

Functional Outcome of Femoral Neck Fractures with Posterior Comminution Managed by Dynamic Hip Screw with Fibular Strut Grafting: A Case Series Study

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Learning Point of the Article:

Importance of posterior cortex comminution in femoral neck fracture.
Role of fibular strut graft in treating femoral neck fracture with posterior cortex comminution.

Abstract

Introduction: Femoral neck fractures with posterior comminution are associated with instability, impaired fracture healing and a higher risk of fixation failure. In young and middle-aged patients, preservation of the femoral head is preferred and stable internal fixation remains a challenge due to posterior cortical defects. Augmentation with a fibular strut graft may enhance mechanical stability and promote union.

Objectives: The aim of this study was to evaluate the functional outcome of femoral neck fractures with posterior comminution treated using dynamic hip screw (DHS) fixation combined with a non-vascularized fibular strut graft.

Materials and Methods: This prospective case series included six patients aged between 20 and 60 years with radiologically confirmed femoral neck fractures with posterior comminution. All patients underwent closed reduction and internal fixation using a DHS with augmentation by a non-vascularized fibular strut graft. Postoperatively, patients followed a standardized rehabilitation protocol. Functional outcomes were assessed using the Modified Harris hip score at 3 and 6 months of follow-up.

Results: At 3 months, outcomes were excellent in three patients, good in two and poor in one. By 6 months, functional status remained stable in the five patients with good or excellent results, while the patient with a poor outcome showed further deterioration.

Conclusion: DHS fixation augmented with a non-vascularized fibular strut graft provides satisfactory short-term functional outcomes in femoral neck fractures with posterior comminution.

Keywords: Femoral neck fracture, posterior comminution, dynamic hip screw, fibular strut graft and modified Harris hip score.

Introduction

Femoral neck fractures in younger individuals usually occur following high-energy trauma. The choice of treatment is influenced by several factors, including patient age, functional demands, fracture morphology and bone quality. Nearly one-fifth of these fractures are non-displaced [1]. In patients below 60 years of age, preservation of the native femoral head is preferred

to prevent the long-term complications associated with prosthetic replacement. Management options include closed or open reduction with internal fixation, with or without the use of bone grafts. Even with appropriate reduction and stable fixation, the incidence of non-union remains considerable, ranging from 10% to more than 40% in some reports. In elderly patients with osteoporotic bone, outcomes are frequently poor due to

Author's Photo Gallery



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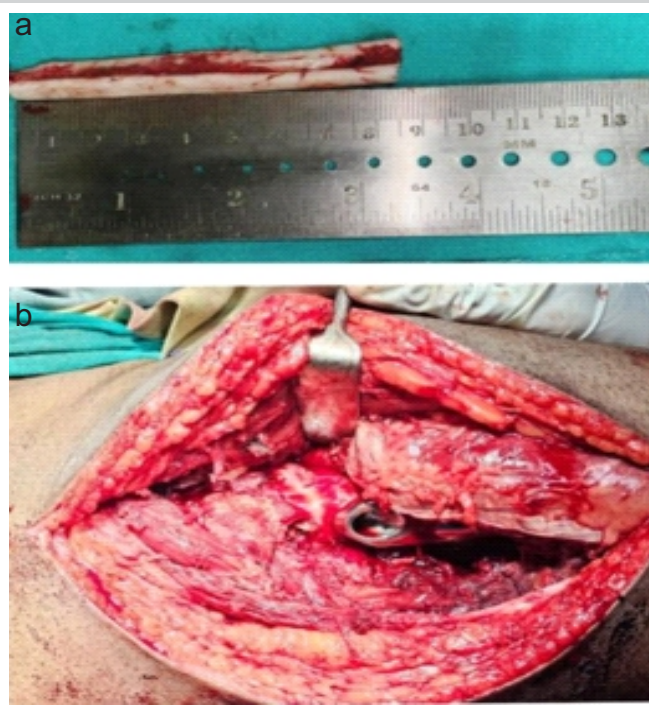


Figure 1: (a) Harvested fibular strut graft and (b) intraoperative picture (arrow indicates fibular strut graft).

impaired blood supply to the femoral head and instability produced by posterior cortical comminution, which eliminates the normal buttress effect against external rotational forces. Internal fixation alone may be inadequate in such situations due to the presence of cavitory defects in the posterior femoral head and neck, predisposing the fracture to secondary displacement. For this reason, adjunctive bone grafting has been advocated to enhance stability [2]. The mechanical stability achieved after fixation is closely related to the extent of posterior comminution and bone loss. This is clinically relevant, as posterior cortical defects have been observed in a substantial proportion of femoral neck fractures up to 70% [3]. For displaced femoral neck fractures in younger patients, surgeons commonly prefer fixation with cannulated screws or a dynamic hip screw (DHS). Rotational instability of fracture fragments is a critical factor contributing to fixation failure in comminuted fractures. Rau et al. reported that DHS fixation alone may be insufficient to control the proximal fragment and can result in loss of reduction and rotational instability during lag screw insertion [4]. Fibular strut grafting provides both biological supports for fracture healing and mechanical reinforcement of the posterior cortex

during reconstruction of the femoral neck [5]. Fibular grafting was used because these fractures had posterior comminution, which leads to instability, high risk of non-union and fixation failure. Since routine DHS fixation alone is insufficient in such cases, a fibular strut graft was added to provide structural support to the posterior cortex, improve mechanical stability, and enhance biological healing, especially important for preserving the femoral head in young patients.

In this case series study, we aimed to analyze the functional outcome of femoral neck fractures with posterior comminution managed by DHS fixation combined with fibular strut grafting.

Materials and Methods

Study design

This was a prospective case series study.

Study duration

This study duration was 1 year, from August 2023 to August 2024.

Study department and place

Department of orthopedics, Osmania general hospital, Hyderabad.

Study criteria

- Inclusion criteria included patients with fractures of the neck of the femur associated with posterior comminution, aged between 20 and 60 years, with a history of trauma within the preceding 3 weeks, without any uncontrolled systemic diseases and who were willing to provide informed consent for participation in the study.
- Exclusion criteria included patients younger than 20 years or older than 60 years, those who were medically unfit to undergo surgery and patients with associated neurovascular injuries or

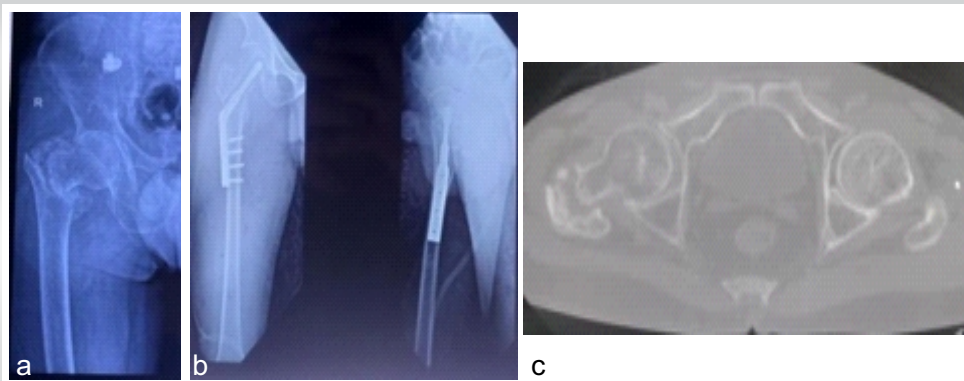


Figure 2: Patient 1 (a) Pre-operative radiograph, (b) pre-operative CT, and (c) post-operative radiograph.

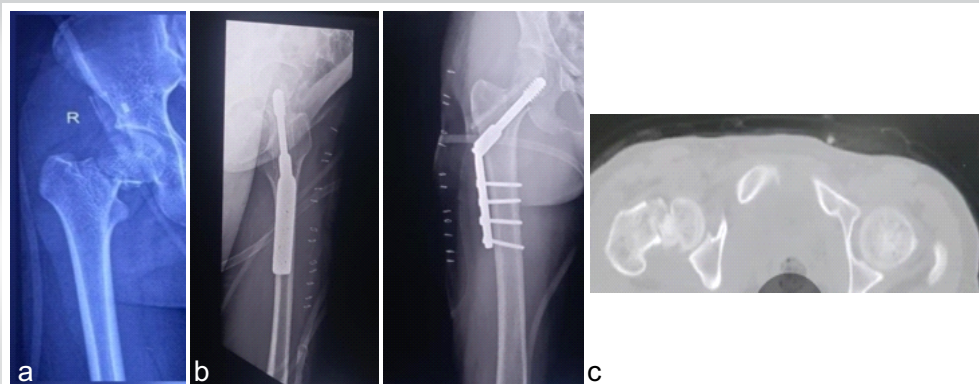


Figure 3: Patient 2 (a) Pre-operative radiograph, (b) pre-operative CT, and (c) post-operative radiograph.

approximately 2 cm below the vastus lateralis ridge. A fixed-angle guide was positioned midway along the lateral cortex and a 3.2-mm guide pin was inserted toward the apex of the femoral head, parallel to and just inferior to the center of the femoral neck on the AP view and centrally on the lateral view. The tip–apex distance was maintained at 25 mm or less after correcting for magnification. Once satisfactory guide pin placement was confirmed, the appropriate lag screw length and

head injuries.

Study population

Six radiologically confirmed patients of femoral neck fractures with posterior comminution, scheduled for open reduction and internal fixation using a DHS with non-vascularized fibular strut grafting, were included in the study. IEC Number and approval date: ECR/300/Inst/AP/2013/RR-16, and January 20, 2023.

Pre-operative evaluation and operative notes

Pre-operative evaluation was performed using plain radiographs and computed tomography (CT) scans. All procedures were carried out under fluoroscopic guidance on a standard fracture table. Closed reduction was achieved in all cases and was confirmed on anteroposterior (AP) and lateral views using the Garden alignment index and Lowell's method. The patient was positioned supine and the proximal femur was exposed through a standard lateral approach.

Two guide pins were inserted that is the primary guide pin was placed inferiorly for the lag screw of the DHS and a second guide pin was inserted parallel and proximal to the primary pin using a guide pin placement device. The second guide pin served as a guide for fibular graft insertion and provided temporary stability in case of primary guide pin back-out after reaming, in addition to preventing femoral head rotation during reaming and screw insertion. Fixation was achieved using a DHS (Fig. 1).

The level for placement of the 135° angle plate was identified using the tip of the lesser trochanter,

reaming depth were determined. Reaming was performed over the primary guide pin according to the measured length and a lag screw of corresponding size was inserted.

Following fixation of the lag screw and side plate, a channel for the fibular graft was prepared using a proximal femoral nail reamer over the proximal guide pin. A non-vascularized fibular graft was harvested from the ipsilateral leg through a posterolateral approach as described by Nagi and Dhillon [6]. The graft was obtained using an oscillating saw, with the middle third of the fibula harvested while preserving at least 10 cm of distal fibula to maintain ankle stability; therefore, syndesmotic screw fixation was not required in any case. The leading edge of the graft was beveled for approximately 1 cm and impacted over the guide wire into the femoral neck using a graft impactor until a subchondral position approximately 3–5 mm from the joint line was achieved. The wound was closed in layers over a surgical drain.

Post-operative care

All patients were encouraged to begin in-bed exercises from the 1st post-operative day (POD). Surgical drains were removed on POD 2 and routine wound dressings were performed on POD

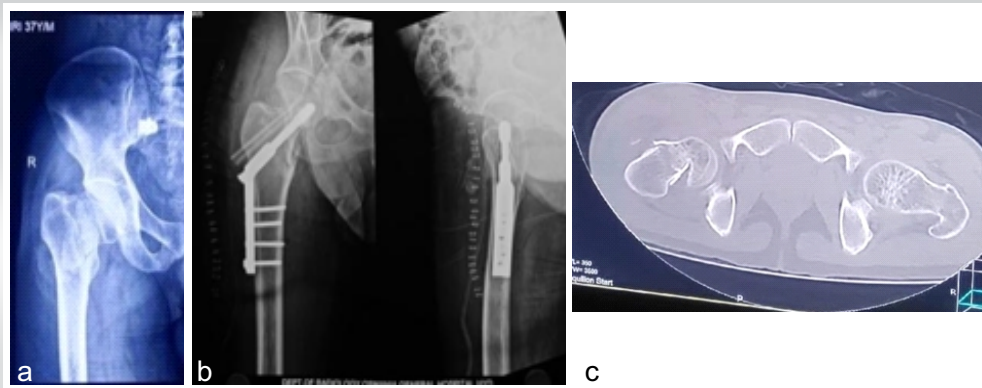


Figure 4: Patient 3 (a) Pre-operative radiograph, (b) pre-operative CT, and (c) post-operative radiograph.

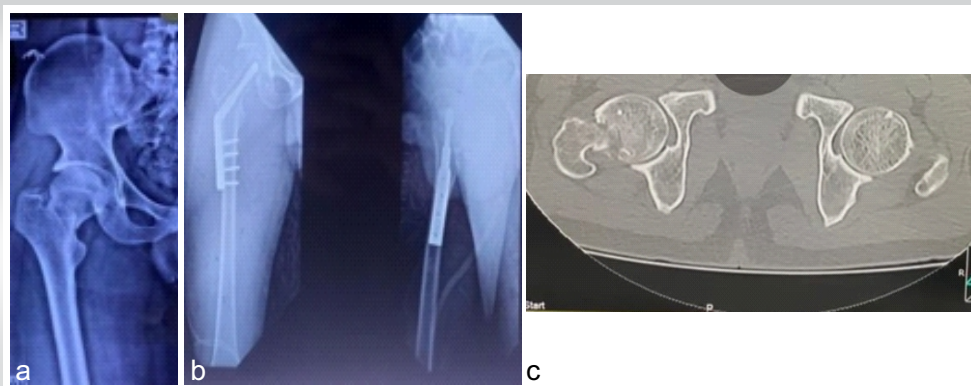


Figure 5: Patient 4 (a) Pre-operative radiograph, (b) pre-operative CT, and (c) post-operative radiograph.

2, 5, and 10. Suture removal was carried out on POD 10. Non-weight-bearing ambulation was initiated on POD 5. All patients were discharged on the 5th POD and were followed up regularly at the 2nd, 3rd, 6th, and 12th weeks after surgery. Partial weight-bearing was commenced at the 3rd post-operative week and full-weight-bearing was allowed from the 6th post-operative week. Functional outcomes were assessed in all patients using the Modified Harris hip score (mHHS) at 3 months and 6 months following surgery.

Results

Six patients (Fig. 2,3,4,5,6) diagnosed with femoral neck fractures associated with posterior comminution were included in this study. The patients belonged to the age group of 20–60 years and most injuries were secondary to high-energy mechanisms such as road traffic accidents and falls from height. All individuals presented with acute hip pain, inability to bear weight, and restricted mobility of the affected limb. Clinical examination consistently revealed tenderness around the hip joint, painful restriction of movements, and external rotation deformity.

Initial assessment with AP and lateral radiographs of the hip suggested femoral neck fractures in all cases. Further evaluation with CT scans provided detailed visualization of fracture configuration and confirmed posterior cortical comminution, along with varying degrees of displacement and bone loss. Surgical planning was individualized based on fracture morphology, extent of comminution and bone quality. Closed reduction was successfully achieved in all patients and intraoperative fluoroscopy confirmed satisfactory

alignment based on the Garden alignment index and appropriate tip–apex distance.

All patients were treated with DHS fixation augmented by a non-vascularized fibular strut graft. The surgical procedures were completed without intraoperative complications. The addition of the fibular graft contributed to improved posterior cortical support and enhanced rotational stability. Postoperatively, patients were managed with a uniform

rehabilitation protocol that included early mobilization, progressive weight-bearing, and scheduled follow-up assessments.

In Case 1, the patient sustained a high-energy injury and presented with severe pain and inability to walk. CT imaging demonstrated a displaced femoral neck fracture with a significant posterior cortical defect. Following successful reduction and fixation, the patient achieved an excellent functional outcome at 3 months (mHHS >90), characterized by absence of pain, normal gait, and full return to daily activities. Radiographs indicated progressive fracture healing. At 6 months, the patient maintained excellent functional and radiological status, with no signs of complications such as implant failure, non-union, or avascular necrosis.

Case 2 showed similar presenting complaints and CT imaging revealed posterior comminution with moderate displacement. The patient demonstrated steady post-operative recovery and achieved an excellent functional outcome at 3 months, with minimal pain, satisfactory range of motion, and independent ambulation. Radiological findings were consistent with ongoing healing. This favorable outcome was sustained at the 6-month follow-up.

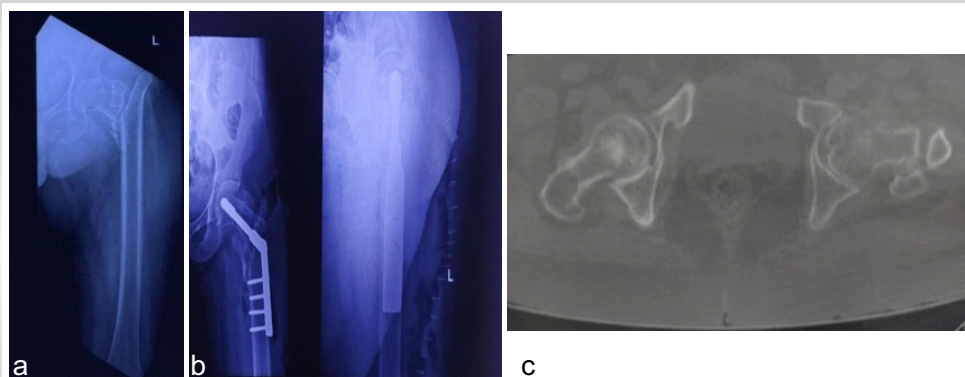


Figure 6: Patient 5 (a) Pre-operative radiograph, (b) pre-operative CT, and (c) post-operative radiograph.

Table 1: Interpretation of mHHS

Modified Harris hip score range	Outcome category
<70	Poor
70–79	Fair
80–89	Good
90–100	Excellent
mHHS: Modified Harris hip score	

In Case 3, CT imaging confirmed a displaced fracture with posterior cortical comminution. Post-surgical recovery was uneventful and the patient exhibited rapid functional improvement. At 3 months, the patient was pain-free, ambulatory without support and able to perform routine activities without limitation, corresponding to an excellent mHHS score. Radiographic evaluation suggested good progression toward union, which was maintained at 6 months.

Case 4 presented with moderate pain and limited weight-bearing ability before surgery. Imaging studies confirmed disruption of the posterior cortex. At the 3-month follow-up, the patient achieved a good functional outcome (mHHS 80–89), with mild intermittent pain, near-normal gait, and slight difficulty during stair climbing. Radiological assessment demonstrated satisfactory healing progression. At 6 months, the functional outcome remained stable without any deterioration.

In Case 5, clinical and radiological findings were comparable, with CT confirming posterior comminution. The patient responded well to surgical intervention and rehabilitation. At 3 months, a good functional outcome was noted, with only mild pain and independent ambulation without assistive devices. Radiographs showed satisfactory alignment and early signs of union. This clinical status was maintained at 6 months.

Case 6 presented with more severe symptoms, including

Table 2: Functional outcome at 3-month follow-up

Outcome category	Number of patients	Percentage
Excellent	3	50
Good	2	33.3
Poor	1	16.7
Total	6	100

persistent pain, limp, and significant functional impairment. CT imaging revealed a displaced femoral neck fracture with extensive posterior comminution and bone loss. Despite adequate reduction and fixation, the patient had a poor functional outcome at 3 months (mHHS 59.5), with ongoing pain, dependence on a walking aid and difficulty performing daily activities. Radiological findings suggested delayed union. At 6 months, the patient exhibited further clinical deterioration, including increased pain and worsening limp, possibly indicating delayed healing or early mechanical failure.

At the 3-month evaluation, functional outcomes were categorized as excellent in three patients, good in two patients and poor in one patient. At 6 months, patients who initially demonstrated good or excellent results maintained their functional status, indicating sustained stability and progression of healing. (Table 1-5).

At the 6-month follow-up, the five patients who had good or excellent outcomes at 3 months showed no deterioration in functional status as assessed by mHHS. In contrast, the patient with a poor outcome exhibited further functional decline, with worsening pain and increased limping reflected by a reduced mHHS score.

Discussion

The frequency of femoral neck fractures among young and middle-aged individuals has increased in recent years, largely due to high-energy trauma. These injuries significantly impair quality of life, hip function, and work capacity, thereby imposing a substantial socioeconomic burden worldwide [7]. Previous studies have reported that femoral neck comminution is present in approximately 50–96% of cases, with posterior comminution accounting for the majority, occurring in about 50–82% of patients [8, 9].

Huang et al. observed that the incidence of

Table 3: Clinical features at 3-month follow-up

Outcome group	Pain	Gait	Stair climbing	Walking aid	Public transport use
Excellent (n=3)	No significant pain	Normal	No difficulty	Not required	Able
Good (n=2)	Occasional mild pain	Near normal	Slight difficulty	Not required	Able
Poor (n=1)	Mild pain	Slight limp	Difficult	Cane most of the time	Unable

Table 4: Comparison of functional outcome at 3 and 6 months

Outcome at 3 months	Outcome at 6 months	Number of patients
Excellent → Excellent	Maintained	3
Good → Good	Maintained	2
Poor → Poor (worsened)	Deteriorated	1

osteonecrosis of the femoral head following internal fixation was markedly higher in patients with posterior comminution (34.2%) compared with those without such defects. Several investigations have identified cortical deficiency as a key contributor to nonunion in femoral neck fractures. Huang et al. further demonstrated that posterior comminution reduces axial load-bearing capacity, leading to early fracture displacement [10]. Similarly, Rawall et al. reported increased rates of nonunion in young patients with significant posterior cortical defects [11]. When fractures with posterior comminution are anatomically reduced and rigidly fixed, contact is often achieved primarily along the anterior fracture surface, leaving the posterior defect unsupported. Ye et al. concluded that anatomical reduction combined with DHS fixation alone may be inadequate to achieve or maintain stable fixation in the presence of posterior comminution [12].

Fibular strut grafting functions both as a structural support and as a biological graft, enhancing fracture union while restoring posterior cortical integrity during reconstruction of the femoral neck and head [13]. Elgeidi et al. reported a union rate of 97% in acute femoral neck fractures treated with DHS fixation supplemented by a fibular strut graft [14]. Lazaro et al. proposed that an optimal fixation construct should provide angular and length stability, resist physiological forces across the fracture site and permit controlled micromotion. They utilized an endosteal fibular allograft as a biological intramedullary strut to reinforce the comminuted femoral neck and improve the mechanical strength of the fixation construct

Table 5: Functional status at 6-month follow-up

Outcome category	Number of patients	Functional status
Excellent	3	No deterioration in mHHS
Good	2	No deterioration in mHHS
Poor	1	Worsening pain and increased limp
Total	6	
mHHS: Modified Harris hip score		

[15]. The limitation of our study is we have followed up only for 6 months and the long-term outcome of the procedure cannot be identified.

Conclusion

Posterior comminution of the femoral neck is a significant factor influencing functional outcome. In this case series, five out of six patients demonstrated favorable functional results when femoral neck fractures with posterior comminution in young adults were managed by closed reduction followed by fixation with a DHS combined with fibular strut grafting. These findings suggest that DHS fixation augmented with a fibular strut graft provides stable fixation and can be considered a reliable treatment option for femoral neck fractures with posterior comminution in young adult patients.

Clinical Message

In femoral neck fractures with posterior comminution, DHS fixation alone may be insufficient due to instability, increasing the risk of non-union and vascular collapse of the femoral head. Augmentation with a fibular strut graft enhances mechanical stability and supports biological healing and bone growth, leading to improved functional outcomes. This combined approach is a reliable option for preserving the femoral head in young and middle-aged patients.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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