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Aims and Scope

The *Journal of the Korean Society of Geriatric Neurosurgery* is the Korean Society of Geriatric Neurosurgery's official journal and is published biannually on 30th June and 31st October. It launched in February 2005 Volume 1 and Number 1. The *Journal of the Korean Society of Geriatric Neurosurgery* aims to allow neurosurgeons worldwide to enrich their knowledge of patient management, education, and clinical or experimental research and increase their professionalism. This journal publishes Laboratory Investigations, Clinical Articles, Review Articles, Case Reports, Technical Notes, and Letters to the Editor. Our field of interest involves geriatric-associated clinical neurosurgery (cerebrovascular disease, neuro-oncology, skull base neurosurgery, spine, functional neurosurgery, epilepsy, neuro-trauma, and peripheral nerve disease) and laboratory work in neuroscience. Any authors affiliated with an accredited biomedical institution may submit manuscripts.

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Case Report
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Treatment strategy for osteoporotic vertebral body fractures in the lumbar spine: a case report and literature review

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This report describes the successful treatment of an osteoporotic compression fracture. A 74-year-old woman presented with severe low back pain and left sciatica that had lasted for 6 weeks. Four week of conservative treatment was not effective. The patient was bedridden and had difficulty walking. A past history of osteoporosis was noted. Multilevel compression fractures, central stenosis, and spondylolisthesis with overt instability were evident in the preoperative images. Decompression and fusion surgery, vertebroplasty, and preoperative and postoperative teriparatide administration were planned. A severe endplate injury in the lower vertebral body was detected during interbody fusion surgery using an anterior approach. Additional screw insertion with posterolateral fusion was planned to prevent aggravation of cage subsidence. Postoperative magnetic resonance imaging, computed tomography (CT), and X-ray images revealed sufficient decompression, no cement leakage, and no nerve injury. On the first postoperative day, the patient reported that the left sciatica symptoms had improved. Satisfactory ambulation was observed at the outpatient department after 6 months. Fusion in progress was evident on follow-up CT and X-ray images. This case offers insights into possible treatment strategies for osteoporotic compression fractures with severe endplate injury, overt instability, and radiculopathy of the lower lumbar spine.

Keywords: Compression fractures; Spinal instability; Cage subsidence

Introduction

Osteoporosis is also associated with compression fractures. These fractures can worsen, and lead to additional fractures or spinal deformities [1]. If multilevel osteoporotic compression fractures in the lumbar spine are accompanied by overt instability and radiculopathy, decompression and fusion surgery, and vertebroplasty (VP) can be planned after conservative treatment [2,3].

Complications associated with fusion surgery, including cage subsidence, instrumentation failure, and pseudarthrosis are widely recognized [4]. Cage subsidence is a common complication in lumbar lateral interbody fusion [5]. Many risk factors for subsidence have been reported, including osteoporosis and endplate injury [6–8]. In particular, endplate injury is frequently associated with osteoporotic compression fractures [9].

Preventative measures to reduce the risk of cage subsidence are important for patients with osteoporotic compression fractures and severe endplate injuries who require fusion surgery. In this report, we describe the management of a patient with osteoporotic compression fractures with severe endplate injury, overt instability, and radiculopathy in the lower lumbar spine.

Case Report

In March 2022, a 74-year-old woman presented to our hospital with a 6-week history of severe low back pain and left sciatica. Past history of osteoporosis was noted (bone mineral density [BMD] at the lumbar spine = –5.0) (Fig. 1). The patient had undergone conservative treatment for 4 weeks; however, this was not effective.

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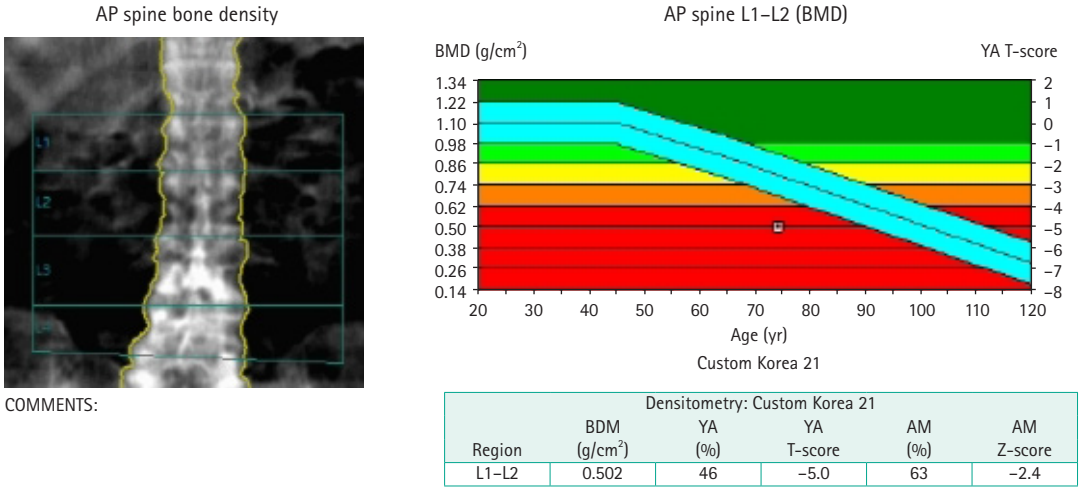

Fig. 1. Preoperative bone mineral density (BMD) at the lumbar spine. YA, young-adult; AM, age-matched.

She had difficulty walking and was bedridden because of pain. The patient's numerical rating scale (NRS) score for pain was 8. Preoperative magnetic resonance imaging (MRI), computed tomography (CT), and X-rays revealed multilevel involvement of the spine including subacute compression fractures between L3 and L4, an acute compression fracture at L5, central stenosis with spondylolisthesis at L3–4 and L4–5 and instability at the L4–5 level (Fig. 2). Preoperative MR myelography showed signal blocks at the L3–4 and L4–5 levels (Fig. 2).

The proposed management included oblique lumbar interbody fusion (OLIF) with cement-augmented pedicle screw insertion at the L4–5 level, unilateral laminotomy for bilateral decompression at the left L3–4 and L4–5 levels, VP at the L3 level, and preoperative and postoperative teriparatide (recombinant human parathyroid hormone, PTH 1–34). After informed consent was obtained from the patient, we proceeded with OLIF and severe endplate injury was observed in the lower vertebral body. Aggravation of the cage subsidence was expected after the operation (Fig. 3). Subsequently, after obtaining informed consent from the patient's guardian, additional cement-augmented pedicle screw insertion at the S1 level with posterolateral fusion was performed to minimize the risk of cage subsidence (Fig. 3).

Postoperative MRI, CT, and X-rays revealed sufficient decompression, no cement leakage, and no nerve injury (Fig. 4). On the first postoperative day (POD), the patient reported improved left sciatica symptoms (NRS score decreased from 8 to 3). The patient remained in bed until POD 14. On POD 15, the patient was allowed to sit with a brace while eating. On POD 25, the patient began walking with brace support. The patient was discharged on POD 30. At the outpatient department follow-up after 6 months, the patient was well ambulated. Progress in fusion was observed on follow-up X-rays and CT, without halo signs (Fig. 5).

Discussion

Compression fractures usually occur at the mid-thoracic spine (T7–8) and thoracolumbar junction (T12–L1) [10]. Multiple compression fractures occur in approximately 20 to 30 percent, and multilevel fractures occur in 1 to 5 continuous vertebral bodies. Spinal deformity is a common complication of compression fractures. Low BMD is significantly associated with vertebral deformities, including loss of mid-vertebral height. Together with old age, these factors predicted greater vertebral collapse and kyphoscoliotic deformities [1].

Conservative treatment alleviates back pain and functional disability [11]. However, long periods of immobilization and bed rest can lead to bone and muscle loss and adverse effects on cardiac and pulmonary functions in geriatric patients [12]. After conservative treatment, VP can be planned for continuous severe low back pain [13], and decompression and fusion surgery can be devised for overt instability and sciatica to improve clinical outcomes and reduce hospital stays [2,3].

Osteoporosis is a risk factor for complications of following fusion surgery including cage subsidence, instrumentation failure, and pseudoarthrosis [6,7,14]. Osteoporotic compression fractures are commonly accompanied by endplate injury [9] and endplate injury is a risk factor for cage subsidence following fusion surgery [8]. Strategies to prevent or minimize cage subsidence are necessary in a patient with osteoporotic compression fractures and severe endplate injuries.

Teriparatide is an anabolic agent approved by the US Food and

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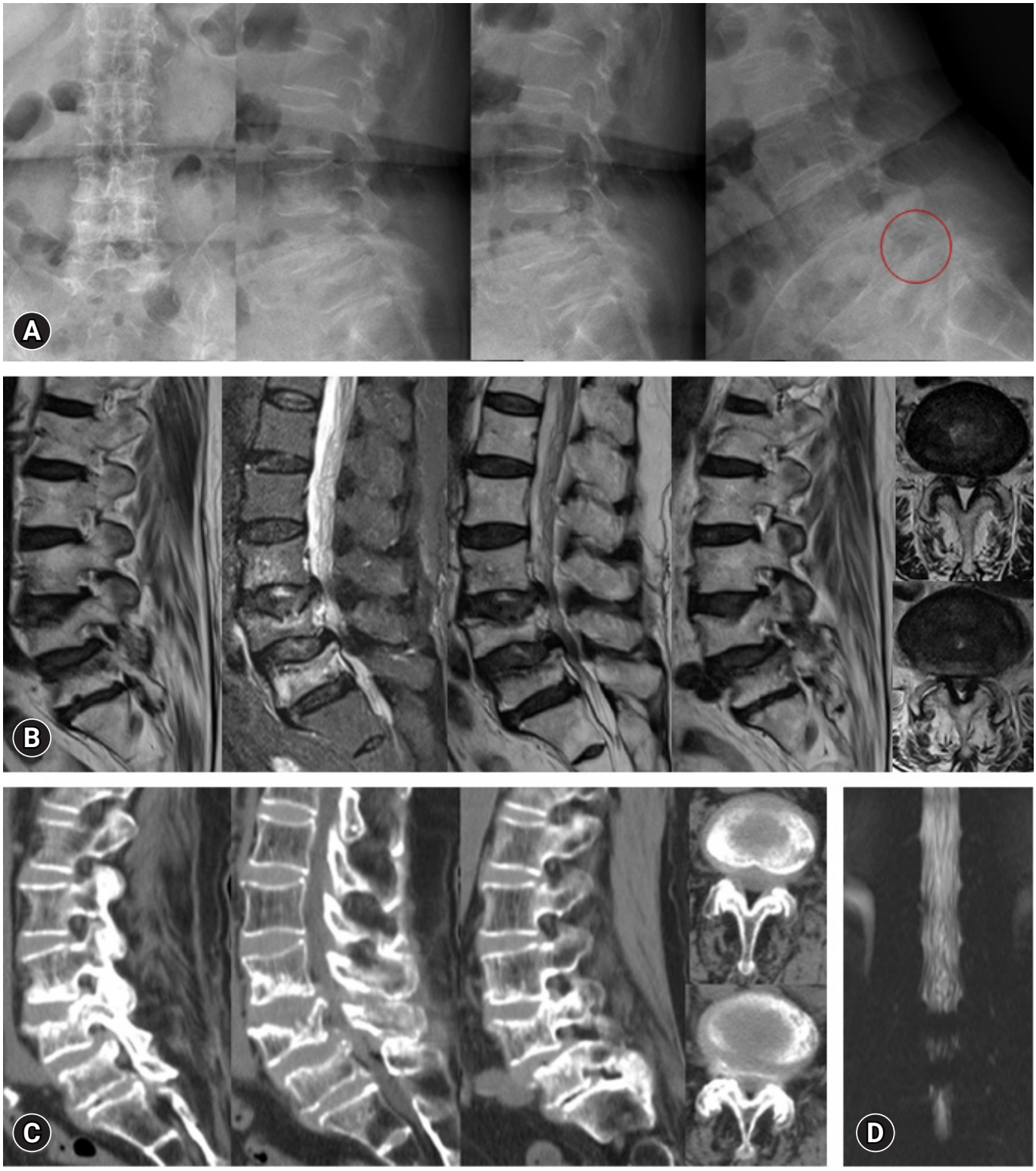

Fig. 2. Preoperative images on X-rays, magnetic resonance imaging (MRI), computed tomography (CT), and magnetic resonance (MR) myelography. (A) X-rays (circle: instability). (B) Sagittal and axial MRI. (C) Sagittal and axial CT images. (D) An image on MR myelography.

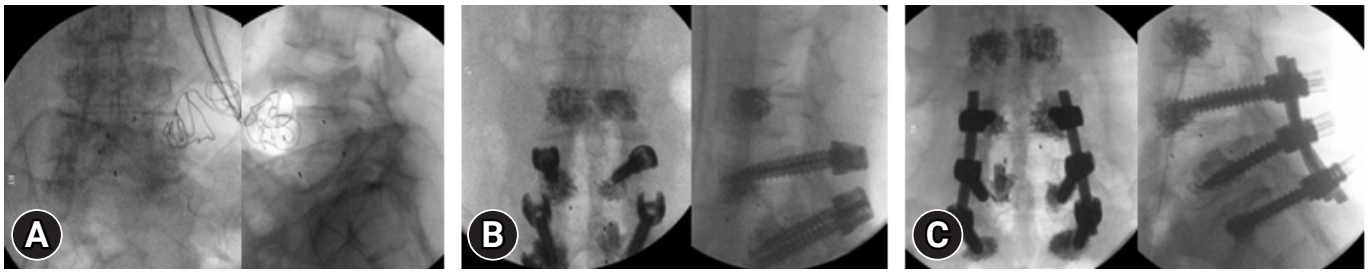

Fig. 3. Intraoperative images. (A) Cage insertion. (B) Vertebroplasty at L3 and cement-augmented screw insertion at L4 and L5. (C) Additional S1 screw insertion with cement augmentation and posterolateral fusion.

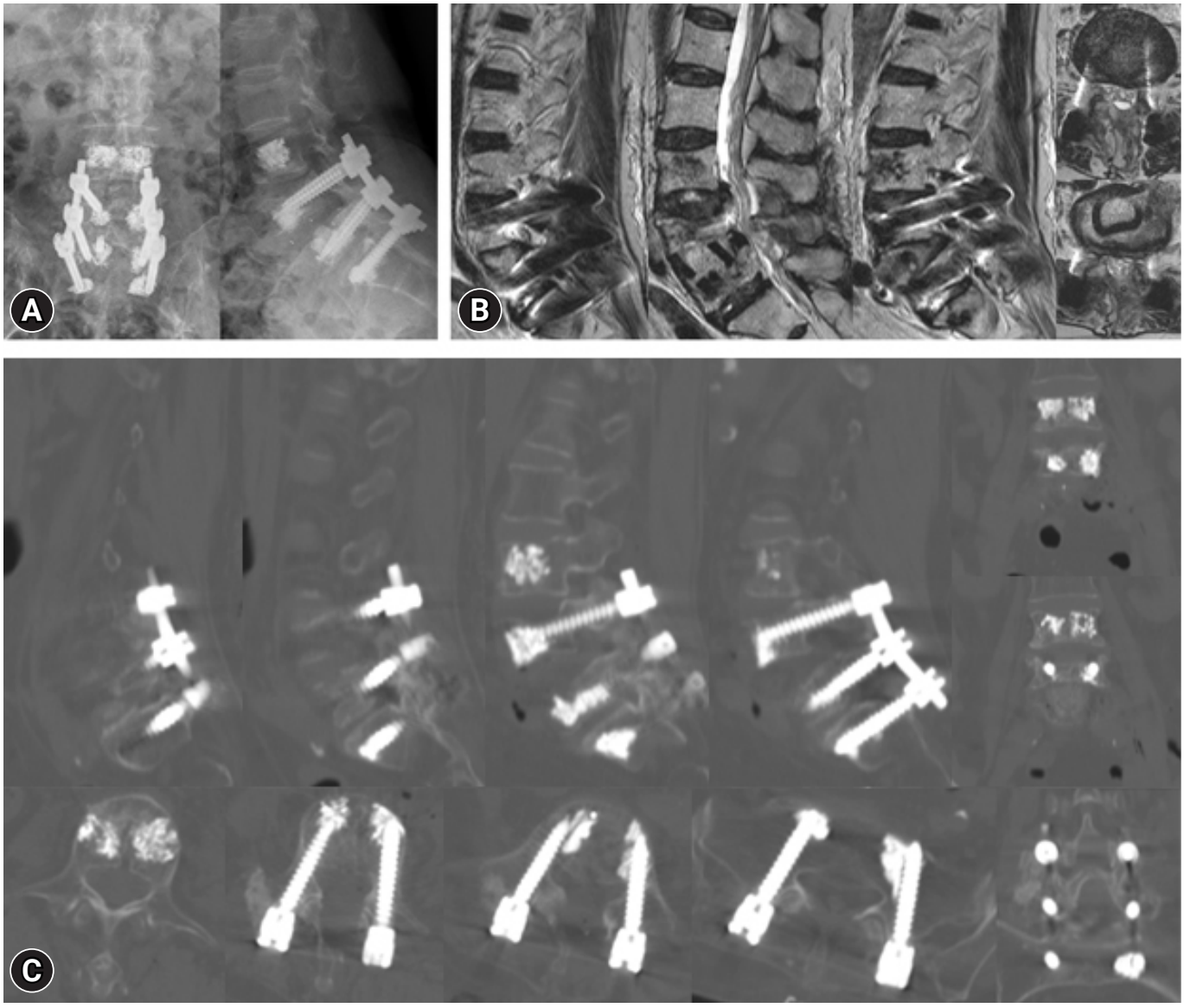

Fig. 4. Postoperative images. (A) X-ray. (B) Sagittal and axial magnetic resonance imaging. (C) Sagittal, axial, and coronal images on computed tomography.

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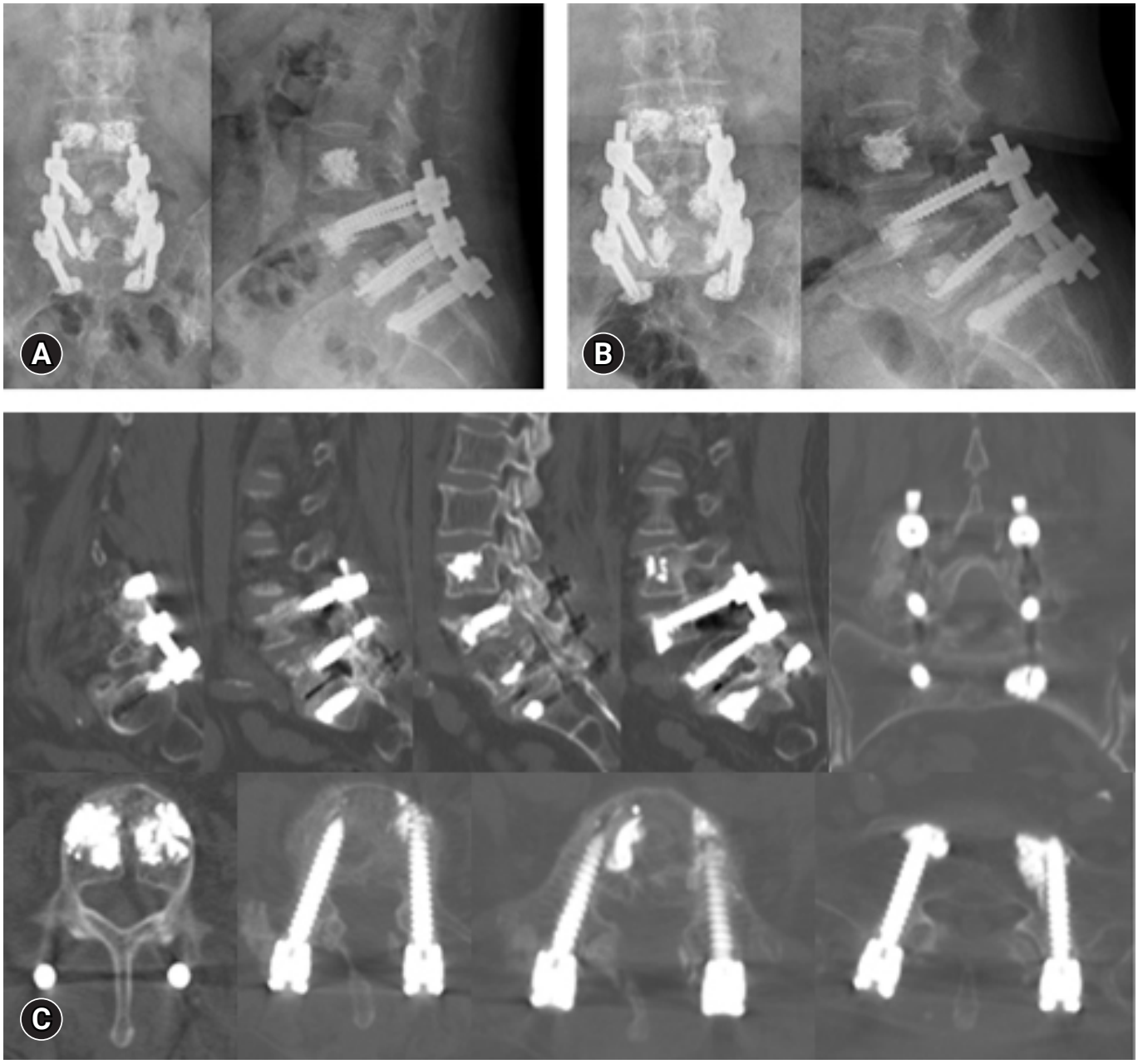

Fig. 5. Follow-up images. (A) X-rays after 1 month. (B) X-rays after 6 months. (C) Computed tomography after 3 months.

Drug Administration to enhance bone formation. Subcutaneous administration of teriparatide during lumbar fusion surgery effectively improved the fusion rate [15]. The application of cement-augmented pedicle screws for multilevel lumbar fusion may provide better stability and lesser screw loosening than conventional pedicle screw fixation. The selective use of cement-augmented cranial and caudal screws may decrease the risk of complications associated with cement-augmented screw fixation [16].

After evaluating the preoperative images, osteoporotic compression fractures with endplate injuries at the interbody fusion level were confirmed. During interbody fusion using the anterior approach, severe endplate injury was observed macroscopically in the lower vertebral body. As a result, aggravation of cage subsidence was expected following fusion surgery. Consequently, additional cement-augmented pedicle screw insertion with posterolateral fusion was planned, and informed consent was obtained from the patient's guardian.

Six months after surgery, the patient appeared well-ambulated at the outpatient follow-up department. Subsidence was not aggravated, and fusion was in progress on follow-up X-rays or CT, with-

out halo signs.

If osteoporotic compression fractures present with endplate injury and radiculopathy but without overt instability after conservative treatment, only decompression or ligamentoplasty with cementoplasty may be considered to prevent cage subsidence after interbody fusion surgery.

Conclusion

This case offers insights into the possible treatment strategies for osteoporotic compression fractures with overt instability and radiculopathy of the lumbar spine.

Conflicts of interest

No potential conflict of interest relevant to this article was reported.

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Interspinous ligamentoplasty for symptomatic lumbar spinal stenosis coexisting with mild segmental instability and vertebral body fracture: a report of 2 cases and a literature review

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This report aimed to present successfully treated cases of lumbar spinal stenosis coexisting with mild segmental instability and vertebral body fracture. Two patients presented with chief complaints of sciatica and back pain that had lasted for 2 months. Preoperative images revealed lumbar spinal stenosis with mild segmental instability and compression fracture. Interspinous ligamentoplasty was done under general anesthesia. Treatment outcomes were assessed by numeric rating scale (NRS) scores, postoperative magnetic resonance imaging (MRI), and X-ray examinations. Favorable treatment outcomes were observed: Sciatica and back pain improved and the patients' NRS scores also improved. Postoperative MRI showed sufficient decompression, and X-rays showed stabilization at the index level. Postoperative complications were not reported. Interspinous ligamentoplasty can be a good surgical option for lumbar spinal stenosis that coexists with mild segmental instability and vertebral body fracture.

Keywords: Compression fracture; Segmental instability; Ligamentoplasty

Introduction

Decompression alone has been performed to treat degenerative lumbar spinal stenosis without instability for many years. In case of degenerative lumbar spinal stenosis with instability, fusion surgery has been the primary choice to prevent worsening of instability. However, there are borderline patients with mildly unstable degenerative lumbar spinal stenosis. Ligamentoplasty can fill a gap between decompression alone and fusion in the spectrum of surgical treatment for degenerative lumbar spinal stenosis, and many studies supported that ligamentoplasty represents a viable option for patients who have significant comorbidities or are elderly [1–3].

Fusion surgery needs additional blood loss and tissue stripping, and this method inevitably increases the risk of damage at the adjacent structure and perioperative complications, including cage subsidence, screw failure, non-union, and so on [4]. Comparatively, ligamentoplasty can decrease perioperative complications, because it can reduce incision and injury to surrounding tissues. Furthermore, it can lessen the possibility of fusion surgery due to lumbar instability after surgery [5]. In this report, we present 2 patients with lumbar spinal stenosis that coexists with mild segmental instability and vertebral body fracture, who were successfully managed with interspinous ligamentoplasty.

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Instability

When flexion and extension X-ray in the sagittal plane show 10 degrees angular motion or more, or 4 mm translation or longer, instability can be defined [6]. And fusion surgery can be considered. In case of 10 degrees angular motion or less, or 4mm translation or shorter in dynamic X-ray, minimal or mild instability can be decided [2]. Fusion surgery in traumatic thoracolumbar fractures (T10–L2) can be also chosen in case of 4 points or more in the modified

thoracolumbar injury classification and severity score (TLICS) system using magnetic resonance imaging (MRI) and computed tomography (CT) images [7].

Case Report

Case 1

A 74-year-old woman presented to our hospital in April 2022, with a two-month history of right sciatica. The pain as assessed by the numeric rating scale (NRS) leg was 8. The patient also complained of continuous back pain (NRS back = 7) regardless of 4 weeks of conservative treatment after slip down. Past history included osteoporosis (bone mineral density at lumbar spine = –2.5 standard deviation). Preoperative MRI, CT, and plain X-ray revealed central stenosis with grade 1 degenerative spondylolisthesis at the L4–5 level and acute compression fracture at L4 level (Fig. 1). The preoperative flexion and extension X-ray demonstrated slippage and instability. Interspinous ligamentoplasty using the sagittal horizontal ligament (SHL, Ligament Vertebralde Renfort; Cousin Biotech) at the L4–5 level and vertebroplasty (VP) at L4 were performed after obtaining informed consent from the patient. On the first postoperative day (POD), right sciatica and back pain improved to 4 on the NRS leg and back scores. The patient was discharged on the eleventh POD and the pain improved to 3 on the NRS back and leg scores. On the outpatient department (OPD) follow-up after 1 month and 1 year, improved state remained.

Case 2

A 74-year-old man presented to our hospital in April 2022, with a two-month history of bilateral sciatica. The patient's pain scored 8 on the NRS leg. He also had accompanying back pain (NRS back = 8). Preoperative MRI, CT, and plain X-ray revealed central stenosis with grade 1 degenerative spondylolisthesis at the L2–3 level and subacute compression fracture at L3 level, and the preoperative flexion and extension X-ray demonstrated minimal instability, because he can't make flexion and extension well due to severe back pain (Fig. 2). Interspinous ligamentoplasty with the SHL at the L2–3 level was performed after obtaining informed consent from the patient. On the first POD, bilateral sciatica and back pain improved to 4 on the NRS back and leg scores. The patient was discharged on the tenth POD and the pain improved to 3 on the NRS back and leg scores. On the OPD follow-up after one month, the pain improved to about 90 percent. On the OPD follow-up after 1 year, segmental instability was not aggravated.

Technical notes

The patient is placed in the prone position under general anesthesia. A midline skin incision was made at the relevant level. Bilateral partial laminotomy with foraminotomy and medial facetectomy was done with a drill and all thickened ligamentum flava including foraminal extension were completely removed under microscopic view. Spinous process and supraspinous ligament were preserved at the target level. The artificial ligament (SHL) was soaked in saline containing antibiotics and povidone-iodine solution. After checking for sufficient decompression and removing the bony spikes and remnant ligamentum flavum, the spine position was changed from flexion to extension to form a lordotic curvature. Initially, the upper and lower spinous processes were wrapped with the sagittal ligament of the SHL in a figure-eleven pattern (Fig. 3A). The horizontal ligament of SHL was tightly tied near the center of the sagittal ligament to replace the interspinous ligament and stabilize the target level with sutures (Fig. 3B). The artificial ligaments were fixed to position using a non-absorbable suture.

Discussion

Degenerative lumbar spinal stenosis, a common disease for elderly patients, has been treated with decompression alone to relieve neural component. Additional spinal stabilization may improve the surgical outcomes and fusion surgery is the most widely accepted stabilization method. Moreover, in the thoracolumbar vertebral fracture, fusion surgery can be chosen in case of 4 points or more in the modified TLICS system [7]. However, for some patients with mild segmental instability, fusion methods are more invasive. Soft stabilization methods have been introduced to fill a gap between fusion and only decompression in the spectrum of surgical treatment for degenerative spinal stenosis, including ligamentoplasty [8,9].

Ligamentoplasty can't be a full replacement for fusion surgery, because no hard interspinous anchoring can't be strong enough to correct advanced spondylolisthesis. A potential complication of the ligamentoplasty is fractures of spinous processes. This is particularly relevant to elderly women with osteoporosis, but this complication was not observed in previous study [2]. However, the artificial ligament can give support to the existing structures. And the development of a fibrous fusion can also provide structural support and prevent postoperative instability after decompression and progressive spondylolisthesis [9,10]. Ligamentoplasty can also be a feasible option for patients who are elderly or have significant comorbidities [3].

Many studies reported that VP for acute vertebral compression

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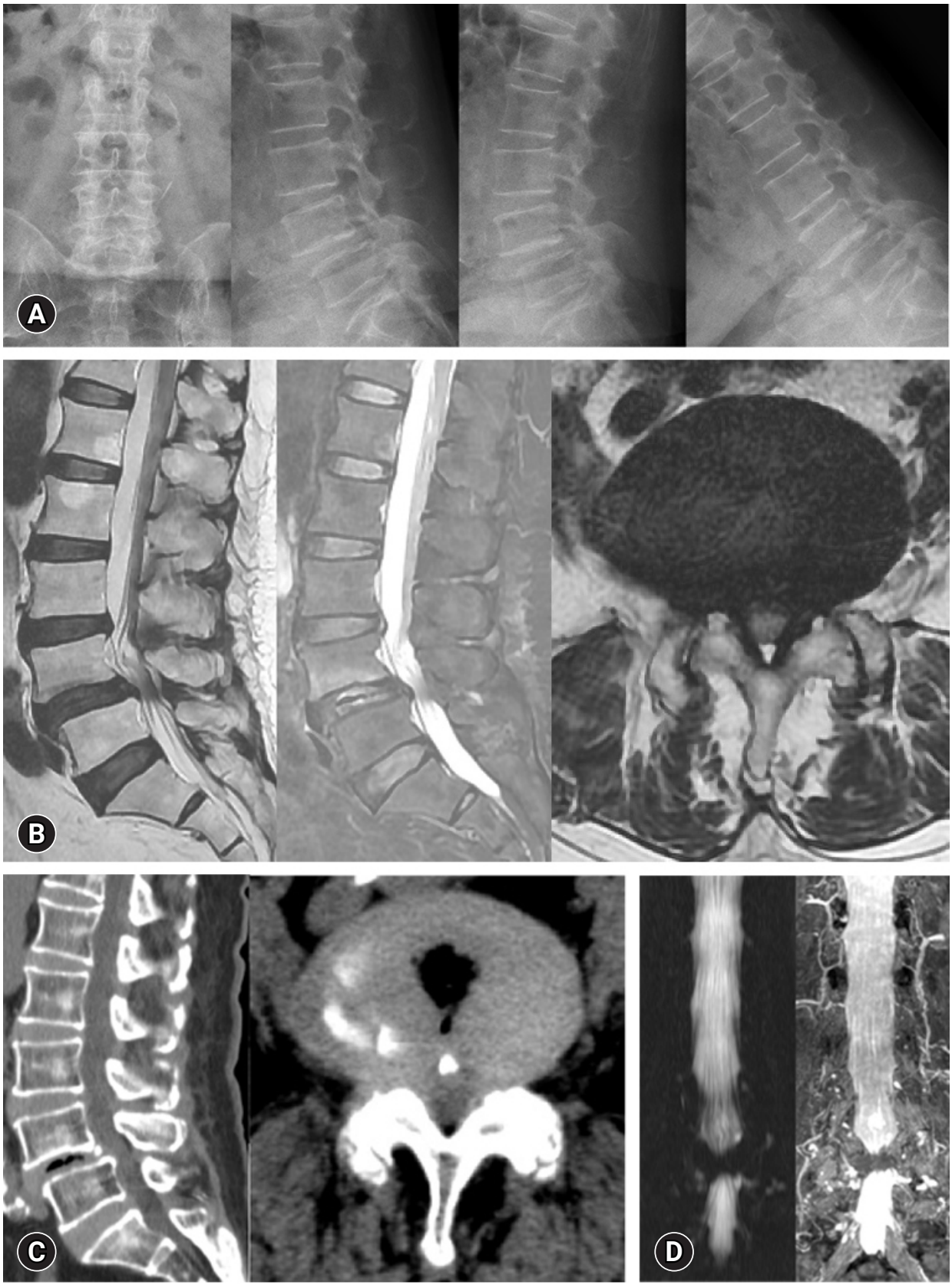

Fig. 1. Preoperative imaging: X-rays, magnetic resonance imaging (MRI), computed tomography (CT), and magnetic resonance (MR) myelography. (A) X-ray. (B) Sagittal and axial MRI. (C) Sagittal and axial CT. (D) Image on MR myelography.

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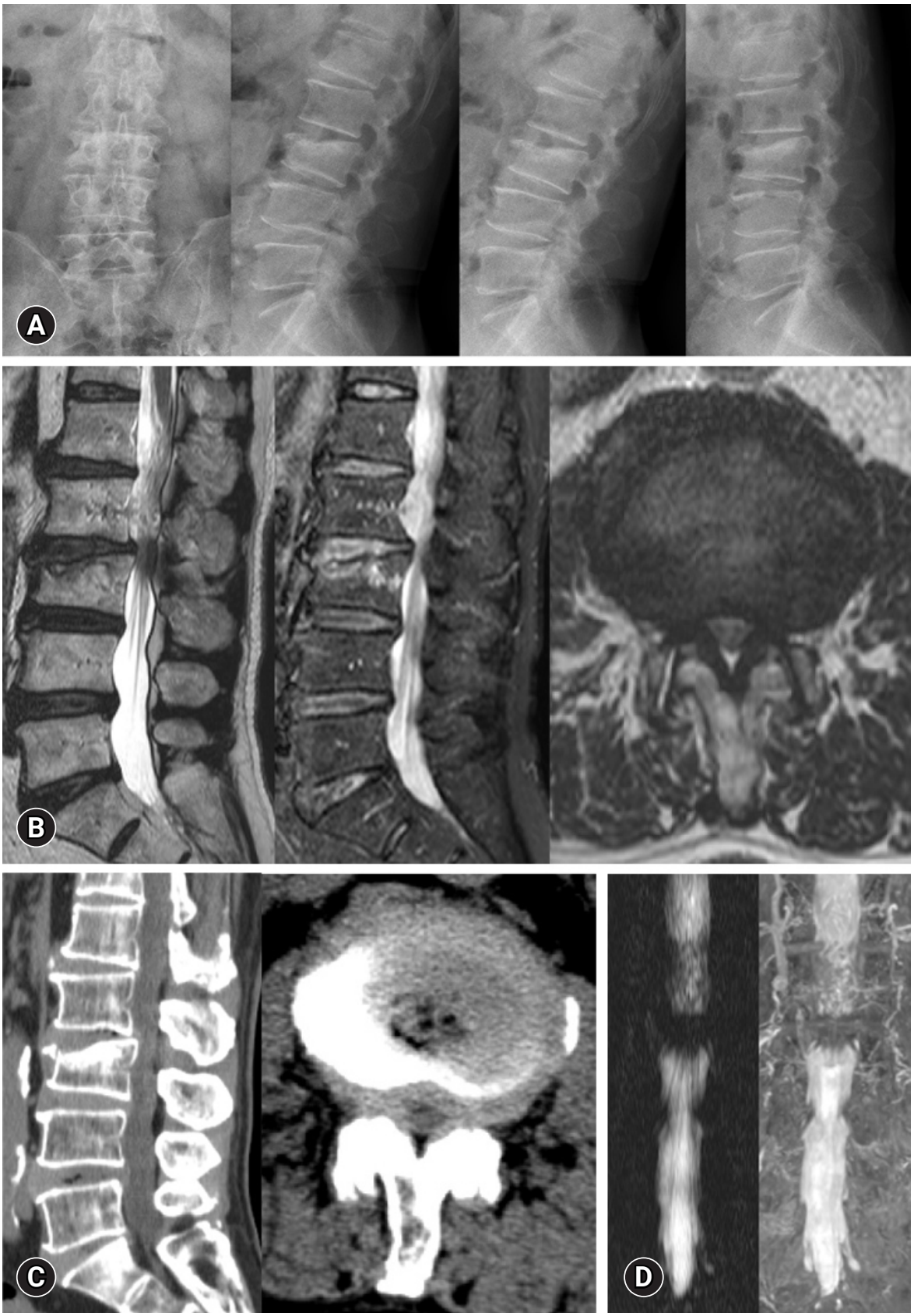

Fig. 2. Preoperative imaging: X-rays, magnetic resonance imaging (MRI), computed tomography (CT), and magnetic resonance (MR) myelography. (A) X-ray. (B) Sagittal and axial MRI. (C) Sagittal and axial CT. (D) An image on MR myelography.

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fracture (≤ 6 weeks), particularly in patients with severe pain, was superior to conservative treatment [11]. Delayed VP did not lessen the operation ratio compared to early VP. This delayed strategy may also lead unnecessary delay of treatment for patients who want rapid pain relief and spend more medical expenses for hospitalization and conservative treatment. Furthermore, in the current study, cement leakage and interdigitation were significantly favorable in the patient group with early VP compared with delayed VP group [12].

Our 2 patients had compression fractures. After applying interspinous ligamentoplasty to the relevant level, the patients' symptoms improved and postoperative MRI demonstrated sufficient decompression (Figs. 4, 5). These patients were prevented from

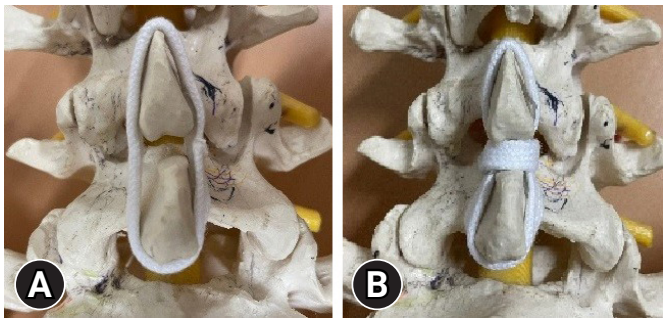

Fig. 3. Images of the sagittal and horizontal ligaments. (A) The upper and lower spinous processes were wrapped with the sagittal ligament in a figure-eleven pattern. (B) The horizontal ligament was tightly tied near the center of the sagittal ligament to replace the interspinous ligament and stabilize the target level with sutures.

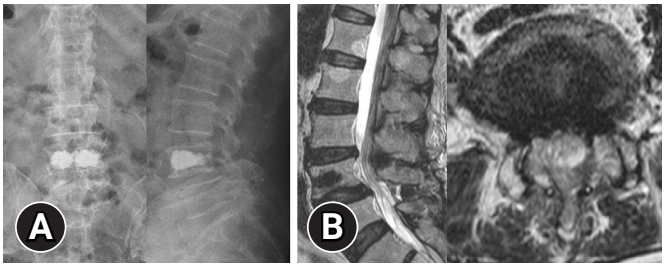

Fig. 4. Postoperative images. (A) X-ray. (B) Sagittal and axial magnetic resonance imaging.

Fig. 5. Postoperative images. (A) X-ray. (B) Sagittal and axial images magnetic resonance imaging. (C) X-ray after 1 year.

postoperative complications after fusion surgery, including aggravation of cage subsidence, because vertebral body fractures in the relevant level increase the progression of cage subsidence. At the time of discharge, the back pain and sciatica were improved to an NRS score of 3. Further improvements of symptoms were observed during the outpatient follow-ups.

Conclusion

Interspinous ligamentoplasty can be a good surgical option for lumbar spinal stenosis that coexists with mild segmental instability and vertebral body fracture.

Conflicts of interest

No potential conflict of interest relevant to this article was reported.

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1. Choi YH, Pee YJ, Jang IT. Percutaneous vertebroplasty: can it be an alternative treatment option for thoracolumbar burst fractures? J Korean Soc Geriatr Neurosurg 2020;16:67–70.
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