

Case Report



Non-operative Treatment of Osteoporotic Thoracolumbar Extension-distraction Fracture Using Teriparatide in Elderly Female Patient with Severe Osteoporosis under Inoperable Condition: A Case Report

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Conflict of Interest

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ABSTRACT

Vertebral extension-distraction fractures are a type of unstable fracture and require surgical stabilization with instrumentation. Unfortunately, in elderly patients with severe osteoporosis, poor bone quality can be related to postoperative pseudo-arthritis and instability. Teriparatide is known as an effective anabolic agent for bone healing, union, and managing osteoporosis. In this report, we describe a rare case of extension-distraction thoracolumbar fractures in 86-year-old female patient with severe osteoporosis, which was treated conservatively. The patient was inoperable due to the presence of concomitant cardiopulmonary problems and the patients' old age. She had poor bone quality on bone mineral densitometry (-6.7, lumbar spine) but no neurologic deficits. As conservative treatment, bedrest and pain control were first performed for three weeks along with the use of teriparatide for 6-month and supplementation of calcium and vitamin D. Afterwards, sitting and standing with wearable orthoses were gradually implemented. After 1 year, the patient achieved bone fusion and was able to walk by herself, and there was radiological correction of the initial segmental lordotic curvature and disappearance of the intravertebral gap caused by the extension-distraction fracture.

Keywords: Spine; Fracture; Teriparatide; Extension-distraction injury; Osteoporosis

INTRODUCTION

Osteoporotic vertebral fractures are increasing rapidly in aging populations worldwide. Vertebral fractures are associated with a significant decrease in quality of life and an increase in mortality in elderly patients.^{3,12)} Compression fractures are the most common type of osteoporotic vertebral fracture, and can be usually managed by either conservative treatment or vertebroplasty/kyphoplasty. In progressed compression fractures or initially unstable vertebral injuries, open surgical fixation with fusion is required. However, elderly patients usually have poor bone quality with lower screw-anchoring strength, as well as higher perioperative morbidity and mortality after spine fusion with instrumentation in spine fractures.^{5,14,17)} These

problems cause a lot of worry to patients and surgeons when surgical treatment is inevitable. In this study, we present a rare case of osteoporotic extension-distractio thoracolumbar fractures presenting with hyperlordotic changes in elderly female patient with severe osteoporosis. The patient was treated with teriparatide alone due to inoperable medical problems and poor bone quality, although surgical stabilization is required for the unstable injured spine.

CASE REPORT

An 86-year-old woman presented with acute severe back pain with no neurologic deficit. Plain X-ray, computed tomography (CT) scan, and magnetic resonance imaging (MRI) (**FIGURE 1**) showed acute extension-distractio fracture of the T12 body with the intravertebral cleft and segmental lordotic change of the thoracolumbar spine. There were also multiple planar vertebral bodies as a result of previous osteoporotic thoracolumbar fractures. The condition of the thoracolumbar spine was highly unstable, and the aggravation of extension-distractio of the fractured vertebral body was likely to lead to neurological deficits. We decided to perform surgical treatment with instrumentation and fusion for the long segments above and below the fractured T12. However, it was predicted that stable fixation of pedicle screws would not be easy and that postoperative pseudoarthrosis and instability were likely to recur, considering the deformed vertebral bodies around the fractured T12 and the bone mineral densitometry (BMD) findings (-6.7 , lumbar spine). Most importantly, the patient was judged as inoperable due to her weak physical condition caused by greatly reduced cardiopulmonary function (originating from heart failure and restrictive lung disease), in addition to a weak constitution (a height of 140 cm and weight of 38 kg). After deep consideration, the patient and her family refused surgical treatment and decided that she should be treated conservatively. As conservative treatment, bedrest in the lateral decubitus posture and pain control were performed for the initial three weeks along with the use of teriparatide (subcutaneous injection, 20 $\mu\text{g}/\text{day}$) with calcium and vitamin D supplementation. Afterwards, sitting and standing with wearable orthoses were

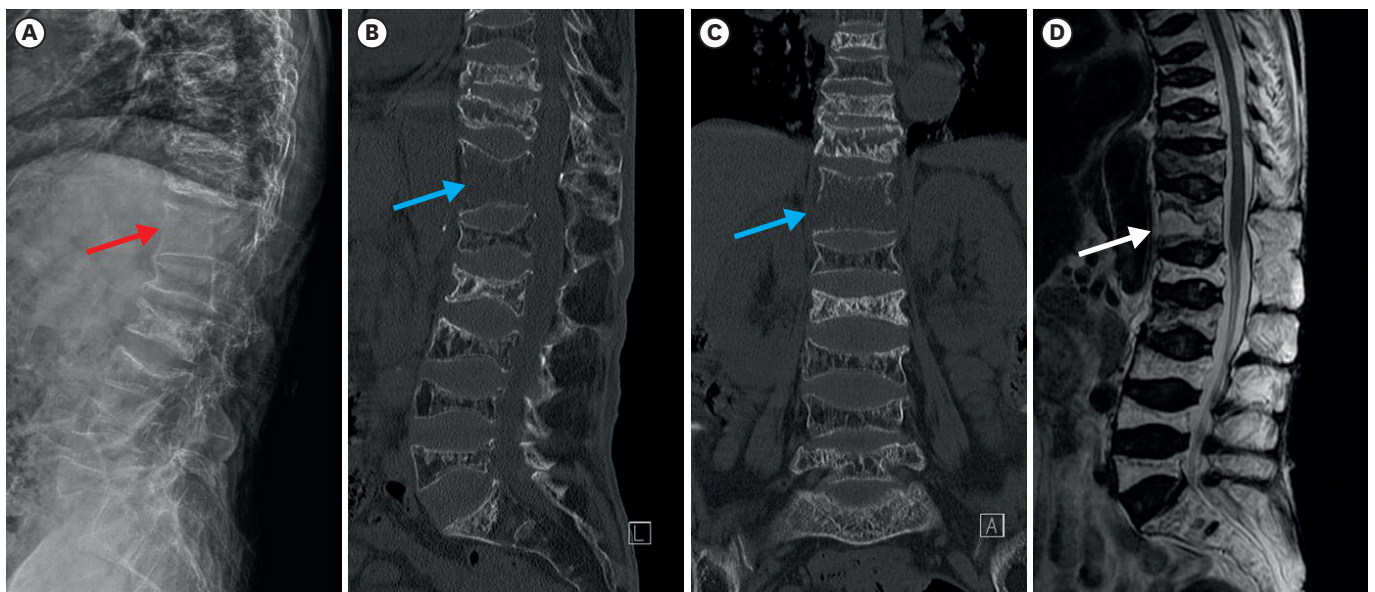


FIGURE 1. Case 1, 86-year-old female patient presenting acute severe back pain. Initial lateral plain X-ray (A) and sagittal and coronal views of computed tomography (B and C) shows extension-distractio fracture with segmental lordotic change and loss of cortical continuity of vertebral body of T12. On magnetic resonance imaging (D), there are fluid signal within the intravertebral cleft and disconnection of anterior longitudinal ligament of T12.

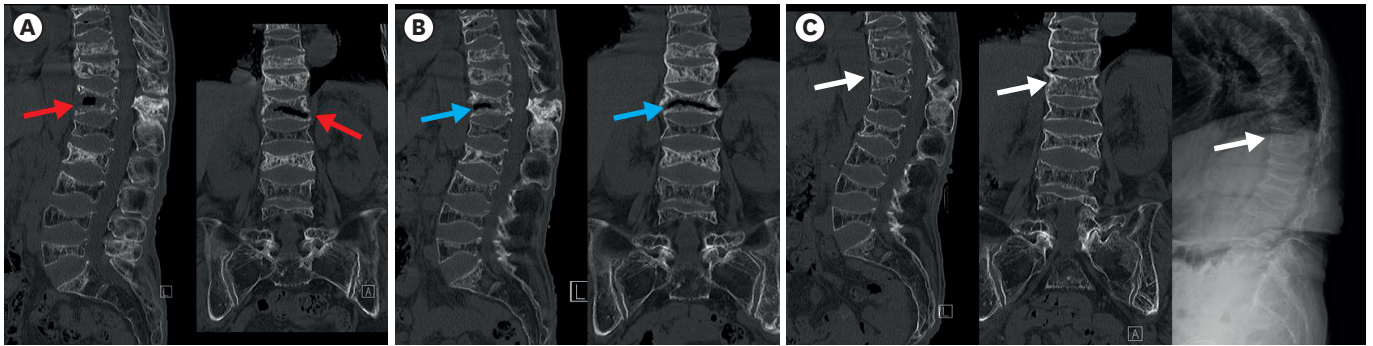


FIGURE 2. Case 1, 12-month follow-up after conservative treatment with 6-month of teriparatide. On 3- and 6-month follow-up CT scan (A and B), the collapse of fractured vertebral body proceeds with reducing intravertebral cleft. The calcification and fusion of the interspinous space were identified earlier than the formation of bone bridges around and inside the fractured vertebra. Bone fusion with bone bridging and ankyloses around the fractured vertebral body, correction of the initial segmental lordotic change, and disappearance of the intravertebral gap were noted at 1-year follow-up on CT scan and lateral plain X-ray (C). CT: computed tomography.

carried out gradually depending on back pain. On the follow-up radiological examinations (**FIGURE 2**), the collapse of fractured vertebral body proceeds with reducing intravertebral cleft at 3- and 6-month follow-up CT scans. The calcification and fusion of the interspinous space were identified earlier than the formation of bone bridges around and inside the fractured vertebra. Bone fusion with bone bridging and ankyloses around the fractured vertebral body, correction of the initial segmental lordotic change, and disappearance of the intravertebral gap were noted at 1-year follow-up CT scan. She completely recovered from her back pain, and is carrying out self-walking and normal daily activities.

DISCUSSION

Traumatic extension-distractio fractures are less than 3% in the injuries of thoracolumbar spine.¹ These lesions are highly unstable under hyperextension mechanism and cause anteroposterior translation and neurological problems.² These extension-distractio fractures correspond to subtype B3 (AO type B3) or reverse type C (AO type C) in the AOSpine Thoracolumbar Spinal Injury Classification System, and most of them are over seven points on the Thoracolumbar Injury Classification System and Severity (TLICS) score, thus requiring surgical treatment to prevent secondary neurologic deterioration.^{9,15,16} In these unstable fractures, open surgical reduction with either posterior or anteroposterior fixation is the standard treatment. However, as in the elderly female patients in this study, osteoporotic vertebrae have lower screw-anchoring strength due to the reduced pullout strength and insertional torque caused by poor bone quality, which can lead to the loosening of pedicle screws and pseudo-arthritis after surgery.^{4-6,10} These problems are more frequent in elderly patients with severe osteoporosis.¹⁴ Along with these bone quality-related problems, age-based surgical risks can be a big burden for both patients and surgeons. Winkler et al.¹⁷ reported that spine fusion and instrumentation in thoracolumbar spine injury is associated with high perioperative morbidity and mortality in old age.

Teriparatide is commonly used in spine fusion and fracture healing, and is known to be superior in increasing bone mineral density and lowering fracture risk.^{7,11} Some studies have described the effect of teriparatide on bone healing and union at various fracture sites with different lengths of use. However, there are no sufficient reports about the use of teriparatide in vertebral fractures. Tseng et al.¹³ reported that 18 months of teriparatide treatment for adjacent vertebral compression fractures after vertebroplasty was better than additional vertebroplasty

combined with an anti-resorptive agent. Yu et al.¹⁸⁾ reported that 8 months of teriparatide showed similar functional outcomes at 12-month follow-up in inoperable elderly female patients with osteoporotic thoracolumbar burst fractures to teriparatide plus percutaneous vertebroplasty and surgical fixation with fusion. Additional percutaneous vertebroplasty to teriparatide or surgical fixation with fusion showed better radiological outcomes and acute pain control. Ma et al.⁸⁾ also showed similar results: teriparatide showed similar improvements in functional outcome at three months to percutaneous vertebroplasty for osteoporotic vertebral compression fracture, although with better pain control in the acute phase.

Although teriparatide has effects on fracture healing and union, how these unstable extension-distractio fractures in the thoracolumbar spine can be treated conservatively without development of additional deformations and neurologic deficits is unclear. Yu et al.¹⁸⁾ assumed that conservative treatment of osteoporotic burst fractures with teriparatide alone was possible with synchronous collapses of the fractured anterior and posterior portions of the vertebral body under the axial loaded body weight, which may lead to the avoidance of kyphotic changes similar to that of compression fractures involving only the anterior portion of the vertebral body. There were no statistically significant differences in the radiological parameters between baseline and at 12-month follow-up. In addition, compared to the burst fractures developed by high force trauma, we think that osteoporotic fractures developed under minor force trauma, which are expected to less damage in the paraspinal ligaments and maintained stability during conservative treatment of bone healing and union with teriparatide.

The case of extension-distractio fracture in this study is osteoporotic vertebral fracture in female patient with severe osteoporosis. On initial MRI, the posterior longitudinal ligament and the posterior spinal complex including spinous processes and adjacent ligaments were relatively intact, although there was a extension-distractio fracture of the vertebral body with rupture of the anterior longitudinal ligament. These preserved posterior structures acted as a posterior hinge, preventing further displacement of the injured thoracolumbar spine.¹⁶⁾ The calcification and fusion of the interspinous space were identified earlier than the formation of bone bridges around and inside the fractured vertebra, which is thought to have played an important role in the stability of the initial process of bone healing and fusion. As a result, there was no progression to AO type C, nor were there any additional neurological deficits and deformations during the conservative treatment. Bed rest in the lateral decubitus posture relieved acute back pain by minimizing the risk of displacing fractured vertebra. The subsequent sitting and standing postures after pain control led to the disappearance of the intravertebral gap with the collapsing fractured vertebral body. These processes gradually restored the initial segmental lordotic change in the injured thoracolumbar spine with bone healing and union facilitated by the use of teriparatide.

CONCLUSION

We encountered a rare case of osteoporotic thoracolumbar extension-distractio fracture in elderly female patient with severe osteoporosis under inoperable condition, which was luckily treated with teriparatide alone. It was a good opportunity to identify the previously known effects of teriparatide for bone healing and union in these cases. However, it is not yet possible to conclude that teriparatide can be used exclusively for those vertebral fractures requiring surgical treatment. Additional research with a large number of patients is required to demonstrate its effectiveness.

REFERENCES

1. Burke DC. Hyperextension injuries of the spine. *J Bone Joint Surg Br* 53:3-12, 1971
[PUBMED](#) | [CROSSREF](#)
2. Elgafy H, Bellabarba C. Three-column ligamentous extension injury of the thoracic spine: a case report and review of the literature. *Spine (Phila Pa 1976)* 32:E785-E788, 2007
[PUBMED](#) | [CROSSREF](#)
3. Hall SE, Criddle RA, Comito TL, Prince RL. A case-control study of quality of life and functional impairment in women with long-standing vertebral osteoporotic fracture. *Osteoporos Int* 9:508-515, 1999
[PUBMED](#) | [CROSSREF](#)
4. Halvorson TL, Kelley LA, Thomas KA, Whitecloud TS 3rd, Cook SD. Effects of bone mineral density on pedicle screw fixation. *Spine (Phila Pa 1976)* 19:2415-2420, 1994
[PUBMED](#) | [CROSSREF](#)
5. Kim JW, Park SW, Kim YB, Ko MJ. The effect of postoperative use of teriparatide reducing screw loosening in osteoporotic patients. *J Korean Neurosurg Soc* 61:494-502, 2018
[PUBMED](#) | [CROSSREF](#)
6. Lee JH, Lee JH, Park JW, Shin YH. The insertional torque of a pedicle screw has a positive correlation with bone mineral density in posterior lumbar pedicle screw fixation. *J Bone Joint Surg Br* 94:93-97, 2012
[PUBMED](#) | [CROSSREF](#)
7. Liu Y, Levack AE, Marty E, Or O, Samuels BP, Redko M, et al. Anabolic agents: what is beyond osteoporosis? *Osteoporos Int* 29:1009-1022, 2018
[PUBMED](#) | [CROSSREF](#)
8. Ma Y, Wu X, Xiao X, Ma Y, Feng L, Yan W, et al. Effects of teriparatide versus percutaneous vertebroplasty on pain relief, quality of life and cost-effectiveness in postmenopausal females with acute osteoporotic vertebral compression fracture: a prospective cohort study. *Bone* 131:115154, 2020
[PUBMED](#) | [CROSSREF](#)
9. Moon AS, Cignetti CA, Isbell JA, Weng C, Rajaram Manoharan SR. Traumatic hyperextension-distractio injuries of the thoracolumbar spine: a technical note on surgical positioning. *Eur Spine J* 28:1113-1120, 2019
[PUBMED](#) | [CROSSREF](#)
10. Ozawa T, Takahashi K, Yamagata M, Ohtori S, Aoki Y, Saito T, et al. Insertional torque of the lumbar pedicle screw during surgery. *J Orthop Sci* 10:133-136, 2005
[PUBMED](#) | [CROSSREF](#)
11. Saag KG, Shane E, Boonen S, Marin F, Donley DW, Taylor KA, et al. Teriparatide or alendronate in glucocorticoid-induced osteoporosis. *N Engl J Med* 357:2028-2039, 2007
[PUBMED](#) | [CROSSREF](#)
12. Sambrook P, Cooper C. Osteoporosis. *Lancet* 367:2010-2018, 2006
[PUBMED](#) | [CROSSREF](#)
13. Tseng YY, Su CH, Lui TN, Yeh YS, Yeh SH. Prospective comparison of the therapeutic effect of teriparatide with that of combined vertebroplasty with antiresorptive agents for the treatment of new-onset adjacent vertebral compression fracture after percutaneous vertebroplasty. *Osteoporos Int* 23:1613-1622, 2012
[PUBMED](#) | [CROSSREF](#)
14. Umekawa M, Takai K, Taniguchi M. Complications of spine surgery in elderly Japanese patients: implications for future of world population aging. *Neurospine* 16:780-788, 2019
[PUBMED](#) | [CROSSREF](#)
15. Vaccaro AR, Lehman RA Jr, Hurlbert RJ, Anderson PA, Harris M, Hedlund R, et al. A new classification of thoracolumbar injuries: the importance of injury morphology, the integrity of the posterior ligamentous complex, and neurologic status. *Spine (Phila Pa 1976)* 30:2325-2333, 2005
[PUBMED](#) | [CROSSREF](#)
16. Vaccaro AR, Oner C, Kepler CK, Dvorak M, Schnake K, Bellabarba C, et al. AOSpine thoracolumbar spine injury classification system: fracture description, neurological status, and key modifiers. *Spine (Phila Pa 1976)* 38:2028-2037, 2013
[PUBMED](#) | [CROSSREF](#)
17. Winkler EA, Yue JK, Birk H, Robinson CK, Manley GT, Dhall SS, et al. Perioperative morbidity and mortality after lumbar trauma in the elderly. *Neurosurg Focus* 39:E2, 2015
[PUBMED](#) | [CROSSREF](#)
18. Yu D, Kim S, Jeon I. Therapeutic effect of teriparatide for osteoporotic thoracolumbar burst fracture in elderly female patients. *J Korean Neurosurg Soc* 63:794-805, 2020
[PUBMED](#) | [CROSSREF](#)