

**Propagation of Bisphosphonate related femoral stress fractures despite femoral nailing - A cautionary tale from two cases.**

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- 38    **Propagation of Bisphosphonate related femoral stress fractures despite femoral nailing - A cautionary**  
39    **tale from two cases.**

## **Abstract:**

We report two cases of atypical femoral fracture displacement despite treatment with intramedullary nailing. Both patients had received more than three years of bisphosphonates. One patient had prophylactic fixation of an atypical femur fracture due to intractable pain. The other had undergone nailing previously for a traumatic shaft fracture. The patient then received bisphosphonate later and sustained an atypical fracture with the nail in place. Both femoral nails were slotted, cannulated stainless steel piriformis entry designs. These two cases are amongst the first reported failures of intramedullary fixation in preventing displacement of a bisphosphonate stress fracture. We advice caution when using slotted nails in prophylaxis of atypical femur fractures because of its significantly reduced torsional stiffness compared to modern non-open sectioned nails.

## **Keywords:**

Femur fractures, Bisphosphonates, Atypical Fractures, Intramedullary nailing, Case Report, Geriatric Fractures

## **Introduction:**

Atypical femoral fractures have been suggested to be associated with patients receiving bisphosphonates for more than 3-5 years(1-7). The etiology of atypical femur fracture is thought to be reduced bone turnover, leading to accumulation of unrepaired micro-fractures and eventual significant weakening of the bone.(8) The sub-trochanteric and diaphyseal areas of the femur is subjected to high tensile load hence most susceptible to fracture after minimal or no trauma.

Patients may present at an early stage before fracture completion and displacement. These patients typically have cortical stress reactions in the femoral sub-trochanteric or diaphyseal regions, presenting as lateral cortical beaking and cortical thickening. Some may also have prodromal pain and a 'dreaded black line' representing an undisplaced stress fracture.(5, 6, 9-12) Pain and the dreaded black line may indicate an increased risk of secondary displacement. Clinical studies have reported favorable results by prophylactically treating these patients with intramedullary nailing, successfully preventing secondary displacement and alleviating pain.(13-18) We present two cases where an atypical fracture displaced despite previous intramedullary fixation with a slotted stainless steel nail.

## **Case one (Figure 1):**

A 71 year old lady with a history of surgical menopause was prescribed alendronate for osteoporosis. Despite being on treatment, she sustained a displaced femoral neck fracture four years later. She was treated with a hemiarthroplasty. She continued to take the drug for a total duration of 5 years. The patient was maintained on calcium and vitamin D supplements. She was able to ambulate outdoors with a stick.

At the age of 77, around 14 months after stopping alendronate, she experienced right sided thigh pain which worsened and became debilitating after two months. There was no significant pain over the contralateral limb with previous hemiarthroplasty. X-ray revealed cortical 'beaking' and thickening over the mid diaphysis of her right femur. There was corresponding local tenderness. The diagnosis was an atypical femur fracture. She underwent prophylactic antegrade intramedullary nail fixation to prevent secondary fracture displacement and to alleviate intractable pain.

Reaming was performed up to 12mm with use of a distal intramedullary suction vent. A 10mm piriformis entry stainless steel slotted nail (Universal Femoral Nail, Synthes, Oberdorf, Switzerland) was inserted with one static locking bolt distal and one proximal locking bolt in the dynamic position.

The patient recovered uneventfully after operation. She was allowed immediate full weight bearing walking. She remained to be on calcium carbonate and multivitamin supplements. Strontium ranelate was started 2 months after surgery. The patient had decreased pain but it was not completely alleviated by the surgery.

The patient then sustained a minor fall injury on level ground 1 year and 3 months after intramedullary nailing. X-ray showed a displaced comminuted fracture of the femur propagating from the original site of the stress fracture despite the nail.

The patient was re-operated with nail exchange to a reamed trochanteric entry non-slotted cannulated titanium femoral nail (A2FN, Synthes, Oberdorf, Switzerland). Open reduction was performed. Reaming was performed to 13.5mm and a 12mm nail was used. Two reconstruction locking bolts were used proximally and two static locking bolts were used distally. She was rehabilitated with progressive weight bearing walking exercise. The fracture united after 4 months and the patient was able to return to her pre-fracture functional status.

**Case Two (Figure 2):**

A 78 years old lady presented to the trauma unit 3 years ago when she missed a step while walking downstairs. She sustained an oblique fracture at the distal shaft of her right femur. She had good general health prior to this injury. The fracture was managed by intramedullary nailing. An 11mm piriformis entry slotted stainless steel nail was used (Universal Femoral Nail, Synthes, Oberdorf, Switzerland). Reaming was performed up to 13mm. Two proximal and two distal interlocking screws were placed at the static positions. The fracture united uneventfully and the patient was put on alendronate. The patient was eventually able to walk unaided with a pain free lower limb.

Two and a half years after the initial fracture, the patient began noticing increasing pain over the operated hip. The patient continued to ambulate with a walking frame for four months.

The patient then had a low energy fall and was readmitted into hospital. Radiographs on admission showed a displaced subtrochanteric stress fracture with bending of the intramedullary nail. X-ray indicated a stress fracture with beaking and breakage of the lateral cortex occurring at the proximal screw hole.

The patient underwent surgical fixation of the fracture. The implant was exchange to a long cephalomedullary nail (PFNA, Synthes, Oberdorf, Switzerland). The retrieved IM nail showed fatigue failure at its proximal locking screw hole.

Bisphosphonate therapy was stopped and the patient was rehabilitated with progressive weight bearing walking exercise. The fracture eventually united on X-ray four months following surgery with alleviation of pain.

## **Discussion**

Atypical femur fractures may be difficult to diagnose at an early, undisplaced stage. They may be appreciated by screening the contralateral femur in patients presenting with displaced fractures. The typical features are, lateral cortical beaking, diaphyseal cortical thickening or a 'dreaded black line' with prodromal pain in patients who has been on a few years of bisphosphonates. Judicious use of MRI and bone scintigraphy can assist diagnosis when X-rays alone are non-confirmatory.

The recommended treatment is prophylactic surgical stabilization of these stress fractures. The indications for surgery are to prevent secondary fracture displacement and to alleviate prodromal pain. The reported rate of secondary displacement in un-operated cases is thought to be high. Banffy(14) reported fracture displacement occurring in 5 out of 6 patients who were not prophylactically stabilized. Ha(18) saw

secondary displacements in 5 out of 14 femurs and another 5 had to be operated due to intractable pain. Koh(9) reported that patients with cortical stress reactions and subsequent fracture displacement were more likely to have had pain and a 'dreaded black' line on X-ray. Prophylactic stabilization were reported to be associated with shorter hospital stay (14, 16) when compared to treatment after fracture displacement.(19) When there is persistent radiological features and prodromal pain after a drug holiday of one to two months, prophylactic intramedullary nailing should be strongly advised.

Prophylactic treatment has shown to be generally effective. Ward(16) described 14 successful prophylactic fixations with reconstruction nails. Banffy(14) treated 6 with cephalomedullary devices. Capeci(15) reported 4 successful antegrade IM nailing as prophylaxis. Das De(13) reported success using both IM nails in 2 cases and DCS plates in 2 other cases where the canal was too narrow. Wang(17) reported 3 successful prophylactic fixations with non-reconstruction nails. Ha(18) reported 5 patients treated with plate or IM nails with similar success. Oh(23) reported 20 similar successes with intramedullary nails. From all the reported cases, there were no failures noted.

In our two cases both patients suffered from atypical fracture displacement despite presence of an intramedullary nail. In the first case the fracture displaced despite antegrade nailing while the second cases fracture developed with the nail in situ. In the literature, there were no other reports of failures of prophylaxis in undisplaced fractures. Many authors have used newer generation solid nails with fixation into the femoral head.

As illustrated by these two cases, we call for caution if not total avoidance of slotted nails with bisphosphonate fractures. The torsional stiffness of slotted intramedullary nails is only 2% of the intact femur compared to 13% for a solid nail(20). We believe it is important to select a more rigid implant that can bear stress throughout an extended period of time for a biologically compromised femur to heal. Our centers have therefore resorted to routine use of cephalomedullary nails.

A bone scintigraphy can be used to confirm delayed union when patient complains of persistent pain despite prophylaxis. Anabolic agents for osteoporosis such as teriparatide and strontium renelate increases bone formation and osteoblastic activity. The latter is currently licensed for use in Europe and various other countries but not the United States (21, 22). Both had early results that may enhance success after surgery in atypical femur fractures.

Extra effort has to be put in when tackling atypical bisphosphonate related fractures due to the high reported rate of complications (12). Despite reinforcing on preventive measures such as strict adherence

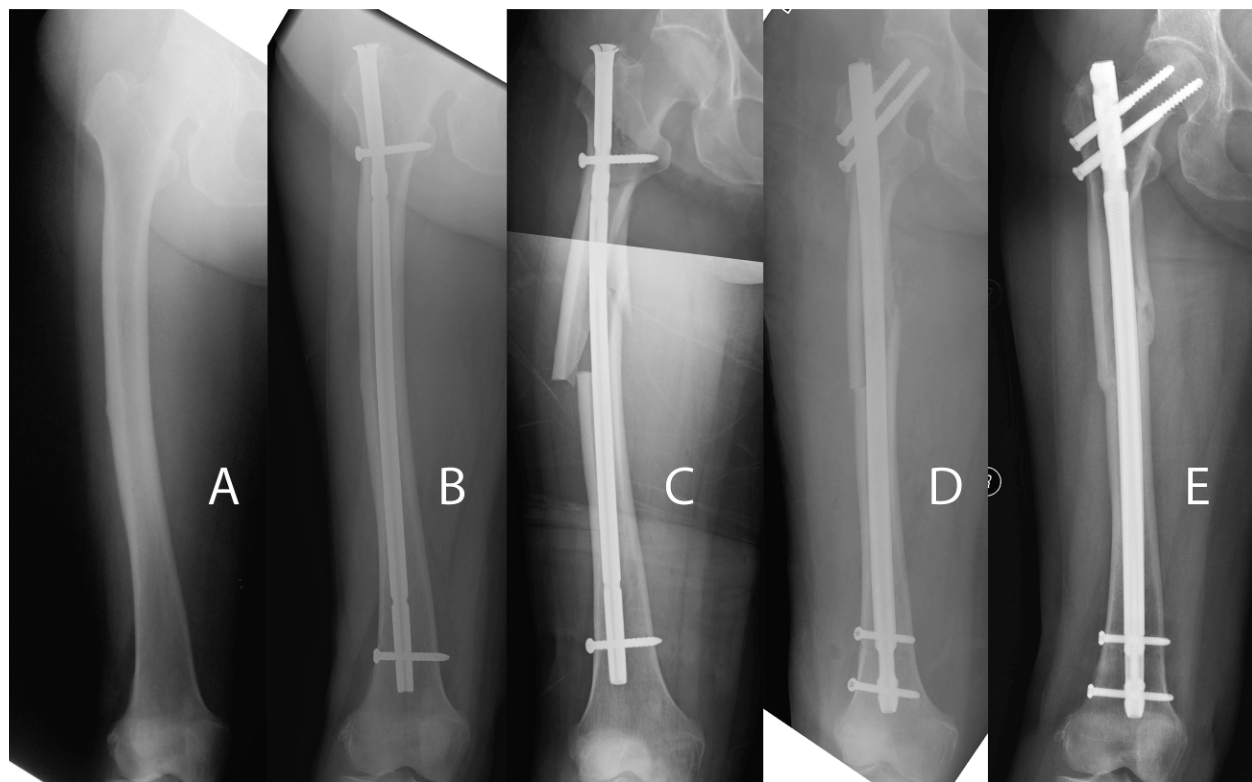
to indications, close monitoring for complications, and cessation of the drug after 3 to 5 years,(1, 22, 24) it is likely that orthopaedic surgeons will still increasingly face such fractures. The surgeon should make a prompt diagnosis, establish a clear understanding with the patient, provide a stable mechanical prophylaxis or fixation, respect the biology of the fracture and maintain vigilance at follow-up to assure healing.

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216 **Figure 1:**

217 Case one. (A) A 77 years old lady who previously received 5 years of Alendronate presented with thigh  
 218 pain with X-ray showing features of an atypical cortical stress reaction at the mid diaphysis. (B)  
 219 Prophylactic fixation with a slotted stainless steel IM nail. (C) The atypical fracture failed to heal and a  
 220 secondary displacement occurred after a fall injury after thirteen months. (D) Revision with a  
 221 cephalomedullary nail. (E) Healing after seven months.

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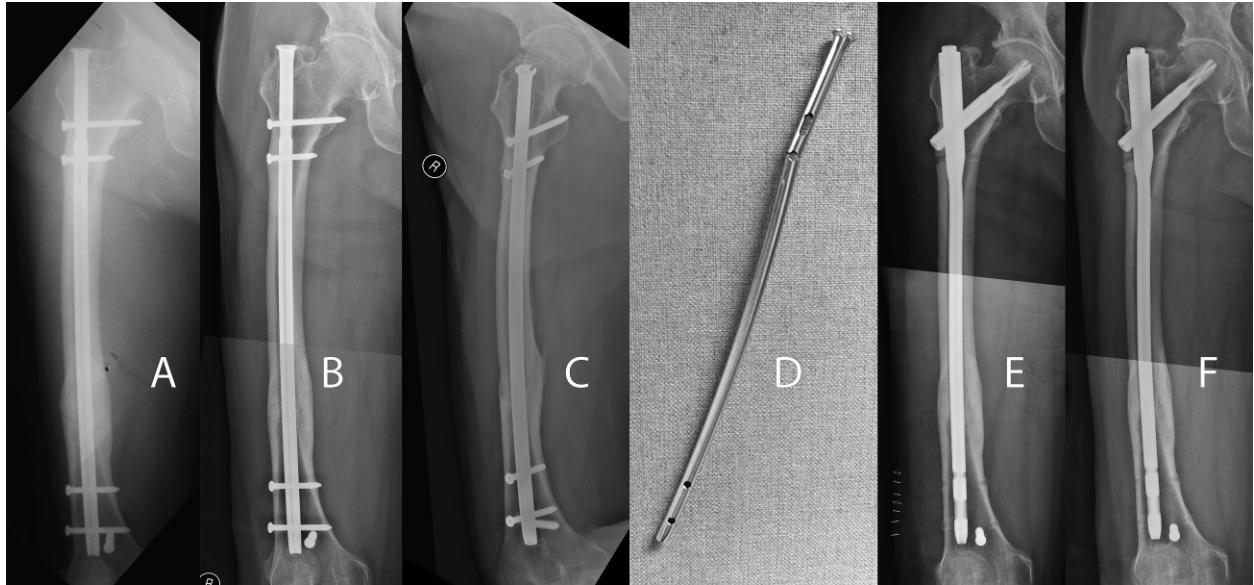


Figure 2:

Case two. (A) A 78 years old lady with previous distal diaphyseal femur fracture treated with IM nailing, with fracture healed nine months afterwards. (B) Patient complained of prodromal hip pain with no definite X-ray changes on the anteroposterior view. (C) Oblique view showing a subtrochanteric atypical fracture at the locking screw position. (D) Retrieval of a broken slotted IM nail. (E) Re-fixation with a cephalomedullary nail. (F) The fracture has healed with patient pain free four months following revision surgery.