Vol 6 | Issue 2 | Pages 542-546

Journal of Orthopedic Surgery and Techniques

ISSN: 2578-7187

Case Report

DOI: 10.36959/453/607

An Atypical Iatrogenic Fracture Pattern: A New Modification of Mallory Classification for Intraoperative Femoral Fracture

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Abstract

Background: With increasing global life expectancy, more hip arthroplasty surgeries were performed for osteoarthritis and femoral neck fractures. Iatrogenic femoral fractures are not uncommon especially during insertion of cement less femoral stem. Correct identification of fracture pattern and stable fixation is required to promote fracture healing and allow early weight bearing.

Case presentation: We report a 92-year-old patient who sustained a displaced femoral neck fracture and was initially planned for cement less hip hemiarthroplasty, but was complicated with an iatrogenic intra-operative femoral fracture during stem impaction. The fracture pattern was misrecognized as a Mallory type II fracture intra-operatively and was treated with exchange to cemented prosthesis and cerclage wiring. Post-operative imaging however showed cement extrusion at lateral femoral shaft indicating an atypical fracture pattern exiting at lateral femoral shaft. Revision locking plate fixation without prosthesis exchange was subsequently performed to enhance fixation stability. She eventually made good functional recovery.

Conclusion: This case illustrates an atypical intra-operative femoral fracture pattern during femoral stem insertion, that was not previously reported in the literature. We propose a new modification of the current modified Mallory classification, adding a type V indicating extension to lateral cortex of femoral shaft. Surgeons should be aware of the exact fracture pattern, especially atypical ones, to ensure adequate fixation and implant stability. Imaging or further exploration should be utilized when in doubt.

Keywords

Arthroplasty, Elderly, Hip fracture, Periprosthetic Fractures, Trauma

Introduction

The global life expectancy is increasing and consequently, there are more hip arthroplasty performed for conditions such as osteoarthritis and femoral neck fractures. For the elderly population, displaced intracapsular fractures of the neck of femur can be treated with cemented or uncemented hemiarthroplasty. The rise in number of hip arthroplasty performed will inevitably lead to an increase in the incidence of periprosthetic femur fractures. Periprosthetic proximal femoral fractures, along with infection, aseptic loosing and dislocation can cause early failure of hip prosthesis [1]. There is an increased morbidity and mortality associated with periprosthetic femoral fracture [2], as well as increased financial burden on the healthcare economics [3]. We report an elderly patient with a fractured neck of femur, initially planned for an un cemented hip hemiarthroplasty but was complicated with an iatrogenic intraoperative a typical periprosthetic fracture pattern, subsequently requiring an open reduction and internal fixation.

Case Presentation

A 92-year-old female, premorbid walks with stick, presented with left hip pain following an accidental slip and fall at home in April 2022. Radiograph showed a displaced fracture of the left neck of femur (Figure 1).

She underwent a left hip bipolar cement less hemiarthroplasty by posterior approach, however, during

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Accepted: August 07, 2023

Published online: August 09, 2023

Citation: Tam JPH, Chung MMT (2023) An Atypical Iatrogenic Fracture Pattern: A New Modification of Mallory Classification for Intraoperative Femoral Fracture. J Orthop Surg Tech 6(2):542-546

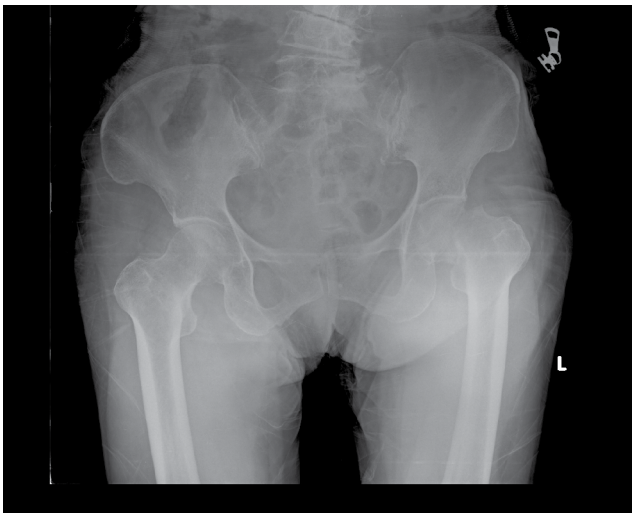

Figure 1: Pre-operative Pelvis Radiograph (Anterior-Posterior).

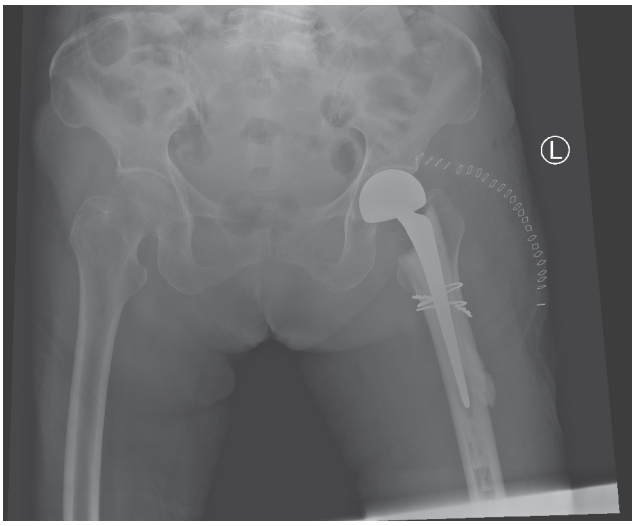

Figure 2: Post-operative Pelvis Radiograph (Anterior-Posterior).

the broaching of the femoral stem (Stryker Accolade II), an iatrogenic longitudinal split fracture over the lateral femoral cortex was noted (Intraoperative periprosthetic femoral fracture Vancouver B2 type). The implant was exchanged to an Exeter cemented stem and the fracture was fixed with two cerclage wires. Post-operative radiograph showed cement extrusion over the lateral cortex of the femoral shaft (Figure 2). Computerised Tomography confirmed a vertical split fracture exiting the lateral femoral shaft at the stem tip level with no distal extension and a stable cement mantle (Figure 3).

Due to the inadequate stability of the stem with an anterior-posterior fracture exiting distal to the cerclage wires placed during the index operation, the patient required a revision surgery. She was placed in a lateral decubitus position under general anaesthesia. A posterolateral approach to the hip extended down to the knee was used following the previous incision. Cement extrusion was excised and loose cerclage wires were removed. Internal fixation was done using a 4.5 mm curved broad locking compression plate, proximal femur fixed with locking attachment plate, and augmented with two additional cerclage wires (Figure 4). She was allowed full weight bear walking and was able to walk with stick 1 week post-operatively.

Discussion

In our centre, an uncemented femoral stem for hip hemiarthroplasty is preferred given our past experience with intraoperative bone cement implantation syndrome, cardiopulmonary complications related to cementation in an elderly patient. Cemented stem are used for patients with severe osteoporosis, chronic kidney disease or history of malignancy. The estimation of periprosthetic fracture amongst different implants varies due to the wide range of stem designs available, but it is well known that un cemented stem increases the risk of periprosthetic fractures, with risks averaging ~10% compared with ~2% in cemented stems. Multiple literatures concludes common risk factors for

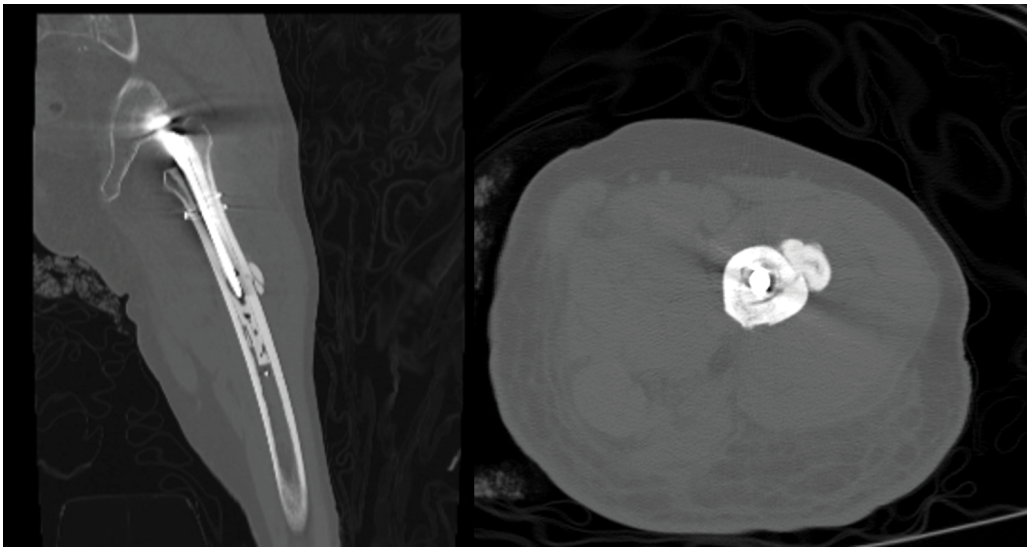

Figure 3: Post-operative CT.

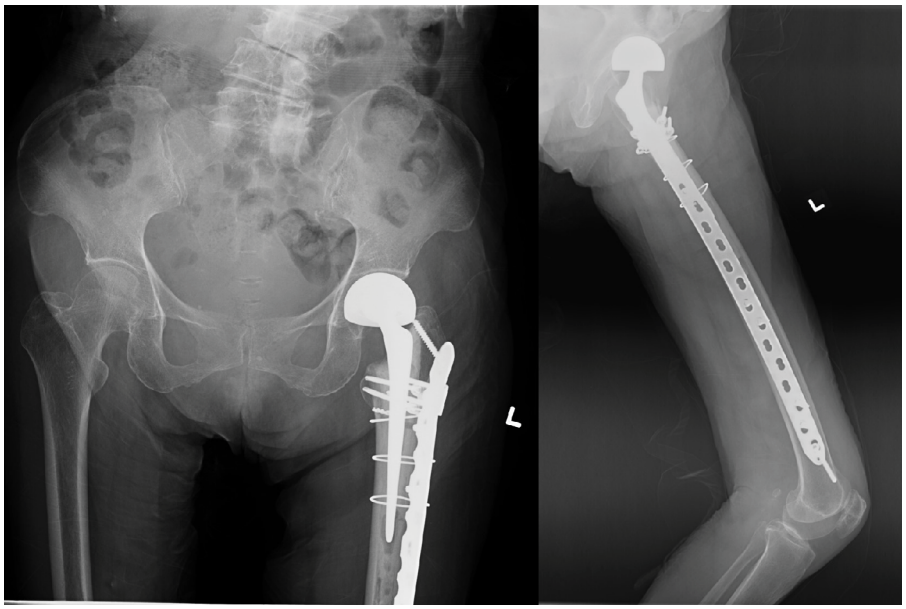

Figure 4: Post-revision Radiograph.

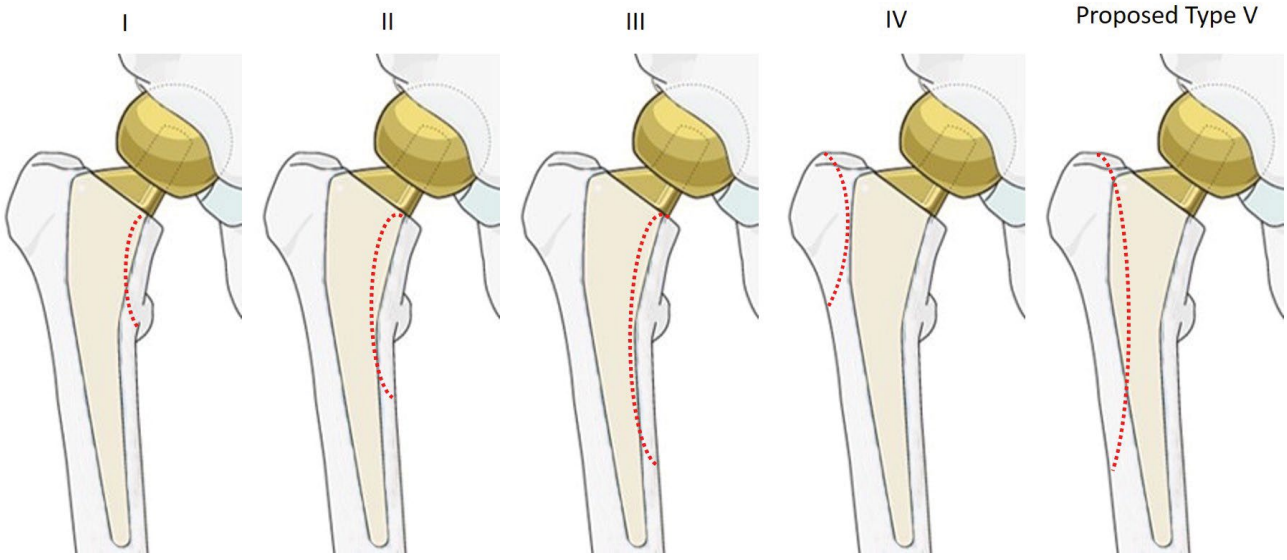

Figure 5: Proposed Mallory Classification.

periprosthetic fractures include female sex, advanced age, osteoporosis, Dorr B/C femur morphology, smaller stem and American Society of Anaesthesiologists grade 3 or higher.

The Vancouver classification is a common and widely used classification when describing intraoperative or postoperative periprosthetic fractures around the femoral stem. It is based on the fracture location, configuration and implant stability. For intraoperative periprosthetic fractures, type A involves the proximal metaphysis, type B if diaphyseal and type C if the fracture is distal to the tip of the femoral stem. Each type can be further subdivided into 1, 2 and 3 depending on the fracture configuration. Mallory intraoperative femoral fracture is also another known classification. Type I is a 1-2 cm calcar fracture at the lesser trochanter. Type II is a fracture at the lesser trochanter extending more than 3 cm distally towards the femoral stem. Type III is a fracture extending 4 cm or more distally towards the medial femoral stem, and a type IV fracture a fracture at the greater trochanter.

In this case, the intraoperative fracture was mis-recognised as a longitudinal split fracture fracture at the diaphyseal level with no extension (Vancouver B2 type), and treated with a cerclage wiring. However, post-operative radiograph showed a fracture over the lateral femoral stemat the tip level with cement extrusion. This atypical fracture pattern has not been reported previously in literature, and doesn't fit into the original Mallory [4] nor the modified Mallory classification [5]. There are a few plausible cause for this atypical pattern; despite adequate broaching, the

stem was placed in a varus position thus concentrating more stress at the lateral cortex, Asian population have increased femoral bowing in the coronal and sagittal plane [6] which concentrates cortical stress at the anterior and lateral cortex, thus increasing the risk for fracture. In view of this atypical pattern, we propose to modify and add this as a type V to the Mallory classification (a fracture at the lateral femoral stem, Figure 5). This highlights the importance of acquiring intra-operative imaging and if the fracture pattern is unclear, surgeons should explore further to identify the exact fracture pattern to ensure optimal method of fixation and reduce the incidence of a revision surgery.

When cortical perforations occur in the lateral or anterior cortex of the subtrochanteric region, the stress is typically higher and predisposes to a crack. Treatment options for intraoperative Vancouver type B2 fracture include multiple cerclage wires, open reduction and internal fixation (ORIF) with plate with or without allograft strut fixation, or a long stem revision arthroplasty bypassing the most distal fracture line by at least two cortical femoral diameters. Reducible fracture with adequate bone stock may be treated with ORIF alone which is a quicker and less technically demanding than revision arthroplasty [7], this was the choice of fixation in this case. When plating alone is compared with revision arthroplasty, Joestl, et al. showed a 100% union rate with ORIF with no subsequent metalwork failure. The combination of shorter operating time and satisfactory healing rate makes ORIF a good alternative for elderly who typically has multiple co-morbidities [8].

The presence of osteoporosis increases the difficulty for initial fracture fixation and bone healing. A solution to improve the bone stock is bone graft. Bone graft, which can be in the form of an autograft or allograft, may improve fracture healing and stability. Allograft is typically prefered over autograft due the to lower donor-site morbidity and better availiability, and is commonly applied in morselised form or strut graft [9]. A combination of cancellous and cortical strut graft has been shown to acclerate fracture healing, provides greater stability and less stress shielding when compared to isolated plating [10]. Union rate of 96.6% at a mean of 8.4 months post-operatively has been reported. Cortical graft is less biologically active than cancellous bone graft as the reduced porosity, surface area and cellular matrix prolongs the time to revascularisation. Therefore, it will take much longer for cortical bone graft to incorporate into host bone when compared to cancellous bone graft. Impaction with morselised cancellous bone graft may provide an easier option to augment bone healing. In a series of 144 periprosthetic Vancouver B2 and B3 fractures treated with long stem revision and cancellous bone graft, it was shown to unite more likely when compared with treating with cemented long stem revision alone [11].

Pre-operative and intra-operative assessment is crucial in this group of patients who often present with other co-morbidities such as osteoporosis, which is a known risk factor for periprosthetic fracture [12]. Principles in managing intraoperative periprosthetic fracture include ensuring the stability of the stem and fracture; preventing fracture propagation and maintaining alignment [13]. There are different approaches to weight bearing status post-operatively. Some advocate partial weight bearing, whilst some prefer full weight bearing, or weight bearing as tolerated. Weight bearing status can be adjusted according to the quality of fixation and bone assessed intraoperatively, and taking into consideration the general condition of the patient. Surgeons should be aware that prolonged protective weight bearing may lead to pressure sore injury or hospital acquires pneumonia, further complicating the recovery of the patient.

Conclusion

Periprosthetic fractures are becoming increasingly common and lead to increased morbidity and mortality. This case illustrates a pattern previously not reported in the literature and may be added to current classification. Surgeons should be aware of iatrogenic intraoperative periprosthetic fractures and use imaging or explore further if in doubt of the fracture pattern, especially if it is an atypical pattern. There are recommended algorithms for specific types of periprosthetic fracture based on the fracture pattern but treatment should be individualised to minimise morbidity and mortality.

Declaration

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article. The author(s) received no financial support for the research, authorship, and/or publication of this article. This case report is compliant with local ethical standards. Consent was obtained from patient for publication of this case report.

Ethics

Written informed consent was obtained from the patient for publication of this case report and any accompanying images.

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