

Well-Reduced Bisphosphonate-Associated Atypical Femur Fractures have Low Rates of Nonunion and Delayed Union

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INTRODUCTION:

Bisphosphonate-associated atypical femur fractures have been reported to have high rates of delayed union and nonunion. There have been limited studies looking at specific factors associated with delayed union or nonunion of atypical fractures. Additionally, no studies to date have examined the effect of reduction technique (closed versus open versus percutaneous) on healing.

METHODS:

This was a retrospective review of patients greater than 50 years of age with atypical femur fractures treated surgically at three academic medical centers between 2005 and 2022. Patients were followed until fracture union at minimum. Exclusion criteria included metastatic disease or primary pathologic fracture, metabolic bone disease other than osteoporosis, and inflammatory arthritis. Patients who were lost to follow up prior to radiographic union or who were lost to follow up prior to 6 month follow up and who had not yet achieved radiographic union were excluded. The primary outcome was union. Secondary outcomes included time to radiographic healing and reoperation, as well as clinical healing and the use of an assistive device. Radiographic union was defined as bridging callus or non-visible fracture line across at least three cortices and was assessed by two independent reviewers (ER, AJ). Delayed union was defined as lack of bridging callus across at least three cortices within six months postoperatively. Clinical healing was defined as none or mild pain.

RESULTS:

A total of 148 patients with atypical femoral shaft fractures were identified. Of these, two were excluded due to pathologic fracture, 4 were excluded due to being prophylactic nails for incomplete fracture, while a further 67 were excluded due to lack of sufficient follow up. A total of 75 patients were included in the final cohort. All were female, with an average age of 75 (standard deviation 8.8). Median ASA score was 3 (IQR 2,3). Fifty underwent a closed reduction, 15 underwent open reduction, and 10 had a percutaneous reduction. Reduction quality was excellent in 97% of patients. All patients were treated with an intramedullary implant.

Two patients (3%) went on to nonunion, which was diagnosed at an average of nine months postoperatively. Three patients (4%) had delayed union. Five patients underwent reoperation – two for nonunion repair, two for peri-implant fractures, and one for removal of a symptomatic distal interlocking screw. The median time to union was 3.1 months (IQR 2.9-3.6).

In univariate analysis, subtrochanteric fracture location, poor reduction quality, and open reduction were each independently associated with increased risk of nonunion or delayed union. All of the cases of nonunion or delayed union occurred in patients with subtrochanteric fractures ($p=0.009$). Similarly, 4/5 of the cases of nonunion or delayed union were associated with an open reduction ($p=0.002$). Finally, the cases of nonunion or delayed union were more likely to have a varus or flexion malunion ($p=0.010$) and a $>2\text{mm}$ gap between fracture fragments ($p=0.029$). Nail diameter and presence of intraoperative cortical breakage were not associated with nonunion.

DISCUSSION AND CONCLUSION:

Atypical femur fractures have been reported to have high rates of nonunion and delayed union. In this multicenter study including 75 patients with atypical femur fractures, we found a nonunion rate of 3% and a delayed union rate of 4%. In accordance with prior literature demonstrating the association between malreduction and delayed union and nonunion, we similarly found that varus and flexion malreduction, and fracture plane gap were associated with increased risk of nonunion or delayed union. Contrary to what has been previously described in typical femur fractures, we found that an open reduction is associated with increased risk of nonunion. Finally, in our cohort, the median time to radiographic union was 3.1 months, which is faster than previously reported, and may be associated with the high rates of excellent radiographic reduction.