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Successful management of subtrochanteric femoral fracture non-union following failed proximal femoral nailing: A case report

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Abstract
The subtrochanteric fractures is a difficult fracture for even the most skilled of surgeons. 41-year-old male with a history of a road traffic accident experienced a proximal to mid-shaft femur fracture, which was treated initially with a dynamic screw plate and with a proximal femoral nail (PFN) and bone grafting. Despite surgery, the patient remained dependent on a walker and developed increasing pain during ambulation. Xray showed atrophic non-union. A revision surgery was undertaken.
This report presents a case of atrophic non-union following proximal femoral nailing, which was successfully revised using a proximal femur locking compression plate (PF-LCP) and cancellous bone grafting.

Keywords: Subtrochanteric non-union, Periloc Plate, bone grafting, varus osteotomy

Introduction
Approximately one-fourth of proximal femoral fractures occur in the subtrochanteric region, which poses considerable biomechanical challenges in management [1, 2]. Due to limited vascular supply and strong muscular forces acting at the site, biological healing is often delayed, predisposing the fracture to fixation failure and non-union. These features, in combination with high muscle forces acting on fracture fragments, increase the risk of fixation failure and non-union [5]. The subtrochanteric hip fractures are at an increased risk for non-union a rate of roughly 4% to 5% [3, 4].
Intramedullary nailing (IMN) is widely regarded as the preferred fixation method because of its biomechanical benefits, though complications may still occur [7]. Mal reduction, screw cut-out, and implant failure can lead to delayed union or non-union. [9, 10] The management of subtrochanteric fracture non-union remains a significant challenge despite advances in surgical technique and implant technology.

Case Presentation
A 41-year-old male with nil co-morbidity presented to us with complaints of right thigh pain, difficulty in weight bearing, and limping.
He had a history of a road traffic accident 3 years back, resulting in a proximal to mid-shaft femur fracture (figure 1) which was a 31-A3.3 as per OTA classification which was initially managed by open reduction and internal fixation with a 10-hole 95° dynamic condylar screw (DCS) plate (figure 2), which was later removed at 1 year of fixation as the patient had consistent pain in the hip region.

Fig 1: Post dynamic screw plate done on 2/2/2020

Fig 2: xray of hip 1 year follow up 6/8/21

Subsequently, 4 months later, he sustained another fall and re-fractured the same femoral segment for which a proximal femoral nail (PFN) (figure 3), sized 10x240 mm, along with bone grafting was done elsewhere and was mobilised with a walker support. However, the pain was persistent. Now after 1-year patient presented with pain and difficulty in bearing weight over the operated hip.

Fig 3: Removal of implant at same year

On clinical examination, the patient had a well-healed surgical scar over the lateral thigh, with no signs of sinus or infection. Local tenderness was elicited at the fracture site. Abnormal mobility at the fracture site was noted, along with limb shortening of 1.5 cm. Hip joint movements were limited, with flexion restricted to 70°, extension to 20°, and internal and external rotations to 10° each. The patient was unable to bear weight on the affected limb.

Blood parameters revealed haemoglobin of -15.1 mg/dl, white blood cell -9300, Erythrocyte sedimentation rate -8, and C-reactive protein -17.5

Plain radiographs and CT revealed non-union at the subtrochanteric region with sclerotic margins and varus angulation of the femoral head with nail insitu(figure4). An MRI scan of the hip was done to confirm the viability of femoral head and neck.

Fig 4: xrayfollowing fall on 23/1/22

Revision surgery was performed under combined spinal epidural anaesthesia with patient on traction table. The initial approach was incorporated and extended distally into the lateral approach, with the fracture site fully exposed, the femoral nail was removed.

The non-union site was exposed, and the fibrous tissue was thoroughly excised, A collection of tissue samples was collected for microbiological analysis which did not show any growth. Callous formation was seen at the fracture site with the femoral head in varus position, a proximal femur valgus osteotomy was performed just below the lesser trochanter to get the femoral head with a 30-degree wedge osteotomy performed under c-arm into an acceptable anatomical position held in place using a 12-hole proximal femur locking compression plate (Periloc design) with six locking screws proximally and six distally.

A 40 g of cancellous bone graft harvested from the ipsilateral iliac crest was packed at the fracture site (figure-5). Intraoperatively, there were no signs of infection. Postoperatively, limb length was restored to within 0.5 cm of the contralateral side.

Fig 5: Post op proximal femur nailing done on 23/1/22

The patient was mobilized non-weight-bearing and gradually progressed to partial weight-bearing over 8 weeks(figure-6,7).1 year follow up. The patient has achieved full Range of motion of hip and is mobilizing well with support. (figure-8)

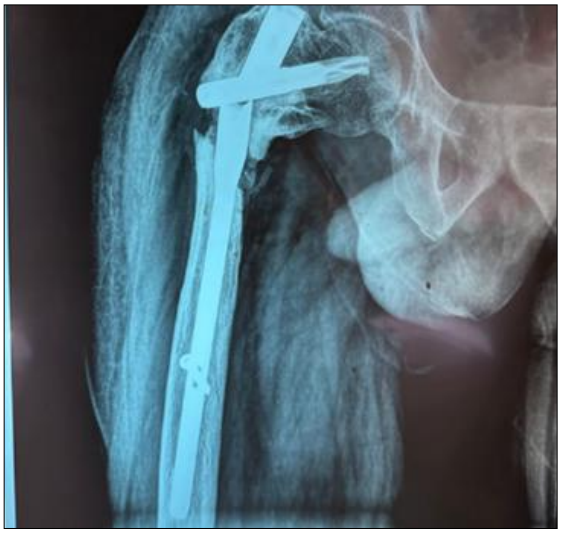

Fig 6: Xray showing a non-union in the subtrochanteric region with evidence of sclerosis along margin of fracture on 23/2/2

Fig 7: immediate post op Xray with periloc plate and bone graft

Fig 8: 1year post op follow up showing good consolidation of the fracture 18/5/24

Discussion

Non-union in the subtrochanteric region presents both mechanical and biological challenges. The presence of dense cortical bone in this region limits the biological potential for union, and high varus and rotational forces act against fracture stability [6].

Regarding our case, there was a mal-reduction before the cephalomedullary nailing insertion, causing the fixation in mild varus and displaced, that is one of key factors in the later breakage of the nail. We think it was impossible to reduce the displaced subtrochanteric fracture with nail insertion. Bending stresses developing at the medial cortex along with the deficiency/comminution of the medial buttress could explain the failure of bone union, especially in the presence of varus mal-reduction leading to eventual implant failure and non-union [8] While intramedullary nails provide strong biomechanical support, their success depends heavily on precise reduction and entry point selection which in this case was difficult.

Revision surgery in non-union cases must adhere to the principles of stability, debridement, and biological enhancement. For a successful treatment of subtrochanteric non-union, treatment principles are previous hardware removal, complete decortication, removal of the fibrotic tissue from the non-union site, selective bone graft and stable fixation with a new plate or nail

According to the 'diamond concept' proposed by Giannoudis *et al*., successful bone healing requires a combination of stability, osteogenic cells, scaffolds, growth factors, and an appropriate biological environment.

In our case, the use of a PF-LCP offered multiple benefits. Its anatomically contoured design negated the need for pre-contouring. The plate accommodates three multidirectional locking screws (angled at 95°, 120°, and 135°), providing enhanced multiplanar stability. Combi-holes allow for both cortical and locking screws, achieving compression and plate-to-bone contact. The device is particularly useful in cases where the fracture extends into the greater trochanter, precluding the use of a nail.

Varus malalignment in subtrochanteric fractures which is the leading factor in non-union, often resulting from technical errors during osteosynthesis as the fracture site endures substantial shear forces in both the medial and lateral zones, which impede the healing process [14]. In fact, residual varus is frequently observed at the non-union site, particularly if the fixation devices fail, hence a valgus osteotomy was performed.

A valgus angulation osteotomy improves the fracture biomechanics by making the fracture plane more horizontal thereby enabling compression at the non-union site. It also helps in improving limb length and restores the neck shaft angle. Several authors have reported success with the procedure [15, 16]

This case emphasizes the need for a patient-specific strategy when treating complex subtrochanteric non-unions. The choice of implant, surgical technique, and biological adjuncts must be tailored to the patient's anatomy, fracture characteristics, and prior surgical history.

Although open reduction was defined as a risk factor for subtrochanteric non-union by some authors [11], there is increasing evidence that the mechanical advantages of preventing varus malalignment and restoration of the medial cortical support outweigh the biological disadvantages of open reduction

Fig 9: 1year post op with complete painless range of motion

Conclusion

Subtrochanteric femoral fracture non-unions are increasingly encountered in orthopaedic practice. While intramedullary nailing remains the standard for primary fixation, revision surgery often necessitates alternative fixation strategies Our experience suggests that anatomical proximal femur locking compression plates, used alongside adequate debridement and bone grafting, can achieve union and restore function after failed PFN. Careful preoperative planning and adherence to the biomechanical and biological principles of fracture healing are essential to achieving favourable outcomes.

The post 1 year follows up patient had an improvement of Harrison hip score from 65 to 80.

In the end, the author would like to conclude that Closed reduction is, therefore, advisable only if it does not forfeit these mechanical advantages.

Clinical Message

Subtrochanteric non-union is largely a preventable complication — varus malalignment at the time of primary fixation is the root cause in most cases. When revision is needed, success depends on correcting the deformity with a valgus osteotomy, switching to a PF-LCP for stable fixation, and augmenting with bone graft. Get the reduction right the first time, or be prepared to address the mechanics — not just the biology — at revision.

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