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# Outcomes for Elderly Patients With Atypical Femoral Fractures Compared to Typical Femoral Fractures for Length of Stay, Discharge Destination, and 30-Day Mortality Rate

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## Abstract

**Introduction:** Despite increasing recognition of atypical femoral fractures (AFFs), there's conflicting evidence about incidence, aetiology, and short-term outcomes of these injuries. This study reports the incidence of AFFs at our center and compares the early postoperative outcomes against typical femoral fractures (TFFs). **Methods:** A retrospective observational cohort study of patients presenting to our trauma unit between November 2015 and July 2016 was undertaken. Inclusion criteria required radiologically confirmed proximal femoral fracture, which was then categorized as AFF or TFF. Primary outcome measures included length of stay, discharge destination, and 30-day mortality. **Results:** Two hundred thirty-nine patients presented to our trauma unit over 9 months with either a fractured neck of femur or proximal femoral fracture. A total of 122 were identified as pertrochanteric, subtrochanteric, or proximal femoral shaft fractures of which 25 (20.5%) displayed atypical radiographic features consistent with AFF. The 2 groups were similar for average age (TFF 85.3 years vs AFF 85.0 years), gender (19% vs 16% male gender), American Society of Anaesthesiology grade (3.0 vs 3.0), cognitive score (abbreviated mental test score = 7.03 vs 7.08), and preinjury place of residence (88.9% vs 92.0% lived in own home). Typical fractures were fixed with either dynamic hip screw or intramedullary nailing, all atypical fractures were fixed with intramedullary nailing. There was no statistical difference between the 2 groups for length of stay (12.8 days vs 14.3 days; $P > .05$), discharge to preinjury residence (45.1% vs 36%; $P > .05$), or 30-day mortality (8.1% vs 12%; $P > .05$). **Discussion:** In our predominantly geriatric population atypical radiographic features were observed in around 10% of patients presenting with proximal femoral fractures or fractured neck of femur. Previous studies have reported poor outcomes for pain, mobility, and length of stay after AFF. However, we observed no difference in short-term outcome measures when compared to patients with typical proximal femoral fracture patterns at our trauma unit. **Conclusion:** With modern principles of trauma care outcomes achieved following AFFs may be equivalent to typical femoral fractures in the geriatric population.

## Keywords

fragility fractures, geriatric trauma, osteoporosis, trauma surgery, atypical fractures, bisphosphonates

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## Introduction

Bisphosphonate use for the prevention of fragility fractures has increased significantly over the past 2 decades, such that they are now the most commonly used drug worldwide in managing osteoporosis.[1] There is however, a growing evidence base in the literature suggestive of an association between long-term bisphosphonate use and "atypical" femoral fractures (AFFs).

Bisphosphonates reduce fracture risk through the inhibition of osteoclasts, preventing excessive thinning of trabeculae

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**Table 1.** The 2010 American Society for Bone and Mineral Research Case Definition of AFFs.[8]

| ASBMR Criteria | |
|---|---|
| Major features | • Located anywhere along the femur from just distal to the lesser trochanter to just proximal to the supracondylar flare<br>• Associated with no trauma or minimal trauma, as in a fall from standing height or less<br>• Transverse or short oblique configuration<br>• Noncomminuted<br>• Complete fractures extend through both cortices and may be associated with a medial spike; incomplete fractures involve only the lateral cortex |
| Minor features | • Localized periosteal reaction of the lateral cortex<br>• Generalized increase in cortical thickness of the diaphysis<br>• Prodromal symptoms, such as dull ache or aching pain in the groin or thigh<br>• Bilateral fractures and symptoms<br>• Delayed healing<br>• Comorbid conditions (eg, vitamin-D deficiency, rheumatoid arthritis, hypophosphatasia)<br>• Use of pharmaceutical agents (eg, bisphosphonates, glucocorticoids, proton pump inhibitors) |

Abbreviations: AFF, atypical femoral fracture; ASBMR, American Society for Bone and Mineral Research.

and the formation of perforations, which contribute to bone fragility. They can however, cause oversuppression of bone remodeling, resulting in the accumulation of microcracks and compromising the mechanical properties of bone.[2,3] This may explain the association with AFFs in this cohort.[4,5] There is further evidence to suggest that patients sustaining these types of fracture have poorer clinical outcomes when compared to typical femoral fractures (TFFs).[6] We recognize the importance of establishing differences in outcomes for day-to-day clinical practice.

Atypical femoral fractures are usually atraumatic or occur following low-energy trauma, with the fracture most frequently occurring in the subtrochanteric region.[7] Radiologically, fractures are typically noncomminuted transverse or short oblique fractures that may be associated with a medial spike in complete fractures and have features of localized periosteal reaction and cortical thickening.[8] They may be associated with prodromal symptoms, such as dull ache or pain in the groin or thigh and can be bilateral. The American Society for Bone and Mineral Research (ASBMR) has proposed major and minor criteria to define AFFs (Table 1).[8]

According to the ASBMR definitions, AFFs require all 5 major criteria to be present while minor criteria are not necessary for diagnosis but are sometimes associated with these fractures. In particular, a well-recognized appearance on plain radiograph is the periosteal thickening often referred to in the literature as "beaking" or "flaring." Fractures of femoral neck, intertrochanteric fractures with spiral subtrochanteric extension, pathological fractures associated with primary or metastatic bone tumors, and periprosthetic fractures are specifically excluded from this definition.

Treatment of atypical fractures is usually by surgical intervention in the form of either intramedullary nailing or dynamic hip screw fixation, with intramedullary nailing being the first-line option.

The outcomes of patients sustaining these AFFs have not been thoroughly investigated, with most current studies concentrating on surgical intra and postoperative complications rather than assessing mortality and social outcomes. The results of these studies have shown conflicting results, with some reporting increased intraoperative fracture rates, longer time to union and poorer outcomes, whereas others have illustrated generally favorable results.[9-13]

This study aims to compare whether patients presenting with AFFs to our trauma unit have significantly different short-term outcomes to patients with TFFs, with a focus on social outcomes including length of stay and discharge destination, as well as assessing inpatient and 30-day mortality.

## Methods

We performed a retrospective observational cohort study for patients with AFFs versus TFFs presenting to our trauma unit over a 9-month period from November 2015 to July 2016. Patient data were collected from the National Hip Fracture Database and local electronic and paper records. All patients with proximal femoral fractures including fractured neck of femur were identified.

Radiographs were assessed independently by 3 observers and atypical proximal femoral fractures identified using the radiographic parameters described by the ASBMR (Table 1). Typical femoral fractures included all other fractures involving the proximal femur including extracapsular neck of femur fractures. Exclusion criteria were intracapsular fracture neck of femur, periprosthetic fractures, associated malignancy, or pathological fracture.

Records were analyzed to include patient age, sex, American Society of Anaesthesiology (ASA) grade, cognitive score using the abbreviated mental test score (AMTS), bisphosphonate use, preinjury residence, operation performed, length of stay, discharge destination, and mortality.

Our primary outcome measures included length of stay, discharge destination (own home or health-care institution), and 30-day mortality. Categorical data were analyzed using $\chi^2$ test and Fisher exact test and continuous nonparametric data using the Mann-Whitney $U$ test. Data were collated on Microsoft Excel version 2016.

## Results

Two hundred thirty-nine patients presented to our trauma unit during the 9-month assessment period with either a fractured neck of femur or proximal femoral fracture. A total of 25 (10.5%) patients displayed atypical radiographic features consistent with AFF. One hundred twenty-two patients were identified as having pertrochanteric, subtrochanteric, or proximal femoral shaft fractures, of which AFF accounted for 20.5%. All

**Table 2.** Baseline Characteristics of Patients With Atypical and Typical Femoral Fractures.

| | AFF (n = 25) | TFF (n = 97) |
|---|---|---|
| Mean age (years) | 86.2 | 86.6 |
| Female, n (%) | 21 (84%) | 75 (75%) |
| Side of injury, n (%) | 14 (56%) right | 49 (50%) right |
| ASA grade (median) | 3 | 3 |
| Admitted from own home, n (%) | 23 (92%) | 86 (89%) |
| AMTS score on admission | 7.08 | 7.03 |

Abbreviations: AFF, atypical femoral fracture; AMTS, abbreviated mental test score; ASA, American Society of Anaesthesiology; TFF, typical femoral fracture.

**Table 3.** Short-Term Outcomes of Patients With Atypical and Typical Femoral Fractures.

| | AFF (n = 25) | TFF (n = 97) |
|---|---|---|
| Mean length of stay (days) | 14.3 | 12.5 |
| Return directly to home on discharge, n (%) | 9 (36.0%) | 44 (45.5%) |
| 30-day mortality, n (%) | 3 (12.0%) | 8 (8.2%) |

Abbreviations: AFF, atypical femoral fracture; TFF, typical femoral fracture.

injuries were unilateral; however, in 1 patient we noted contralateral AFF previously fixed via intramedullary nailing prior to our study time frame. The right leg was injured in 50% of TFF cases compared to 56% of AFF cases.

Table 2 shows the baseline characteristics of both groups. The 2 groups were similar in demographics, ASA grade, and function. Patient average age (TFF 86.6 years vs AFF 86.2 years), gender (25% vs 16% male), median ASA grade (3.0 vs 3.0), cognitive score (AMTS score 7.03 vs 7.08), and preinjury residence (88.7% vs 92.0% own home) were similar with no statistically significant difference ($P$ values > .05). Typical femoral fractures were fixed with either dynamic hip screw (75.3%) or intramedullary nailing (24.7%), whereas all AFFs were fixed with intramedullary nailing. No immediate intraoperative complications were identified. Preinjury bisphosphonate use was higher in the AFF group compared to the TFF group (24% vs 10%).

Table 3 shows the short-term postoperative outcomes of both groups. Mean length of stay in the TFF group was 12.5 days compared to 14.3 days in the AFF group (Figure 1). In the TFF group, 45% of patients returned directly to their own home on discharge compared to 36% in the AFF group (Figure 2). A 30-day mortality rate for TFF and AFF groups, respectively, was 8.2% versus 12.0% (Figure 3). For all primary outcome measures, there was no statistically significant difference ($P$ values > .05).

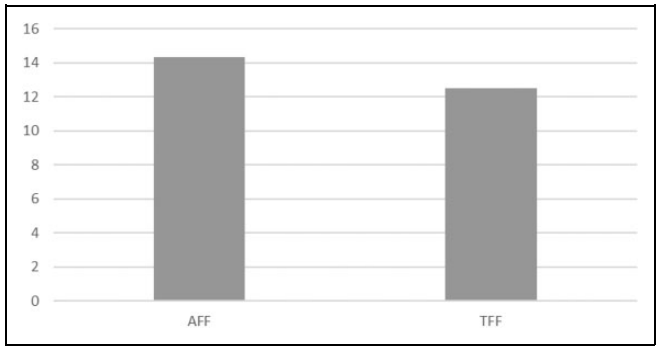


**Figure 1.** There was no significant difference between the average length of stay of the 2 groups (AFF 14.3% vs TFF 12.5%). AFF indicates atypical femoral fracture; TFF, typical femoral fracture.

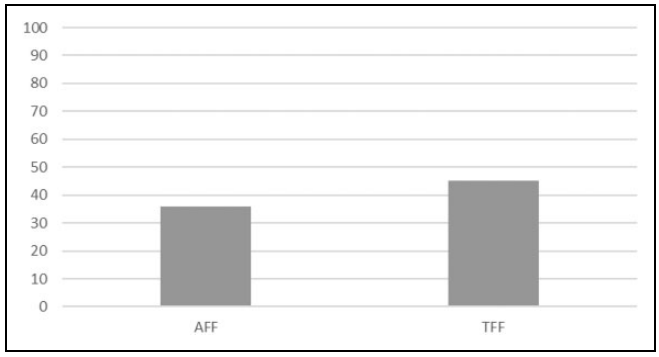


**Figure 2.** There was no significant difference between the proportion of the 2 groups discharged to their own home (AFF 36.0% vs TFF 45.5%). AFF indicates atypical femoral fracture; TFF, typical femoral fracture.

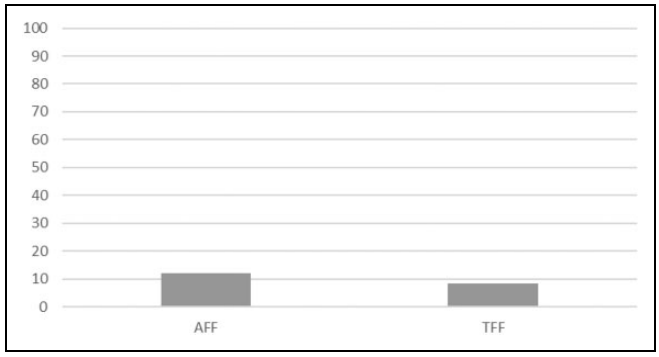


**Figure 3.** There was no significant difference between the 2 groups for 30-day mortality rate (AFF 12.0% vs TFF 8.2%). AFF indicates atypical femoral fracture; TFF, typical femoral fracture.

## Discussion

A 10% incidence of AFFs was identified in fractures of the proximal femur and femoral shaft in this patient cohort. This is comparable to the 7% incidence reported by Thompson et al in their retrospective analysis of 3515 patients. However, there is significant variability with others reporting much lower rates of 0.4% to 1.43%.[9,14,15] The reason for this inconsistency in incidence is unclear but may relate to local variation in bisphosphonate usage or utilization of alternative diagnostic criteria.

Patient demographics were similar in the AFF and TFF groups in all criteria examined. This is in contradiction to

previous studies, which have shown AFFs occurring more frequently in women.[13,14] This is thought to occur as a result of the increased biomechanical stress placed on the lateral femoral cortex in women compared to men because of a broader pelvis and relatively narrower bone.[13]

All AFFs were managed with intramedullary nailing, which is in line with National Institute for Health and Care Excellence guidance on the management of subtrochanteric proximal femoral fractures.[16] No intraoperative complications were identified which is in contrast to the 29.4% rate of iatrogenic fracture during intramedullary nail insertion reported by Prasarn et al in their assessment of 43 AFFs.[10]

No significant difference in terms of length of stay, discharge destination, and 30-day mortality was identified between the AFF and TFF groups. This contradicts many previous studies which have indicated generally poorer outcomes with AFFs but does concur with a recent study performed by Khow et al who retrospectively analyzed 710 hip fracture patients presenting to their unit and found that AFFs had comparable outcomes in terms of mobility, complications, length of stay, mortality, and discharge destination when compared to TFFs.[9,10,11,12]

This study has shown interesting results but does have several limitations. Firstly, small patient numbers resulting from the relative rarity of AFFs makes it difficult to draw firm accurate conclusions from the results. This is further compounded by a single-center data collection model, as data become limited to certain demographics and an element of selection bias is introduced. Finally, the decision to perform a retrospective analysis means data could be prone to observer bias and missing data. Overall, however, we believe our data, which concur with the reports from Khow et al,[9] suggest that with modern principles of trauma care outcomes achieved following AFFs may be equivalent to typical femoral fractures in the geriatric population.

## Conclusion

In our predominantly geriatric population, comparable short-term social outcomes and mortality rates were observed in patients sustaining AFFs compared to those with TFFs. Larger patient numbers are required to confirm these findings and could perhaps be achieved through analysis of National Hip Fracture Database data after isolating AFFs.

### Declaration of Conflicting Interests

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### References

1. Desai PA. Atypical femoral fractures: a review of the literature. *Curr Osteoporos Rep*. 2013;11(3):179-187. doi:10.1007/s11914-013-0167-y.
2. Sheibani-Rad S. Femoral fractures following long-term bisphosphonate use. *Orthopedics*. 2016;39(6):e1036-e1040. doi:10.3928/01477447-20160811-05. Epub 2016 Aug 18.
3. Jin A. The Effect of long-term bisphosphonate therapy on trabecular bone strength and microcrack density. *Bone Joint Res*. 2017;6(10):602-609.
4. Odvina CV. Severely suppressed bone turnover: a potential complication of alendronate therapy. *J Clin Endocrinol Metab*. 2005;90(3):1294-1301.
5. Odvina CV, Levy S, Rao S, Zerwekh JE, Rao DS. Unusual mid-shaft fractures during long-term bisphosphonate therapy. *Clin Endocrinol (Oxf)*. 2010;72(2);161-168.
6. Koh A, Guerado E, Giannoudis PV. Atypical femoral fractures related to bisphosphonate treatment: issues and controversies related to their surgical management. *Bone Joint J*. 2017;99-B(3):295-302. doi:10.1302/0301-620X.99B3.BJJ-2016-0276.R2.
7. Shane E, Burr D, Ebeling PR, et al; American Society for Bone and Mineral Research. Atypical subtrochanteric and diaphyseal femoral fractures: report of a task force of the American Society for Bone and Mineral Research. *J Bone Miner Res*. 2010;25(11):2267-2294.
8. Shane E, Burr D, Abrahamsen B, et al. Atypical subtrochanteric and diaphyseal femoral fractures: second report of a task force of the American Society for Bone and Mineral Research. *J Bone Miner Res*. 2014;29(1):1-23.
9. Khow KS, Paterson F, Shibu P, Yu SC, Chehade MJ, Visvanathan R. Outcomes between older adults with atypical and typical femoral fractures are comparable. *Injury*. 2017;48(2):394-398.
10. Prasarn ML, Ahn J, Helfet DL, Lane JM, Lorich DG. Bisphosphonate-associated femur fractures have high complication rates with operative fixation. *Clin Orthop Relat Res*. 2012;470(8):2295-2301.
11. Weil YA, Rivkin G, Safran O, Liebergall M, Foldes AJ. The outcome of surgically treated femur fractures associated with long-term bis-phosphonate use. *J Trauma*. 2011;71(1):186-190.
12. Subramanian S, Parker MJ. Atypical femur fractures—Patient characteristics and results of intramedullary nailing for a series of 21 patients. *Acta Orthop Belg*. 2016;82(2):376-381.
13. Schilcher J, Koeppen V, Aspenberg P, Michaëlsson K. Risk of atypical femoral fracture during and after bisphosphonate use. *Acta Orthop*. 2015;86(1):100-107.
14. Thompson RN, Phillips JR, McCauley SH, Elliott JR, Moran CG. Atypical femoral fractures and bisphosphonate treatment: experience in two large United Kingdom teaching hospitals. *J Bone Joint Surg Br*. 2012;94(3):385-390.
15. Giusti A, Hamdy NA, Dekkers OM, Ramautar SR, Dijkstra S, Papapoulos SE. Atypical fractures and bisphosphonate therapy: a cohort study of patients with femoral fracture with radiographic adjudication of fracture site and features. *Bone*. 2011;48(5):966-971.
16. National Institute for Health and Clinical Excellence. *Hip Fracture: Management*. NICE guideline (CG124); 2011. https://www.nice.org.uk/guidance/cg124. Accessed December, 2018.