

Original Article

Clinical features of an atypical femur fracture

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Abstract

Objectives: We aim to elucidate the clinical outcomes of bisphosphonate-associated atypical femoral fracture and the clinical results depending on the bisphosphonate therapy period.

Methods: Twenty cases involving 15 patients who had been diagnosed with an atypical femoral fracture between 2004 and 2014 and who had been followed up for at least 12 months were retrospectively analyzed. The control group was composed of 15 typical femoral fracture patients. We used plain radiography and physical examinations to determine the period of time required for fracture healing as well as complication occurrence. We investigated the bisphosphonate administration status and duration and the names of its components, bilateral fracture occurrence status, the period of time required for bone union, and reoperation or bone graft status due to nonunion.

Results: Revision surgery involving a bone graft was performed due to nonunion in 1 out of 15 cases. Except in one revision case, the duration of the union was 11.9 months on average in 14 cases of atypical fracture patients, and 4.3 months on average in the control group. This difference was statistically significant ($p < 0.05$). The bisphosphonate administration duration was positively correlated with the union period ($p < 0.05$). In contrast, there was no statistically significant correlation between the bisphosphonate administration duration and the incidence of bilateral atypical fractures ($p > 0.05$).

Conclusions: Atypical femoral fractures required more time for bone union than typical ones and prolonged bisphosphonate administration led to a longer period of time required for bone union.

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Keywords: Atypical femur fracture; Bisphosphonate

1. Introduction

Typical femoral fractures usually do not occur in the subtrochanteric area and comminuted fracture patterns appear in many cases. Conversely, atypical femoral fractures are relatively more commonly found in the subtrochanteric area with specific features [1]. Atypical femoral fractures are primarily characterized by transverse or exhibit short oblique fracture configurations, non-comminuted fracture patterns, medial

spikes, localized periosteal thickening of the lateral cortex, generalized thickening of the femoral cortices, and confer prodromal symptoms such as pain [2–4] (Fig. 1).

The ASBMR task force established major and minor features of atypical femoral fractures and classified them into complete and incomplete categories [5]. Although these criteria are of great help in understanding atypical femoral fractures, some features are still controversial.

While bisphosphonate is commonly used to prevent osteoporotic fractures, many researchers have recently reported atypical femoral fractures without trauma or following mild trauma among the patients who have been administered bisphosphonate for extended periods of time [5–7]. However, it is actually difficult to conduct research on the association between bisphosphonate and an atypical femoral fracture, which occur very infrequently. The direct associations

List of abbreviations: ASBMR, American Society for Bone and Mineral Research; MTX, methotrexate.

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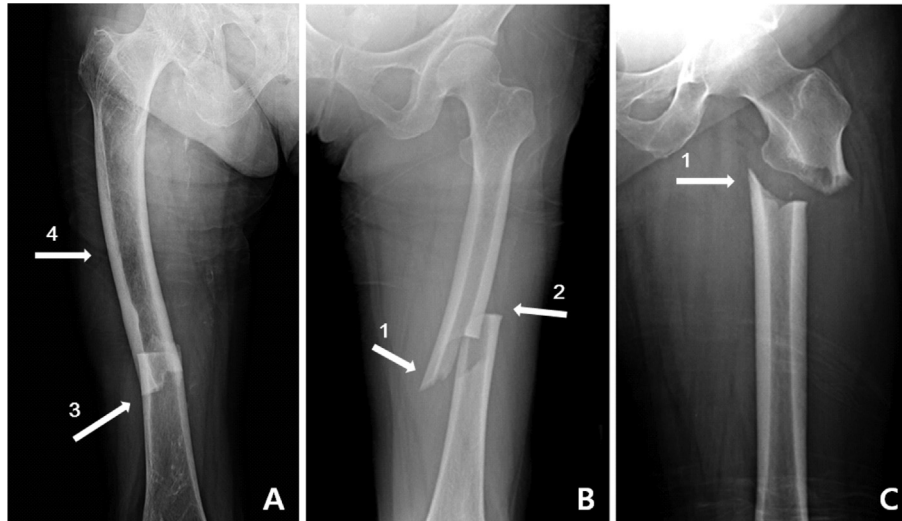


Fig. 1. Radiographs of the atypical femoral fracture. (A, B) shows atypical femoral fracture in femoral shaft region, and (C) in the subtrochanteric area. The radiographic features of atypical femoral fractures: (1) medial spike; (2) transverse fracture pattern (3) localized periosteal thickening of the lateral cortex; (4) generalized thickening of the femoral cortices.

between atypical fractures are still controversial and the definite cause of atypical femoral fractures is unknown.

This study aimed to determine the period of time required for bone union in atypical femoral fractures associated with bisphosphonate, evaluate their prognoses and determine the association between the bisphosphonate administration duration and the prognoses.

2. Subjects and methods

2.1. Study population

Twenty cases involving 15 patients who had been diagnosed with an atypical femoral fracture between 2004 and 2014 and who had been followed for at least 12 months, were

retrospectively analyzed (Table 1). The control group was composed of 15 typical femoral fracture patients, taking into account gender, age, injury sites, BMI, fracture patterns, and surgical procedures. The patients with underlying disease, which could possibly affect bone union, were excluded from the control group. In 5 out of 15 cases of atypical femoral fractures, bilateral atypical femoral fractures were found.

A case in which an atypical fracture occurred seven years after a typical fracture on the other side was included in the control group.

2.2. Methods

We used plain radiography and physical examinations to determine the period of time required for fracture healing as

Table 1
Demographics of 15 patients of atypical femur fracture.

| Case | Age | Sex | BMI | Injury mode | BMD | | Fracture type | Used nail | Medication periods | Union periods |
|------|-----|-----|-------|-------------|-------|-------|---------------|-----------------|--------------------|---------------|
| | | | | | Femur | Spine | | | | |
| 1 | 74 | F | 23.12 | Slip down | -2 | -2.3 | Shaft | Sirus nail | 80 | 8 |
| 2 | 58 | F | 24.97 | Slip down | -2.3 | -1.6 | Subtrochanter | Long Gamma nail | 67 | 6 |
| 3 | 61 | F | 22.96 | Slip down | -3.2 | -2.8 | Subtrochanter | PFNA | 127 | 30 |
| 4 | 73 | F | 19.98 | Slip down | -0.6 | -1.7 | Subtrochanter | Long Gamma nail | 79 | 9 |
| 5 | 73 | F | 28.99 | Slip down | -3.1 | -4.2 | Subtrochanter | PFNA | 84 | 17 |
| 6 | 70 | F | 22.27 | Slip down | -3.6 | -2.6 | Shaft | A2FN | 12 | 5 |
| 7 | 85 | F | 24.73 | Slip down | -2.4 | -2.7 | Shaft | ITST | 38 | 4 |
| 8 | 85 | F | 26.84 | Slip down | -0.9 | 0.9 | Subtrochanter | Long Gamma nail | 135 | 34 |
| 9 | 103 | F | 24.89 | Slip down | -4.4 | -3.9 | Shaft | Sirus nail | 89 | 9 |
| 10 | 85 | F | 26.49 | Slip down | 0.5 | 4.2 | Subtrochanter | PFNA | (-) | 10 |
| 11 | 85 | F | 20.41 | Slip down | -4.3 | -5.7 | Shaft | M/DN recon nail | 58 | 6 |
| 12 | 84 | F | 19.98 | Slip down | (-) | | Shaft | Plate & screws | (-) | 8 |
| 13 | 85 | F | 18.75 | Slip down | -4.4 | -4.7 | Shaft | CFN | 31 | 8 |
| 14 | 89 | F | 16.80 | Slip down | (-) | | Shaft | A2FN | 78 | 16 |
| 15 | 58 | F | 27.06 | Slip down | 0.6 | 0.6 | Subtrochanter | Long PFNA | (-) | 20 |

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