

A Case Report: Atypical Femoral Fracture Nonunion Over 5 Years was Introduced to Solid Fusion Using Teriparatide

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Abstract

In this report, we highlight a case in which a complicated fracture nonunion, after an atypical femoral shaft fracture operation, has been cured with a 56 µg weekly administration of teriparatide preparation that was used after a fresh pelvic ring fracture in a severe osteoporosis patient. It is suggested that the osteogenesis promoting effect of teriparatide preparation may also promote the healing of a fracture nonunion, which has not been cured for several years or more after an operation.

Keywords: Weekly Teriparatide; Nonunion; Severe Osteoporosis; Atypical Femoral Shaft Fracture

Introduction

In osteoporosis therapies, daily and weekly teriparatide are offered to treat osteoporosis patients who have a high risk of fracture [1]. In addition, a few reports on the osteogenesis promoting effect of weekly teriparatide, not only for the prevention of bone fracture but also for repair of the fracture site, have been published recently. Peichl, *et al.* reported that the mean time of fracture healing was significantly shorter in the daily teriparatide group for a pubic-ischium fracture than in the control group (7.8 vs 12.6 weeks) [2].

Here, we report a case in which a long lasting complicated fracture nonunion, after an atypical femoral shaft fracture operation, has been cured with a weekly administration of 56 µg teriparatide for 9 weeks when used after fresh pelvic ring fractures have occurred in a severe osteoporotic patient.

Cases and Symptoms Elapsed

The patient was a 90-year-old female, injured by a 12th thoracic vertebral compression fracture in June 2002, and was hospitalized in our department.

At that time, the patient was diagnosed with osteoporosis (L2-4 BMD:78% of YAM). BP was started and regularly continued the administration of risedronate 2.5 mg and alfacalcidol 1.0 µg daily. The patient complained of spontaneous right femoral pain in September 2006 and was assessed by bone scintigraphy. From this examination, an abnormal accumulation was observed in the femoral shaft (Figure 1.1). In the plain X-ray examination in October, localized outer cortical beak-like periosteal thickening was observed (Figure 1.2) and the treatment of resting was recommended. The patient was injured by an atraumatic right femoral shaft fracture in December and transported by ambulance to our hospital. A transverse fracture, accompanied by a beak, was detected from an X-ray examination and the patient was

diagnosed as having an atypical right femoral shaft fracture caused by the administration of long-term bisphosphonate (BP) therapy and stopping the administration of BP. For the treatment of fracture, intramedullary nailing was conducted (Figure 1.3). In the operation, a static type intramedullary nail (T2 nail: 360 × 11 mm made by Stryker) that fixed both ends of the proximal and distal sides with a lateral fixation was used. Because the bone union was prolonged, even 9 months after the operation, and ultrasonic therapy was continued for further 2 months. However, bone union was not identified from an X-ray examination and the injury became a fracture nonunion. Eleven months later, an iliac transplant operation was performed, but after the operation, pain during walking remained in the same area. In addition, there was a cleft that had appeared in the fracture area, which was identified from an X-ray examination. This was recognized as a state of hypertrophic fracture nonunion (Figure 1.4).

As for treatment of osteoporosis, only the active vitamin D3 derivative (EDIROL 0.75 µg/day) was continued.

In 2009, despite the fact that after three years to stop the BP, a fracture of the atypical left femoral shaft of the contralateral side also occurred, and bone union was achieved by conducting a retrograde intramedullary nailing operation. There was no remarkable past medical history on record except for hypertension. Nevertheless, pain remained in the contralateral right femoral nonunion during subsequent follow-up consultations, and no bone union was apparent from an X-ray examination. The fracture had not been cured after 3 years (Figure 1.5 and 1.6).

Five years later, this patient fell down in her home in August 2014 and consequently found it difficult to walk. She was admitted to hospital for detailed examination and received the appropriate treatment. According to the results of an X-ray and CT examination, the patient was diagnosed with having right pelvic ring fractures. (Figure 2.1A and 2.1B) The right femoral region, which was a nonunion, also displayed osteophyte formation in front of the fracture, and the condition was lasted as a nonunion condition for 7 years and 8 months after the first operation (Figure 1.7). Because there had been an atypical femoral fracture as a result of BP therapy in the patient’s medical history, an early exit from bed and load walking in order to improve walking ability in older aged patients was recommended. We also proposed surgical treatment to assist with early withdrawal from bed, but the patient did not agree, but pelvic fracture vulnerability associated with osteoporosis was considered, and once a week therapy with teriparatide administration was attempted. When using teriparatide for 6 weeks, the pain from the fractured right hip and pubic-ischium section was relieved and preferable bone formation was also obtained, as observed by an X-ray examination (Figure 2.2), allowing walking with a cane, as like before the injury. At the same time, the pain from the right femoral fracture nonunion, where symptoms occurred before the injury, disappeared. The disappearance of the anterior cleft from the fracture nonunion and the preferable rigid ossification were observed from an X-ray in December (Figure 1.8). Finally, teriparatide preparation was continued for 9 weeks. After that, the patient had difficulty visiting the hospital, therefore the treatment has been changed to an oral osteoporotic medication: activated vitamin D3 and the patient remains under observation.



Figure 1: Femoral shaft fracture.

1 Bone Scans.

2 Plane radiograph in October 2006.

2A: Showing localized outer cortical periosteal thickening of the right femoral shaft.

2B: Enlarged view of affected area.

3A: Showing atraumatic right femoral shaft fracture in December 2006.

3B: Surgical fixation with intramedullary nail.

4: Eleven months after fixation of the right femoral shaft fracture. It was a state of hypertrophic fracture nonunion?

5: Three years and 6 months from the first surgery.

6: Five years from the first surgery.

7: Initial postoperative 7 years and eight months, at the time also nonunion status observed.

8: Showing right femoral shaft in October 2014. At the same time as bone healing in the nonunion area, bone curing of surrounding bone is also observed.



Figure 2: Pelvic ring fracture.

1A: Showing right pubic fracture in August 2014.

1B: 3D-CT reveals a fracture line with no dislocation in the right sacral wing and reveals dislocation of the right suprapubic and ischium fractures.

2: Pelvic ring fracture 6 weeks after TPTD administration.

Discussion

Among osteoporotic formulations that can be used in Japan, one of the medications that have an osteogenesis promoting action is the teriparatide [1]. Teriparatide improves bone microstructure, which increases bone density and bone strength and shows an excellent inhibiting and healing effects to the vertebral body fracture [1,2]. In addition, the bone union promoting effect of teriparatide has been recognized clinically for spinal fractures and limb fractures, besides pelvic fractures [3-5]. Numerous applications to be conducted in early bone union in fresh fractures and in cases of prolonged time to bone union after operation have been reported [4,6]. An atypical femoral fracture is caused by factors such as bone resorption suppressant, curvature of the femur and other similar symptoms, which can be difficult to treat. In general, bone fixation using an intramedullary nail is often conducted, but the time when bone union is liable to be prolonged after the operation [6,11]. It is considered that the symptom is caused as a result of suppression of the excessive bone resorption, which accompanies medication as a result of microdamage accumulation. Miyakoshi, *et al.* evaluated bone union after treatment for 45 atypical femoral fracture cases with presence or absence of the combination of teriparatide. In 37 surgical cases, the combination therapy of daily and weekly teriparatide was used and the mean time for bone union was 5.4 months, shorter than 8.6 months in the control group, which did not use teriparatide. The bone union rate was 93.8% in the combination therapy of teriparatide. It was reported that the combination of teriparatide was more reliable when attempting bone union than in the treatment of atypical femoral fracture [12]. On the other hand, Watts, *et al.* conducted a prospective study using daily teriparatide for 2 years to 14 atypical femoral fractures with BP treatment history. The bone union of the limbs suggested that the combined use of teriparatide did not necessarily promote efficacy [13]. The cases we experienced were cases of using teriparatide for fresh pelvic-ring fractures. Bone union was observed not only in fresh pelvic-ring fractures, but also coincidentally in complicating fracture nonunion of atypical femoral shaft fracture, which occurred more than 6 years past after the intramedullary nailing. The factors involved in whole-body bone metabolism were discussed in the case of long-term femoral nonunion achieving bone healing. The contralateral atypical fracture appears after the BP's withdrawal and heals as usual without bone grafting or ultrasound therapy.

Quite a long period after healing has passed, and it is hard to think that it affected bone metabolism in the nonunion this time. It cannot be ruled out that BP's withdrawal worked to become effective in bone healing of the nonunion, but considering that the contralateral fem-

oral fracture was bone healing at an early stage, it was possible to go to the nonunion earlier as bone healing is assumed to be obtained. However, no healing was actually obtained. The new fall in 2014 resulted in some new fractures in the nonunion area, and it could not be denied that bone metabolism has been activated again. However, intramedullary nailing was in progress, therefore, there was no apparent fracture line in the thigh, re-fracture occurred, and it is unreasonable to think that bone healing was obtained in the nonunion due to the re-fracture. As far as the final X-ray examination results were examined in detail, not only the nonunion part but also the surrounding bone hardening was obtained. It was thought that a direct bone formation promoting the effect of TPTD was acting on the nonunion part. The pelvic fractures in this case are unstable fractures, which are considered to be indications of future surgery. However, since the patient's original activity of daily living was low due to the femoral nonunion, and furthermore, consent was not obtained for surgery by the family or patient herself, we selected a conservative therapy when applying TPTD. Finally, using TPTD in this case is a treatment for severe osteoporosis, and the purpose was to select a treatment for a brittle bone pelvic fracture. Bone fusion at the nonunion site was a secondary effect. It is therefore suggested that the possibility of the osteogenesis promoting the effect of teriparatide therapy may promote fracture healing both in the fresh pelvic-ring fractures but also in prior fracture nonunion, which occur in patients with several years of severe osteoporosis.

Conclusion

We experienced a case which complicating a fracture nonunion after a femoral shaft fracture operation was healed by weekly administration of teriparatide to fresh pelvic-ring fractures in patients with severe osteoporosis. It was suggested that the osteogenesis promoting effect of teriparatide may also promote the healing of fracture nonunion, which has not been cured for several years or more after the operation.

Highlights

Teriparatide advances the healing of the fracture nonunion, which has not been cured for more than 6 years.

Conflict of Interest

The authors have no conflict of interest.

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