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Case Report

The Consequences of Subtrochanteric Fracture with Suboptimal Surgical Fixation Leading to Multiple Surgical Revisions: A Case Report

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Abstract

Subtrochanteric fractures are relatively rare and challenging for orthopedic surgeons. Failing to achieve proper alignment during surgery can result in devastating sequela and necessitate more complex reoperation. We present a case of a 50-year-old man with a history of diabetes and hypertension who suffered a right subtrochanteric fracture after a motor vehicle collision. He was treated with intramedullary fixation of the femur. Upon follow-up, the fracture was complicated by nonunion due to improper alignment and fixation method at the index procedure. Two attempts at revision with nailing and plating failed. Ultimately, we treated the patient with a revision nailing and autograft of the nonunion site which led to a desirable outcome and union of the fracture. This case highlights the complex and challenging nature of subtrochanteric fractures, which can require multiple interventions, consideration of underlying medical conditions, and perseverance in treatment before achieving successful outcomes.

Keywords: Fixation Failure; Modes of Fixation; Nonunion; Malalignment; Subtrochanteric Fracture

Abbreviations

IM: Intramedullary; AP: Anterior to Posterior

Introduction

Subtrochanteric fractures are classically defined as fractures occurring between the lesser trochanter and 5 cm distal to the shaft of the femur [1]. These fractures tend to exhibit a characteristic deformity at the fracture site, due to the muscular deforming forces. [1] They remain a challenge to orthopaedic surgeons due to the short proximal fragment and high biomechanical forces, there's an added risk of implant failure, which further complicates their treatment [1]. Although the literature rarely reports nonunion rates stemming from unsuccessful treatments, some studies estimate the rate as high as 7-20% when defined as implant or fixation failure, or nonunion within six months postoperatively [2]. Addressing nonunion revision remains a highly demanding task that necessitates a comprehensive understanding and analysis of fracture and fixation biomechanics. Wang and associates compared different fixation modalities to fix these fractures. They concluded that proximal femoral nailing was the most biomechanically favorable device to fix subtrochanetric femur fractures [3]. Krappinger and associates concluded that intraoperative correction of the varus malalignment and restoration of the medial cortical support were the most critical factors that can prevent nonunion after intramedullary nailing of subtrochanteric femoral fractures [4]. In this context, we present a case of a subtrochanteric fracture that progressed through multiple stages of nonunion and implant failure, presenting it with a 10 year follow-up period.

Case Presentation

A 50-year-old man with a history of diabetes mellitus and hypertension sustained a right subtrochanteric fracture following a high-speed motor vehicle accident in 2013 (Figures 1A and 1B). Trochanteric intramedullary (IM) nailing with two standard interlocking screws proximally and distally was done (Figures 1C and 1D) On follow-up, signs of proximal hardware failure started to manifest in the form of progressive varus deformity (Figure 2). Exchange nailing was performed with reconstruction screws (Figures

3A and 3B). He was followed over one year and did not show any signs of healing. He also showed signs of fatigue implant failure (Figures 3C and 3D). Open reduction and internal fixation were performed using a nonlocking proximal femur plate and screws, which also failed on follow-up (Figure 4). During work up, the patient was found to have hyperparathyroidism, which was referred to and managed by an endocrinologist. Afterward, the patient underwent implant removal, sampling to rule out infection, and open reduction and nailing with bone grafting (Figure 5). Subsequent follow-up visits showed no signs of healing at six weeks and three months. The patient had lost follow-up and had only returned to the clinic after three years postoperatively, with radiography showing healing of the fracture. Clinically, the patient has regained mobility without pain, and reported self-rated improvement and ability to do activities of daily living.

Materials and Figures

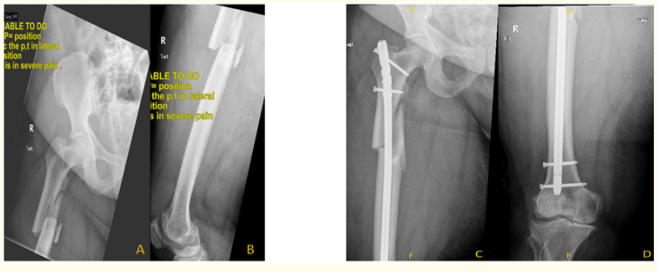

Figure 1: (A) AP and (B) lateral radiography views showing B3.1 subtrochanteric fracture with medial wall comminution; (C) AP radiograph of proximal femur and distal femur; (D) Postoperative X-ray showing intramedullary nailing with proximal locking involving two standard interlocking screws and two distal interlocking screws.

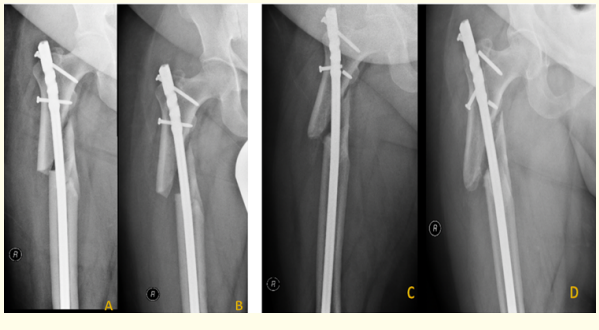

Figure 2: (A and B) AP radiograph of proximal right femur showing varus deformity with implant failure and nonunion; (C and D) AP radiograph of right proximal femur showing broken proximal screws.

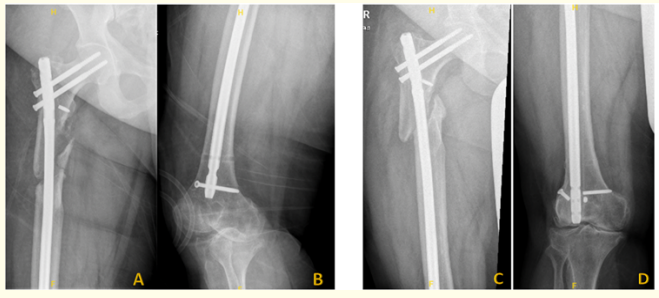

Figure 3: Postoperative radiographs of right proximal femur (A) and distal femur (B) showing interlocking nail locked proximally with two recon screws and one distal interlocking screw. AP radiographs of right proximal femur (C) and distal femur (D) after one year showing mild varus displacement (A) and evidence of a broken distal interlocking screw (D).

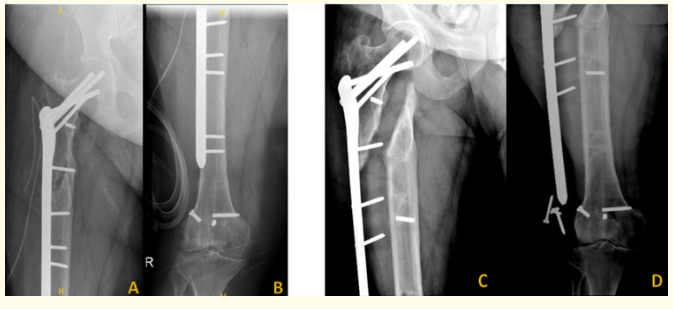

Figure 4: Postoperative radiographs of right proximal femur (A) and distal femur (B) showing fixation with proximal femur locking plate. AP radiographs showing complete failure of the implant with (C) and (D) back out of plate with the screws.

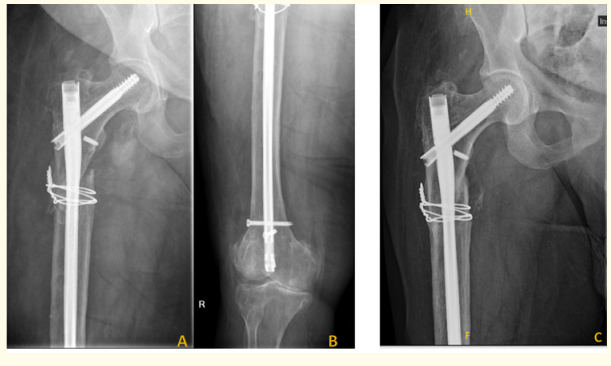

Figure 5: Immediate postoperative radiographs showing cephalomedullary nailing with cerclage wire proximally (A) locked with distal interlocking screws distally (B). (C) AP radiographs of right proximal femur showing complete union three years postoperatively.

Results and Discussion

We presented the case evolution of a middle-aged man with a complicated subtrochanteric fracture, which was eventually successfully treated with IM nailing and cerclage wire, resulting in an excellent outcome one year postoperatively after years of failure and nonunion. This paper also follows his healing evolution for 10 years. Subtrochanteric femoral fractures pose significant challenges in treatment, with a complication rate of 19%- 32% [3]. Several issues may arise, making healing difficult in subtrochanteric fractures. Eccentric loading on the femoral head generates axial and bending forces, leading to compressive stress on the posteromedial cortex and tensile stress on the lateral cortex of the subtrochanteric region. During muscle contraction, hip joint reaction can reach three times body weight [5], and the subtrochanteric area experiences the highest stress concentration in the human skeleton, estimated to reach 1200 lb/in2 [6]. This high stress concentration can lead to implant fatigue and eventual failure if the fracture does not heal promptly. Moreover, the subtrochanteric area primarily consists of cortical bone, which has a lower blood supply compared to cancellous bone. Additionally, strong muscle attachments exert deforming forces in this region [3]; these include iliopsoas and glutei, which contribute to flexion and external rotation of the proximal fracture segment, as well as the adductors and hamstrings, which cause adduction and shortening of the distal fragment, respectively. Therefore, it is challenging to maintain fragment stability while allowing some micromotion at the fracture site to promote callus formation and accelerate the healing process [3]. Over the years, various devices have been developed to address subtrochanteric fractures, with cephalomedullary nails becoming the primary treatment option due to their minimally invasive nature and stable fixation, with a healing rate of up to 95% [7]. Although percutaneous fixation reduces surgical time and minimizes blood loss while preserving soft tissue and periosteum integrity, which is crucial in a poorly vascularized region, IM nailing demonstrates superior stability compared to other fixation methods [3]. However, complications such as malunion, nonunion, and implant failure can occur. The overall incidence of nonunion or delayed union in subtrochanteric fractures is 7%-20%. Park and associates found a significant difference in nonunion incidence based on fracture severity and displacement in radiographic views, but not patient-related factors [2]. Risk factors for nonunion following IM nailing include varus malalignment, lack of medial cortical support, and autodynamization of the nail 12 weeks post-surgery [4]. Additionally, chronic diseases (e.g., diabetes mellitus) were found to contribute to delayed union and nonunion [8]. We believe that the main reason for our patient's long treatment journey was that the initial procedure was done suboptimally, as the varus malalignment was likely caused by the lateralized entry of the nail and the use of standard-locking-mechanism screws, which gave the fixation device an unnecessary disadvantage of short working length. Cerclage wire can facilitate anatomic reduction and stabilization, preserving vascular supply, and reducing varus malreduction and implant failure rates [9]. Our patient experienced delayed union, which might be attributed to his comorbidities and the type of surgery he underwent. Halvachizadeh and associates found that open reduction and internal fixation (OR = 6.17, 95% CI: 1.54-24.70, p = 0.01) and type 2 diabetes mellitus (OR = 5.74, 95% CI: 1.39-23.72, p = 0.016) were independent risk factors for delayed union [8]. 4 of 5 Our current study poses a few limitations. First, it is a case report of a single patient experience. Second, the case was further complicated by the presence of an underlying endocrinological issue. Third, our patient had missed a periodof 3 years of follow-up, where it is unclear whether or not he sought different medical opinions and unclear whether the medical management has had an additional effect on the patient's healing. As far as we are aware, this case was managed at a single facility by the same surgeon. This facility is a well-known tertiary facility and training and referral center that exhausts all efforts in treating complex trauma cases around the region.

Conclusion

Achieving anatomical reduction, preventing medial wall collapse using cerclage wire, and selecting a more medial entry point all contributed to the satisfactory outcome observed in our patient, despite the literary consensus leaning towards planning to the contralateral femur. This case report highlights the complex and difficult nature of subtrochanteric fractures, which frequently necessitate many treatments, evaluation of underlying medical issues, and persistence in therapy before obtaining positive outcomes. In our case, this took about 10 years of follow-up. In addition, it highlights the importance of pre-operative planning prior to cases with higher risk of failure.

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Conflict of Interest

Disclosures

- **Human subjects:** Consent was obtained or waived by all participants in this study.
- **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following:
- **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work.
- **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work.
- **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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