsened to 9°, 34°, 24°, and 115 mm [Figure 2g]. At the final follow-up, the vertebral column replacement site was fused [Figure 2g]. The postop and final follow-up JOA scores were 22 and 23,

respectively. The recovery rate for the JOA score at the final follow-up (3 years after the surgery) was 67%.

Case 3

A 71-year-old female presented with low back pain, bilateral leg pain, and numbness without any identifiable cause for 9 months. She was treated with PSL (10–20 mg/day) for RA and interstitial pneumonia for 3 years. Although she was started on bisphosphonate (risedronate, 2.5 mg/day), this was discontinued due to a dental treatment, and thus, she was subsequently prescribed raloxifene (60 mg/day) for 2 years. The sagittal T2WI of the MRI demonstrated that there was low signal intensity in the L5 with canal stenosis [Figure 3a]. CT after myelography showed a complete burst fracture and vertebral collapse of the L5 (Magerl classification Type A3.3), and canal stenosis at L3-4 and L4-5 [Figure 3b]. Total spinal X-ray showed spinal deformity with 17° of LL, 64° of PI-LL, 53° of TPA, and 109 mm of SVA [Figure 3c]. Preop JOA

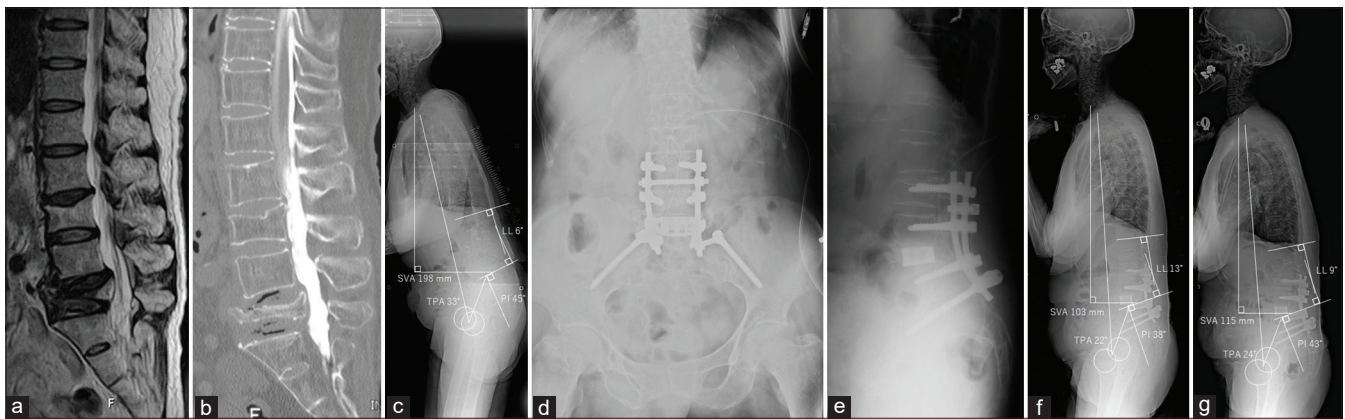


Figure 2: Case 2. A sagittal T2-weighted image of magnetic resonance imaging (a). A sagittal image of computed tomography after myelography (b). Preoperative lateral plain radiograph of the total spine (c). Postoperative anteroposterior (d) and lateral (e) plain radiograph of the lumbar spine. Lateral plain radiograph of the total spine after the surgery (f) and at the final follow-up (g).

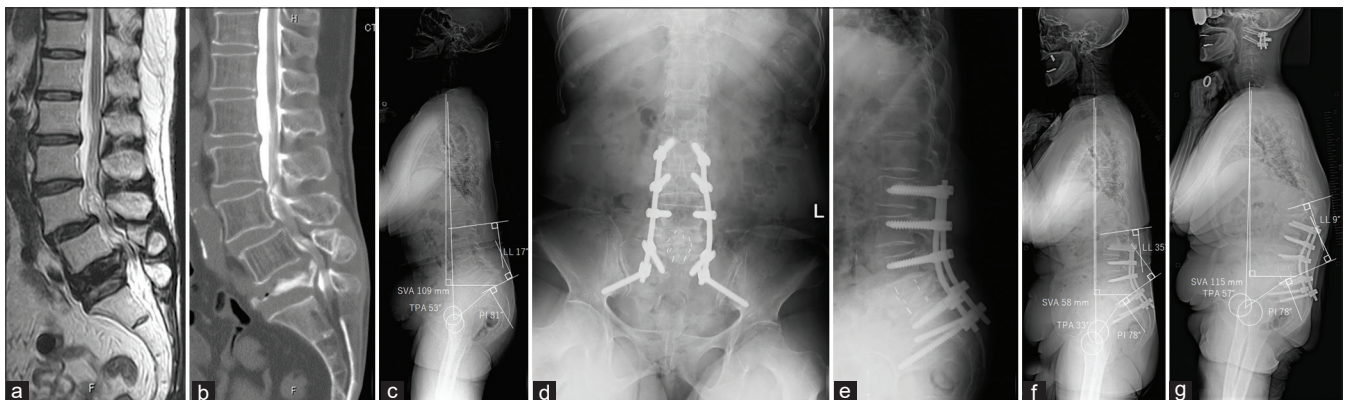


Figure 3: Case 3. A sagittal T2-weighted image of magnetic resonance imaging (a). A sagittal image of computed tomography after myelography (b). Preoperative lateral plain radiograph of the total spine (c). Postoperative anteroposterior (d) and lateral (e) plain radiograph of the lumbar spine. Lateral plain radiograph of the total spine after surgery (f) and at the final follow-up (g).

score was 11 points. We performed PLIF at L4–5 and L5–S1, with total facetectomy of L4-5 and L5-S1, and posterior instrumentation from L2 to the pelvis [Figure 3d and e]. Operation time was 4 h 58 min, with an estimated blood loss of 512 cc. The patient complained of transient right leg pain, with the pain improving at 1 month after the surgery. Spinal alignment after the surgery, which included LL, PI-LL, TPA, and SVA, improved to 35°, 43°, 33°, and 58 mm, respectively [Figure 3f]. However, at the final follow-up, these spinal alignment parameters worsened to 9°, 69°, 57°, and 115 mm, due to other thoracolumbar vertebral fractures [Figure 3g]. The two-level PLIF achieved fusion at the final follow-up [Figure 3g]. The postop and follow-up JOA scores were 20 and 22 points, respectively. The recovery rate for the JOA score at the final follow-up (3.5 years after the surgery) was 61%. A month before the surgery, her osteoporosis treatment was switched from raloxifene to teriparatide (56.5 µg/week) and alfacalcidol (1.0 µg/day). However, teriparatide was stopped at 3 months after the surgery due to the development of anorexia.

DISCUSSION

This report retrospectively reviewed the medical history and results for three females (mean age ± standard deviation: 74 ± 7 years) with a complete L5 OVBF that was treated with posterior surgery. Two of the patients were also being treated for RA. The surgeries were performed by L5 vertebroplasty or osteotomy, with posterior instrumentation from L2 or 3 to the pelvis. Although there was improvement of the LL, PI-LL, TPA, and SVA parameters at postop as compared to that observed at preop, these worsened at the final follow-up. There was improvement of the postop JOA score as compared to that observed at preop, with the score maintained at the final follow-up. Mean recovery rate for the JOA score at the final follow-up was 62% [Table 1].

Nakajima *et al.* have previously reported on the characteristics of 30 cases of lower lumbar osteoporotic vertebral collapse (OVC), which included L5 OVF cases (*n* = 5).^[6] The results of their evaluation showed that the main types of lower lumbar OVC were the flat and concave types, which resulted in neurological symptoms caused by retropulsed bony fragments that generated foraminal stenosis and/or canal stenosis. In addition, they found that in lower lumbar OVC patients, the use of decompression of the foraminal and canal stenosis with short fusion surgery through the posterior approach was able to improve the neurological symptoms.^[6] Since all of the patients in the present cases had neurological symptoms in the lower extremities due to foraminal and/or spinal canal stenosis, we performed posterior fusion from the pelvis to the upper lumbar spine using L5 vertebroplasty or vertebral osteotomy, as well as posterior decompression due to severe collapse of the L5 and osteoporosis.

For the complete L5 OVBF, we performed one-level PLIF (L5-S1) and vertebroplasty in case 1 and posterior corpectomy in case 2. In addition, we performed two-level PLIF (L4-5 and L5-S1) as well as posterior fusion from L3 to pelvis by S2 alar-iliac screw. Since we found spondylolisthesis at L4-5 in case 1 and at L3-4 in case 3, we extended the fusion level to L2 using sublaminar tape and a transverse rod or pedicle screw to prevent loosening or the backing out of the pedicle screws of L3. In our cases, the upper instrumented vertebra (UIV) was two or three levels above that from L5. However, all three cases had proximal junctional kyphosis (PJK) after surgery. Yamashita *et al.* have reported satisfactory clinical results for one- or two-level PLIF or posterolateral fusion (PLF) when used for incomplete OVBF at the middle to lower lumbar spine, which included three cases in L5.^[8] Kohno *et al.* also have demonstrated that a short-segment instrumentation and fusion with some augmentation techniques along with strong osteoporotic medication may be required to avoid postoperative vertebral collapse after one-

Table 1: Patients' characteristics.

	Age (years)	Follow-up period (months)	Comorbidity	Treatment for osteoporosis		LL	PI-LL	TPA	SVA	JOA score
Case 1	69	20	RA	BP TPTD DMAB	Preop	26	18	27	151	8
				DNT	Postop	41	7	17	101	23
					Final follow-up	6	43	34	143	20
Case 2	82	35	-	VD	Preop	7	38	33	198	11
					Postop	13	25	22	103	22
					Final follow-up	9	34	24	115	23
Case 3	71	42	RA	BP SERM	Preop	17	64	53	109	11
				TPTD VD	Postop	35	43	33	58	20
					Final follow-up	9	69	57	115	22

RA: Rheumatoid arthritis, BP: Bisphosphonates, TPTD: Teriparatide, DMAB: Denosumab, DNT: Denotas®, VD: Activated Vitamin D, SERM: Selective estrogen receptor modulator, Preop: Preoperative, Postop: Postoperative, LL: Lumbar lordosis, PI-LL: Pelvic incidence-lumbar lordosis, TPA: T1 pelvic angle, SVA: Sagittal vertical axis

or two-level PLIF and/or PLF for an incomplete or complete OVBF in the middle to lower lumbar spine.^[4] This suggests that we need to consider the level of the UIV of the posterior decompression and fusion surgery for a complete L5 OVBF.

In contrast, Vazan *et al.* reported that an anterior L5 corpectomy was a technically challenging but feasible procedure, even though the overall complication rate can be as high as 36%, along with a high lordotic angle (>50°) between L4 and S1.^[7] However, lower bone mineral density appears to be a major risk factor for implant failure after a L5 corpectomy.^[7] While there have also been other reports on the use of anterior corpectomy, these were associated with trauma and performed in relatively young patients, with ages ranging from 37 years to 65 years (mean 42.5 years).^[1] Therefore, anterior L5 corpectomy and fusion appear to be high-risk procedures for elderly patients with osteoporosis.

Treatments of osteoporosis and other comorbidities are also important factors that need to be considered in these patients. Murata *et al.* reported that preoperative neurological deficit, perioperative complications, and absence of postoperative recombinant parathyroid hormone administration were considered to be predictors for postoperative poor ADL in patients with OVF.^[5] In the present cases, we performed osteoporosis treatment in two of the cases before the surgery and in all of the cases after the surgery. Since we consider postoperative treatments for osteoporosis to be an important option for the treatment of OVF, we aggressively use this treatment. However, all of our current patients had OVF at the cranial adjacent vertebral body, which caused PJK at 2 months–3 years after the surgery. The patients with PJK have not complained of severe pain or impairment of ADL nor have they required any revision surgery. Therefore, in patients with poor bone strength or quality, such as RA patients, the UIV of the fusion surgery for L5 OVF needs to be taken into consideration before any surgeries or treatments.

CONCLUSION

Posterior instrumentation surgery of a complete L5 OVBF improved spinal alignment and the JOA score after the surgery. Despite a worsening of the spinal alignment parameters, the JOA score was maintained at the final follow-up. The treatment of a complete L5 OVBF requires a combination of decompression, osteotomy, vertebroplasty, and vertebral fusion. These are all dependent on the patient's comorbidity, symptoms, and fracture morphology. In addition, it is also important to treat any osteoporosis in accordance with the severity of the disease.

Ethical approval

This study was approved by the Medical Ethics Board of Akita University Hospital (approval number 1879).

Declaration of patient consent

Institutional Review Board (IRB) permission obtained for the study.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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