

Challenges in Subtrochanteric Femur Fracture Management: A Case Report of Inappropriate Implant Choice Leading to Fixation Failure and Update on Management Options

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Case Report

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ABSTRACT

Subtrochanteric fractures of the femur remains one of the most challenging fractures encountered by orthopaedic surgeons. They account for 10 to 15% of all hip fractures. Subtrochanteric region of the femur is defined as the proximal femoral shaft located within 5 cm of the lesser trochanter. It is common in older patients after low energy trauma along with osteoporosis and in younger patients with high energy trauma. The management of subtrochanteric fractures is challenging because of the inherent instability of the fracture pattern. Fractures to this area can result in significant complications and poor clinical outcomes such as failure of fixation, shortening, malrotation and non-union if not managed properly and inappropriate choice of implant was used. We are presenting a case report of an elderly lady with history of alleged fall in bathroom at home and sustained closed left subtrochanteric femur fracture. She was initially planned for dynamic hip screw fixation however choice of implant was changed to interlocking femoral nail during preoperative census meeting. Patient underwent interlocking nail of left femur. Intraoperative

reduction was satisfactory. However, on day 1 postoperative was noted that distal femur was externally rotated and proximal femoral fragment displaced in valgus direction. There was a failure of fixation and patient was counselled for operation in which patient's family declined and opted for conservative management. The purpose of this presentation is to highlight the challenges, examine the various treatment modalities and implant options in treatment of subtrochanteric femur fracture for optimal postoperative outcome.

Keywords: *Subtrochanteric fractures; hip fractures; proximal femoral fractures; trochanteric fractures; muscle forces; stresses.*

1. INTRODUCTION

Hip fractures rank in the top ten of all impairments worldwide in terms of loss in disability-adjusted years for people over 50 years old [1]. Consequences of hip fractures are significant in terms of loss of life and the associated negative impacts on hip fracture patients' quality of life and level of functioning [2]. Subtrochanteric fracture of the femur is a variant of peritrochanteric fracture of the femur [3]. It lies in the area which is 5cm below the lesser trochanter and may extend proximally into the intertrochanteric area and distally up to the isthmus of the shaft of the femur [4]. A bimodal age distribution is noted where young patients (usually male) mostly present with high-energy injuries, and the elderly (usually female) present with low-energy injuries and osteoporotic bone [5]. Subtrochanteric fractures of the femur remains one of the most challenging fractures encountered by orthopaedic surgeons. The management of subtrochanteric fractures is challenging because of the inherent instability of the fracture pattern and this area experience high levels of stress due to large muscular deforming forces on the proximal and distal fragments which render reduction difficult. During normal activities of daily living, up to 6 times the body weight is transmitted across the proximal femoral region of the femur [6]. Fractures to this area can result in significant complications and poor clinical outcomes such as failure of fixation, shortening, malrotation and non-union if not managed properly and inappropriate choice of implant was used. A multitude of different intra- and extramedullary devices for their surgical fixation have been advocated.

2. PRESENTATION OF CASE

An 85 years old lady with no medical comorbidities presented to us with history of alleged fall in bathroom at home due to slippery floor. Post trauma she was unable to ambulate and weight bear. On examination, her vital signs were stable and left hip was swollen with limited

range of motion due to pain. Distal pulses otherwise palpable and neurology of bilateral lower limbs were normal. X ray of pelvis showed left subtrochanteric femur fracture with oblique extension to lesser trochanter as shown in Fig. 1. X ray of left femur showing subtrochanteric femur fracture with proximal fragment tilted anteriorly. She sustained closed left subtrochanteric femur fracture and was initially planned for dynamic hip screw fixation however choice of implant was changed to interlocking femoral nail during preoperative census meeting. Patient underwent interlocking nail of left femur and intraoperatively noted bone loss with short oblique fracture extending to the lesser trochanter. Reduction was satisfactory when checked with image intensifier intraoperatively. However, post-operatively after check x ray was done noted distal femur was externally rotated and proximal femoral fragment displaced in valgus direction as shown in Fig. 3. There was a failure of fixation and patient was counselled for operation (Removal of implant and reverse dynamic condylar screw fixation) in which patient's family declined and opted for conservative management. On day 5 postoperatively noted there was femoral nail backout a shown in Fig. 4.



Fig. 1. Plain radiograph of pelvis showing left subtrochanteric femur fracture with oblique extension to lesser trochanter

Patient was again counselled for operation in which she refused. Patient was seen again in clinic 1 week after discharge and patient was bedridden and non-ambulatory since discharged. Patient is counselled back for operation in which patient and family refused. Patient is currently still under follow up to monitor her condition and wellbeing.



Fig. 2. Plain radiograph of left femur showing subtrochanteric femur fracture with proximal fragment tilted anteriorly

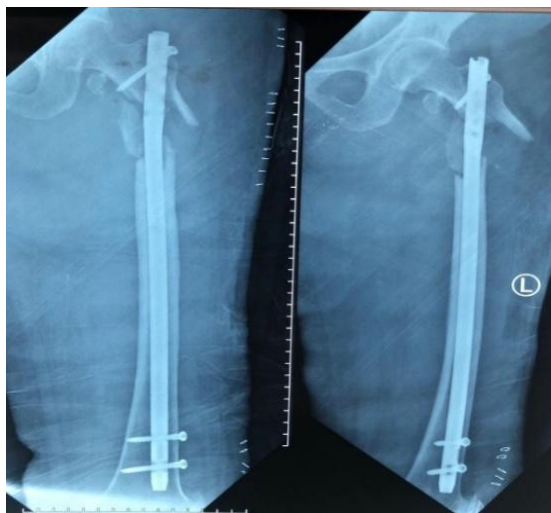


Fig. 3. Plain radiograph taken on Day 1 postoperative showing distal femur was externally rotated and proximal femoral fragment displaced in valgus direction

3. DISCUSSION

Subtrochanteric fracture of the femur accounts for 10-15% of all hip fractures [7].

Subtrochanteric fracture occurs at the junction between the trabecular bone and cortical bone where the mechanical stresses are highest in the femur. High compressive medial stresses and tensile lateral stresses were placed on fracture fixation devices. Therefore, a medial buttress is important to minimise implant stress and fatigue failure [8]. It is difficult to treat these fractures conservatively and surgical management is the current standard of care [9]. A decision to forego surgery may have profound sequelae, as conservative management of hip fracture is associated with a high risk of hip displacement, increased pain and loss of mobility [10-12]. Conservative management is indicated only for patients who present late with a fracture that has begun to heal, are moribund, lack prospects for any functional recovery, or decline surgery [13,14].



Fig. 4. Plain radiograph taken on day 5 postoperative showing femoral nail backout

The primary goal of surgical management is to provide the anatomical restoration of the normal abductor-lever-arm mechanism of the hip joint [15]. Surgical fixation maintains good anatomical alignment, limb length and avoids complications of prolonged bed rest as early mobilization and weight bearing are possible with the implants presently available. Basically, the implants include extramedullary and intramedullary devices. Extramedullary devices like the dynamic hip screw or the dynamic condylar screw has potential disadvantages of extensive exposure, more blood loss which then leads to nonunion and implant failure. Intramedullary device is a more biological fixation and has mechanical benefits over extramedullary fixation for fixation of proximal femoral fractures as it provides a

support to posteromedial cortex, a more efficient load transfer and prevents varus collapse of the fracture site [16]. Intramedullary devices also have less implant strain, shorter lever arm for load bearing because of its closer positioning to the mechanical axis of the femur, controlled impaction of the fracture, significantly less soft tissue disruption and periosteal stripping of the femoral cortex around the fracture site, excellent axial and rotational control, shorter operative time and hospital stay, fewer blood transfusions, better postoperative walking ability, and lower rates of leg-length discrepancy [17-21].

However, the use of intramedullary devices has introduced a new set of complications with unique clinical implications [22]. A weakness in the use of intramedullary devices is the security of the lag screw, as screw- holding power in the osteoporotic bone is affected by bone quality [23]. The optimal positioning of surgical implants is of paramount importance for good outcome and reducing the risk of complications. Cephalomedullary nail like proximal femoral nail is associated with implant failure, which can be due to Z effect, reverse Z effect, screw backout, cut through of implant through bone or implant breakage [24].

Initially, standard femoral nail was tried in subtrochanteric fractures but the proximal fragments were usually not long enough for stable fixation which is what happened in this case. The direction of the proximal interlocking bolts which faces caudally doesn't allow engagement of the femoral neck and permits rotational instability. The reconstruction nail which changes the direction of the proximal interlocking bolts, has greatly expanded the indication of intramedullary fixation for subtrochanteric fractures. Cephalomedullary nail prevents the rotation and collapse of the head-neck fragment and smaller diameter of distal shaft of nail results in less stress concentration at the tip of the nail. The antirotational screw at the proximal aspect of nail increases the biomechanical stability of the fracture fixation. Cephalomedullary nail also gave a better control of the length and proximal purchase. The load shearing nature of this implant which allowed compression at the fracture site and even in the osteoporotic bone and its cephalomedullary location had decreased moments as compared to the plate [25]. In a study done by Ravinath et al, 88 trochanteric fractures and 65 subtrochanteric fractures underwent surgical

fixation with proximal femoral nail. The functional results assessed by Harris Hip score showed excellent in 65 cases (42.48%), good in 46 cases (30.07%), fair in 27 cases (17.64%) and poor in 15 cases (9.80%). They recommend proximal femoral nail as an implant of choice for trochanteric and subtrochanteric fractures of proximal femur which was biomechanically compatible with the stability of the fracture pattern with minimal complications. The load sharing device, proximal femoral nail, decrease the patient related morbidity during intra & post-operative period and improve the functional status of the patients [15].

The most common complications of hip fractures include deep vein thrombosis, pulmonary embolism, dislocation, infections and delayed or nonunion. Problems associated with immobility such as urinary tract infection, pneumonia, and pressure ulcers can complicate recovery [26]. Extracapsular hip fractures were associated with poor functional recovery outcomes. It could be related to older age, osteoporosis, and more frequent load-bearing complications which may delay rehabilitation and recovery process [27]. Comorbid conditions may also have a negative impact on functional recovery after hip fracture. Leibson, et al. [28] reported that 45% of hip fracture patients had a CCI >1. A great comorbid disease burden at the time of the fracture could be a marker of physical frailty, and it may be associated with worse short-term recovery outcomes. Cognitive function, nutritional status, and preinjury functional level are three main factors closely related to hip fracture rehabilitation success [29]. Malnutrition has been associated with poor functional recovery, with increased requirements regarding walking aids, and longer length of hospital stay [30]. Prefracture functional status is another main predictive factor of gaining recovery after hip fracture [31].

Rehabilitation of patients after hip fractures includes treatment and education to return the patient to fullest potential and quality of life. The main goals of physical therapy and rehabilitation are: reducing the severity of pain; preventing muscle atrophy; cardiopulmonary and vascular complications; psychological changes; and depression. The rehabilitation program should also aim to improve the maximal range of motion in the hip joint, muscle strength in the affected extremity and to restore movement coordination [32]. The rehabilitation team should consist of a board certified and licensed physiatrist,

physical therapist, occupational therapist and in some cases psychologist and social worker. Such a professional team coordinates its treatment with the surgeon and medical doctors of other specialties, including: cardiology; neurology; endocrinology; etc. Most frequently the success of the treatment is closely associated with the good cooperation between the rehabilitation team and the relatives of the patient [33].

An early rehabilitation program is preferred to begin with breathing exercises for the prevention of pulmonary complications and active isotonic exercises particularly plantar and dorsal foot flexion with elevated leg for vascular complications (thrombosis) prevention. Initial isometric and passive exercises during the rehabilitation program will then be replaced with active exercise and gradual verticalization. Active exercises are performed by a gradual introduction of increasing resistance for the purpose of muscle strengthening [34]. Kinesiotherapy as part of the rehabilitation program in patients who have suffered hip fractures consists of a group of exercises that are designed according to the patient's needs, functional state and surgical treatment mode. Such a rehabilitation mode is aimed to improve the range of motion in hip and knee joints, muscle strengthening, coordination and balance restoration, and quality of patient life. Occupational therapy presents significant component in the rehabilitation of patients with hip fracture, particularly in an older population, since it enables them to proceed with maximal functioning in everyday activities after discharge from rehabilitation treatment [35].

4. CONCLUSION

Subtrochanteric fractures of the femur remains one of the most challenging fractures encountered by orthopaedic surgeons. Fractures to this area can result in significant complications and poor clinical outcomes such as failure of fixation, shortening, malrotation and non-union if not managed properly and inappropriate choice of implant was used. Intramedullary devices are better compared to extramedullary devices in treating this type of fracture as shown by numerous studies. Cephalomedullary nail is a good choice of implant for subtrochanteric fracture of the femur. The advantages include minimal exposure (closed technique), better stability and early mobilisation.

CONSENT AND ETHICAL APPROVAL

As per international standard guideline participant consent and ethical approval has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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