

Original Research Article

Functional outcomes of augmented intramedullary nailing for unstable intertrochanteric fractures with lateral wall deficiency in elderly patients with Dorr type C femur: a prospective observational study

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ABSTRACT

Background: Managing unstable intertrochanteric femur fractures in older adults remains challenging, particularly when lateral wall disruption coexists with severe osteoporosis. In patients with Dorr type C femoral morphology, compromised bone quality further reduces fixation stability and increases the risk of mechanical failure. Although intramedullary nailing is widely accepted for unstable fracture patterns, additional lateral wall reconstruction using an extramedullary implant may provide enhanced structural support. Evidence regarding the clinical effectiveness of this combined fixation strategy in elderly osteoporotic patients remains limited. This study evaluated the functional and radiological outcomes of augmented intramedullary fixation in this high-risk population.

Methods: A prospective observational study was conducted in 30 patients aged 65–75 years presenting with unstable intertrochanteric fractures associated with lateral wall deficiency and Dorr type C femoral morphology. All participants underwent fixation using a proximal femoral intramedullary nail supplemented with an extramedullary implant. Clinical assessment, radiographic evaluation and functional outcome measurement were performed at 2 weeks, 2 months and 6 months after surgery. Functional recovery was assessed using the Harris Hip Score (HHS), while fracture union, postoperative complications and the timing of weight bearing were also recorded.

Results: The mean patient age was 69.5±2.59 years and females represented 53.3% of the study population. Low-energy falls accounted for most injuries (80%). Radiographic union was achieved within 15–20 weeks in 80% of patients. Partial weight bearing commenced within 5–6 postoperative days in 53.3% of cases. Functional performance improved steadily during follow-up, with the mean Harris Hip Score increasing from 47.73±3.08 at two weeks to 86.60±5.96 at six months ($p<0.001$). At final evaluation, excellent and good functional outcomes were observed in 46.7% and 43.3% of patients, respectively. An uncomplicated postoperative course was documented in 86.7% of patients, while implant-related complications were uncommon.

Conclusions: Augmentation of intramedullary fixation with an extramedullary implant provides stable fixation for unstable intertrochanteric fractures with lateral wall deficiency in elderly patients with Dorr type C femora. The technique supports early mobilisation, facilitates timely fracture healing and results in favourable functional recovery with a low incidence of postoperative complications. These findings suggest that augmented fixation is a reliable treatment option for complex osteoporotic intertrochanteric fractures.

Keywords: Dorr type C femur, Harris hip score, Intertrochanteric fracture

INTRODUCTION

Intertrochanteric fractures of the femur are among the most common osteoporotic fractures found in elderly individuals and comprises a major public health issue because of their association with prolonged disability, loss of independence and increased mortality. As life expectancy continues to increase worldwide, the incidence of these fractures is expected to increase, placing an even greater burden on healthcare systems. In older people, the most of the intertrochanteric fractures result from low-energy trauma, typically a simple fall, whereas younger patients usually sustain these injuries following high-energy mechanisms such as road traffic accidents. Despite considerable advances in surgical techniques and perioperative care, these fractures continue to be associated with substantial medical, social and economic consequences leading to prolonged hospitalization, rehabilitation requirements and functional impairment.^{1,2}

The primary objective of treatment is to restore pre-injury mobility with stable internal fixation that allows early mobilisation while minimizing complications. Conservative treatment is now reserved for certain circumstances because prolonged immobilization in elderly is associated with adverse events, including deep vein thrombosis, pulmonary embolism, respiratory infections, pressure ulcers, urinary tract infections, muscle wasting and increased mortality. Consequently, early operative management has become the accepted standard of care for most intertrochanteric fractures.^{3,4}

The stability of an intertrochanteric fracture is affected by both the fracture pattern and the integrity of the surrounding cortical structures. Among these, the lateral femoral wall has emerged as a main biomechanical component that provides support during weight bearing. Preservation of this structure helps maintain fracture reduction, limits excessive collapse of the proximal fragment and prevents medial displacement of the femoral shaft. In contrast, disruption of the lateral wall compromises construct stability and has been linked to excessive fracture collapse, varus mal-alignment, limb shortening, implant cut-out and fixation failure. These factors often result in poor functional outcomes and a higher likelihood of reoperation.^{5,6}

Several classification systems have been proposed to describe intertrochanteric fractures, with the AO/OTA classification being the most widely accepted because of its clinical relevance in distinguishing stable from unstable fracture configurations. Fractures characterised by reverse obliquity, posteromedial comminution, subtrochanteric extension or lateral wall deficiency are generally regarded as unstable injuries. These fracture patterns are technically demanding to manage, particularly in elderly patients with osteoporosis, where diminished bone quality further reduces fixation strength and increases the risk of mechanical complications.^{7,8} Historically, the dynamic hip screw was considered the standard implant for

intertrochanteric fractures. However, accumulating clinical and biomechanical evidence has demonstrated that this extramedullary device performs less favourably in unstable fracture patterns, especially when the lateral femoral wall is deficient. Excessive sliding, varus collapse and implant failure have been reported more frequently in such situations. Consequently, intramedullary devices, including the proximal femoral nail and proximal femoral nail antirotation systems, have become the preferred treatment for unstable intertrochanteric fractures because they provide a shorter lever arm, superior load transmission, greater mechanical stability and allow minimally invasive fixation.⁹⁻¹¹

Although intramedullary fixation has improved clinical outcomes, achieving reliable stability remains challenging in patients with advanced osteoporosis. This challenge is particularly evident in individuals with Dorr type C femoral morphology, which is characterised by thin cortical bone, a wide intramedullary canal and reduced bone stock. These anatomical characteristics diminish implant purchase and may contribute to loss of reduction, implant migration, delayed fracture healing and fixation failure despite technically satisfactory surgery.^{12,13}

To address these limitations, reconstruction of the lateral femoral wall using supplementary extramedullary support has gained increasing attention. The addition of a trochanteric buttress plate or similar lateral support device to intramedullary fixation has been proposed to restore lateral cortical continuity, enhance rotational and angular stability, improve resistance to varus collapse and distribute mechanical loads more effectively across the fracture site. Biomechanical investigations suggest that this combined construct provides greater stability than intramedullary fixation alone, particularly in highly unstable osteoporotic fractures with lateral wall disruption.^{14,15}

Clinical studies evaluating augmented fixation have reported encouraging outcomes, including improved fracture union, earlier mobilisation, superior functional recovery and lower rates of implant-related complications. However, most published studies have included heterogeneous patient populations with varying fracture patterns or have focused primarily on comparisons between different implant systems. Evidence specifically addressing elderly patients with unstable intertrochanteric fractures, lateral wall deficiency and Dorr type C femoral morphology remains limited.¹⁶⁻¹⁸

In view of these considerations, the present prospective observational study was undertaken to evaluate the clinical effectiveness of intramedullary nailing augmented with an extramedullary implant in elderly patients presenting with unstable intertrochanteric fractures associated with lateral wall deficiency and Dorr type C femur. Functional recovery was assessed using the Harris Hip Score, while radiological union, postoperative complications and mobilisation outcomes were analysed to determine the

overall effectiveness of this augmented fixation strategy in this challenging patient population.

METHODS

This prospective observational study was carried out in the Department of Orthopaedics at a tertiary care teaching hospital over a six-month period after obtaining approval from the Institutional Ethics Committee. The study was designed to evaluate the clinical, radiological and functional outcomes of elderly patients with unstable intertrochanteric femur fractures associated with lateral wall deficiency who underwent augmented intramedullary fixation.

Thirty consecutive patients meeting the eligibility criteria were enrolled. All participants were between 65 and 75 years of age and had unstable intertrochanteric fractures with radiological evidence of lateral wall deficiency and Dorr type C femoral morphology.

The sample size was calculated using the formula for estimating a single population proportion at a 95% confidence level. An expected rate of excellent-to-good functional outcome of 93.75%, derived from the study by Ganjale et al and an absolute precision of 10% were considered for the calculation, yielding a minimum requirement of 23 participants.¹³ To enhance statistical reliability and compensate for possible attrition during follow-up, a total of 30 patients were included in the study.

Inclusion criteria

Patients fulfilling all of the following criteria were considered eligible age between 65 and 75 years. Unstable intertrochanteric fracture of the femur with lateral wall deficiency. Dorr type C proximal femoral morphology. Isolated intertrochanteric fracture. Provision of written informed consent for participation.

Exclusion criteria

Patients were excluded under the following circumstances neglected fractures presenting more than 10–15 days after injury, open fractures, pathological fractures, polytrauma. Significant systemic illnesses likely to interfere with fracture healing or surgical outcome, including uncontrolled diabetes mellitus and thyroid disorders. Patients considered medically unfit for surgery or those unwilling to participate in the study.

After enrolment, all patients underwent detailed clinical assessment, including history taking and physical examination. Standard anteroposterior and lateral radiographs of the affected hip were obtained for fracture evaluation and classification. Computed tomography was performed whenever additional assessment of fracture configuration or lateral wall integrity was required. Routine laboratory investigations and pre-anaesthetic evaluation were completed before surgery in accordance

with institutional protocols. All procedures were performed under either spinal or epidural anaesthesia with the patient positioned supine on a fracture table. Fracture reduction was achieved by applying traction combined with controlled internal rotation under fluoroscopic guidance. Reduction quality was confirmed on both anteroposterior and lateral image intensifier views before definitive fixation. A proximal femoral nail was inserted through the tip of the greater trochanter following standard intramedullary nailing principles. The lag screw and anti-rotation screw were positioned under fluoroscopic guidance to obtain an optimal tip-apex distance. Distal locking was subsequently performed according to the fracture configuration.

Following successful nail fixation, reconstruction of the deficient lateral wall was undertaken using an extramedullary trochanteric buttress plate introduced through the same surgical incision with minimal additional soft-tissue dissection. The plate was secured using the cephalic screws along with supplementary cortical screws wherever necessary to reinforce lateral wall stability. Implant placement, fracture reduction and overall construct alignment were confirmed fluoroscopically before wound closure. Intravenous prophylactic antibiotics were administered perioperatively according to institutional guidelines.

Postoperative rehabilitation was initiated immediately after surgery. Quadriceps strengthening exercises were commenced on the day of the operation. Wound inspection and dressing change were performed on the third postoperative day, after which knee range-of-motion exercises were encouraged. Ambulation with walker-assisted partial weight bearing was initiated as tolerated, usually from the fourth postoperative day. Patients were discharged after achieving satisfactory clinical recovery and independent ambulation with walking support.

Patients were reviewed at 2 weeks, 2 months and 6 months after surgery. At each follow-up visit, clinical examination and radiographic assessment were performed to evaluate fracture healing, implant position and any postoperative complications. Functional recovery was assessed using the HHS at every follow-up visit.

The primary outcome measure was functional outcome based on the Harris Hip Score and Secondary outcome measures included: Time to initiation of partial weight bearing, Time required for radiological fracture union, Operative duration, estimated intraoperative blood loss, Length of hospital stay, Postoperative complications, including varus collapse, implant failure, infection and limb shortening.

Statistical Analysis: Data were entered into Microsoft Excel and analysed using IBM SPSS Statistics version 26.0. Continuous variables are presented as mean±standard deviation, whereas categorical variables are expressed as frequencies and percentages.

Comparisons between follow-up assessments were performed using either the paired Student's t-test or the Wilcoxon signed-rank test, depending on the distribution of the data. Associations between categorical variables were analysed using the Chi-square test or Fisher's exact test whenever appropriate. A two-sided p value less than 0.05 was considered statistically significant throughout the analysis.

RESULTS

A total of 30 elderly patients with unstable intertrochanteric femur fractures associated with lateral wall deficiency and Dorr type C femoral morphology were enrolled in the study. All patients underwent intramedullary fixation supplemented with an extramedullary implant and successfully completed the scheduled follow-up evaluations at 2 weeks, 2 months and 6 months. The mean age of the participants was 69.5 ± 2.59 years. Most patients belonged to the 68–71 years age group (46.7). Women represented a slightly higher proportion of the study population than men (Table 1). Falls from standing height were the predominant mechanism of injury, accounting for 24 patients (80.0%), whereas 6 patients (20.0%) sustained fractures following road traffic accidents. Most patients (86.7%) underwent definitive fixation within three days of injury. Only 4 patients (13.3%) underwent surgery after three days (Table 2). The

mean operative duration was 84.23 ± 6.05 minutes. Average intraoperative blood loss was 166.87 ± 13.85 ml, indicating that augmented fixation could be performed with acceptable operative time and blood loss. Fracture healing progressed satisfactorily in the majority of patients. Radiological union occurred within 15–20 weeks in 24 patients (80.0%), while 5 patients (16.7%) achieved union before 15 weeks. Delayed union beyond 20 weeks was observed in only one patient (3.3%).

Early postoperative mobilization was achieved in most patients. Partial weight bearing was initiated within 3–4 days in 11 patients (36.7%) and within 5–6 days in 16 patients (53.3%). Only 3 patients (10.0%) required more than six days before commencing partial weight bearing. Functional recovery improved progressively during follow-up. The mean Harris Hip Score increased from 47.73 ± 3.08 at two weeks to 69.53 ± 5.12 at two months and further improved to 86.60 ± 5.96 at six months. This improvement over time was statistically significant ($p < 0.001$) (Table 3). At the final evaluation, 14 patients (46.7%) achieved an excellent functional outcome, while 13 patients (43.3%) demonstrated a good outcome according to the Harris Hip Score. Fair and poor outcomes were recorded in only 2 (6.7%) and 1 (3.3%) patient, respectively (Table 4). The incidence of postoperative complications was low. An uncomplicated postoperative course was observed in 26 patients (86.7%) (Table 5).

Table 1: Demographic characteristics of the study population.

Variables	N	%
Age group (in years)		
65-67	8	26.7
68-71	14	46.7
72-75	8	26.7
Mean Age $\pm$ SD	69.5 ± 2.59	
Gender		
Male	14	46.7
Female	16	53.3

Table 2: Time interval between injury and surgery.

Time interval	N	%
≤ 2 days	9	30
2-3 days	17	56.7
>3 days	4	13.3

Table 3: Mean Harris Hip Score during follow-up.

Follow up duration	2 weeks	2 months	6 months	P value
Mean$\pm$SD	47.73 ± 3.08	69.53 ± 5.12	86.60 ± 5.96	<0.001

Table 4: Functional outcome at six months according to Harris hip score.

Harris Hip score	Outcome	N	%
>90	Excellent	14	46.7
80-89	Good	13	43.3
70-79	Fair	2	6.7
<70	Poor	1	3.3

Table 5: Postoperative complications distribution.

Complications	N	%
None	26	86.7
Limb shortening	2	6.7
Implant failure	1	3.3
Varus failure	1	3.3

DISCUSSION

The treatment of unstable intertrochanteric femur fractures in elderly patients remains a demanding aspect of orthopaedic trauma surgery. The present study evaluated the clinical performance of intramedullary nailing supplemented with an extramedullary implant in elderly patients with lateral wall deficiency and Dorr type C femoral morphology. The study population had a mean age of 69.5 years, with a slight predominance of female patients. These observations are consistent with the established epidemiology of osteoporotic hip fractures, which occur predominantly in older adults, particularly postmenopausal women. Reduced bone mineral density, age-related deterioration in bone architecture and an increased tendency to fall contribute to the higher incidence of these fractures in this population. Similar demographic characteristics have been described by Hoffmann et al.¹⁶

Most fractures in the present study resulted from low-energy falls, accounting for 80% of all injuries. This finding reflects the typical mechanism responsible for intertrochanteric fractures in elderly individuals and reinforces the role of osteoporosis as a major contributing factor. Previous epidemiological investigations have likewise shown that simple falls from standing height account for the majority of proximal femoral fractures among older adults.¹⁹ Timely operative intervention is widely recognised as an important determinant of postoperative recovery in hip fracture patients. In this series, definitive fixation was performed within three days of injury in most patients, allowing rehabilitation to begin at an early stage. Prompt surgical management has consistently been associated with lower rates of medical complications, shorter hospital stays and improved functional outcomes because prolonged immobilization predisposes elderly patients to thromboembolic events, pulmonary complications, pressure injuries and muscle deconditioning.²⁰

The mean operative duration of approximately 84 minutes and an average intraoperative blood loss of about 167 ml indicate that the addition of an extramedullary implant can be accomplished without excessive surgical morbidity. Although augmentation inevitably adds procedural steps, the modest increase in operative time appears acceptable considering the additional biomechanical support provided by lateral wall reconstruction. Comparable operative parameters have been reported in previous studies evaluating combined nail-plate constructs for unstable

intertrochanteric fractures.^{13,14} Radiological union was achieved within 15–20 weeks in the majority of patients, while delayed union occurred in only one case. These findings suggest that the augmented fixation construct provided sufficient stability to permit biological fracture healing. Stable reduction, preservation of alignment and restoration of lateral cortical support are likely to have contributed to the satisfactory union rates observed. Similar patterns have been described by George DA et al and Fogagnolo et al, who also reported favourable union following stable fixation of unstable intertrochanteric fractures.^{18,21}

Early mobilisation is a principal objective of surgical treatment in elderly patients because prolonged bed rest is associated with significant morbidity. More than half of the patients in the present study commenced partial weight bearing within five to six postoperative days, reflecting the stability achieved by the augmented construct. Early ambulation facilitates recovery of muscle strength, improves patient confidence, reduces systemic complications and accelerates the return to independent daily activities. Previous studies have similarly highlighted the benefits of early postoperative mobilisation following stable fixation of hip fractures.²⁰

Functional recovery was evaluated using the Harris Hip Score, which demonstrated progressive improvement throughout the follow-up period. The mean score increased significantly from 47.73 at two weeks to 86.60 at six months, indicating continuous restoration of pain relief, mobility and hip function during rehabilitation. At final follow-up, 90% of patients achieved either excellent or good functional outcomes. These findings compare favourably with those reported by Kumar et al, Patel et al and Murugesan et al, all of whom documented satisfactory functional recovery after operative treatment of unstable intertrochanteric fractures.²²⁻²⁴

The low incidence of postoperative complications further supports the effectiveness of augmented fixation. Implant failure and varus collapse each occurred in only one patient, while limb shortening was observed in two patients. These complication rates compare favorably with reports involving isolated fixation of unstable fractures, where inadequate lateral wall support has been identified as a major contributor to mechanical failure. Reconstruction of the lateral femoral wall restores the lateral buttress, limits excessive fracture collapse, improves rotational control and enhances the overall stability of the fixation construct. The present findings are

therefore consistent with previous biomechanical and clinical studies emphasising the importance of lateral wall preservation or reconstruction in unstable intertrochanteric fractures.²⁵

The present study has several limitations that should be considered while interpreting its findings such as the sample size was relatively small, which may have limited the statistical power and generalisability of the results. The study was conducted at a single tertiary care centre and therefore the outcomes may not fully represent those of broader patient populations or different clinical settings. And finally, the duration of follow-up was limited to six months, preventing assessment of long-term implant survival, late complications and sustained functional recovery. extramedullary augmentation.

CONCLUSION

The findings of the present prospective observational study indicate that augmented intramedullary fixation using an additional extramedullary implant is an effective surgical option for managing unstable intertrochanteric femur fractures with lateral wall deficiency in elderly patients with Dorr type C femoral morphology. The augmented construct provided satisfactory mechanical stability, allowing early postoperative mobilisation while promoting reliable fracture healing. A progressive improvement in hip function was observed throughout the follow-up period, as demonstrated by the significant increase in HHS from the early postoperative phase to six months after surgery. Most patients achieved excellent or good functional outcomes and radiological union was obtained within the expected time frame in the majority of cases. Furthermore, the low frequency of implant-related complications suggests that reinforcement of the deficient lateral wall contributes to improved construct stability and reduces the risk of mechanical failure in severely osteoporotic bone.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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