Original Article | Trauma International | 2026 January-June; 12(1): 49-55

Decision Making in Management of Intertrochanteric Femur Fractures in Adults

Sachin Kale[1], Wasudeo Gadegone[2], Sushant Srivastav[1], Nikhil Makhija[1], Ameey Abhishek[1], Arpan Mittal[1]

Abstract

Intertrochanteric femur fractures are among the most common proximal femoral injuries, particularly in the elderly with osteoporosis. They are associated with significant morbidity, mortality, and loss of independence. Although these fractures generally have good vascularity and low nonunion rates, their inherent mechanical instability demands precise assessment of stability and individualized implant selection.

This chapter provides a clinically oriented review of anatomy, biomechanics, classification, radiological evaluation, and evidence-based management strategies. Fracture stability—guided primarily by the integrity of the posteromedial cortex, lateral wall, and overall pattern—remains the cornerstone of decision-making. Stable fractures (AO/OTA 31-A1) are reliably managed with a sliding hip screw (DHS), while unstable patterns (most 31-A2 and all 31-A3) are best treated with cephalomedullary nails (e.g., PFNA or equivalent) due to their superior biomechanical stability and load-sharing properties. The integrity of the lateral wall plays a critical role in determining implant choice, as its compromise significantly increases the risk of fixation failure with extramedullary devices. Achieving proper reduction, particularly avoiding varus malalignment, is essential to prevent complications. Early surgical intervention and mobilization are key factors in reducing systemic complications such as deep vein thrombosis and pulmonary complications.

In India, intertrochanteric fractures predominate among proximal femoral injuries, often with delayed presentation. Osteoporosis (Singh's index), domestic falls, and comorbidities (hypertension, diabetes) are common. Early surgery (ideally within 48 hours when medically optimized), multidisciplinary care, and rehabilitation remain challenges but are essential for improving functional recovery and reducing mortality. Early surgical fixation and mobilization, within a multidisciplinary framework, are critical to optimizing outcomes. Individualized treatment planning, meticulous surgical technique, and early mobilization remain the cornerstones of achieving favorable functional outcomes, particularly in the elderly population.

Keywords: Intertrochanteric fracture, Proximal femoral nail, Dynamic hip screw, Fracture stability, Lateral wall, Cephalomedullary nailing

Introduction

Intertrochanteric fractures occur in the region between the greater and lesser trochanters of the femur and represent a substantial proportion of proximal femur fractures. (Figure 1)

They are particularly common in the elderly due to osteoporosis and account for nearly 56–66% of proximal femoral fractures in India. These injuries are associated with considerable morbidity, mortality, and a decline in functional independence, making timely and effective management crucial [1, 2].

Anatomy and Biomechanics

Several anatomical parameters are important in understanding these fractures:

- Neck-shaft angle: approximately 130° ± 7°
- Femoral anteversion: approximately 10° ± 7°
- Calcar femorale: provides critical medial structural support [3]

Muscle Forces and Resulting Deformity

The deforming forces acting on fracture fragments are predictable:

- Proximal fragment → flexion, abduction, external rotation
- Distal fragment → adduction and shortening

These forces typically result in a varus deformity, which is a key concern during reduction [4].

Blood Supply

Intertrochanteric fractures have a relatively good blood supply, which explains their low rates of nonunion.

Major contributors include:

- Trochanteric anastomosis
- Medial and lateral femoral circumflex arteries
- Periosteal vessels [3] (Figure 2 blood supply)

[1]Department of Orthopaedics, Dr. D.Y. Patil Medical College, Navi Mumbai, Maharashtra, India.
[2]Gadegone Hospital, Chandrapur, Maharashtra, India.

Address of Correspondence
Dr. Sachin Kale
Department of Orthopaedics, Dr. D.Y. Patil Medical College, Navi Mumbai, Maharashtra, India.
E-mail: sachinkale@gmail.com

Submitted: 04/03/2023; Reviewed: 27/03/2023; Accepted: 07/05/2023; Published: 10/04/2026

@Author, Trauma International ISSN 2455-538X | Available on www.traumainternational.co.in | DOI- https://doi.org/10.13107/ti.2026.v12.i01.90

Figure 1: Intertrochanteric femur fracture

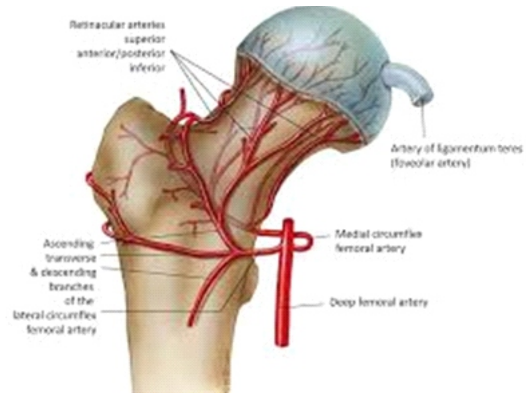

Figure 2: Blood supply

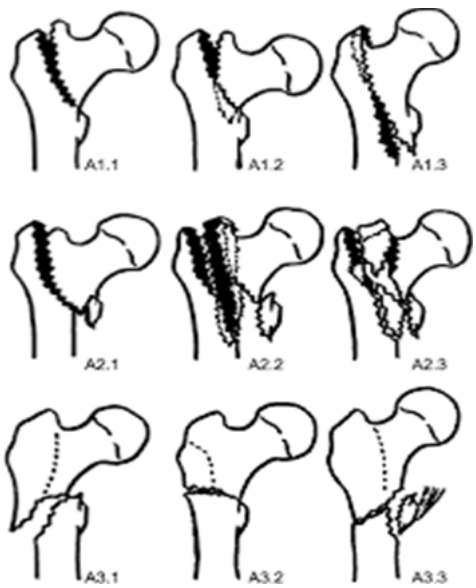

Figure 3: AO Classification

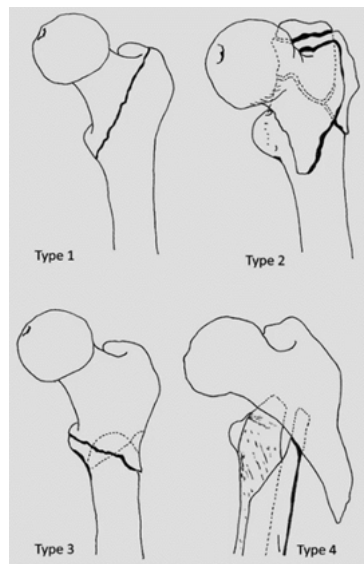

Figure 4: Boyd And Griffin Classification

Classification Systems

AO/OTA Classification (Figure 3)

This is the most widely used and reliable system:

• 31-A1: Simple pertrochanteric (two-part) fractures with intact lateral wall (stable)

• 31-A2: Multifragmantary pertrochanteric fractures; subdivided by lateral wall competence (thickness measured ~3 cm below innominate tubercle at 135°; <20.5 mm indicates incompetence)

• 31-A3: Intertrochanteric (reverse obliquity) fractures with fracture line extending through both medial and lateral cortices (universally unstable) [5]

Evans Classification (and Modified Evans)

Emphasizes post-reduction stability based on posteromedial cortical integrity:

• Stable (Type I): Posteromedial cortex intact or reconstructible → esists varus collapse

• Unstable (Type II): Significant posteromedial comminution, reverse obliquity, subtrochanteric extension, or lateral wall disruption

Core Concept of Stability: An intact posteromedial buttress (calcar) and competent lateral wall are the primary determinants of whether a fracture will behave stably after reduction.

Boyd and Griffin Classification of Intertrochanteric Femur Fractures (Figure 4)

The Boyd and Griffin classification (1949) is one of the early systems used to categorize intertrochanteric fractures based on fracture pattern, comminution, and extension into adjacent regions. Although less commonly used today compared to AO/OTA classification, it remains important for understanding fracture complexity and guiding treatment principles.

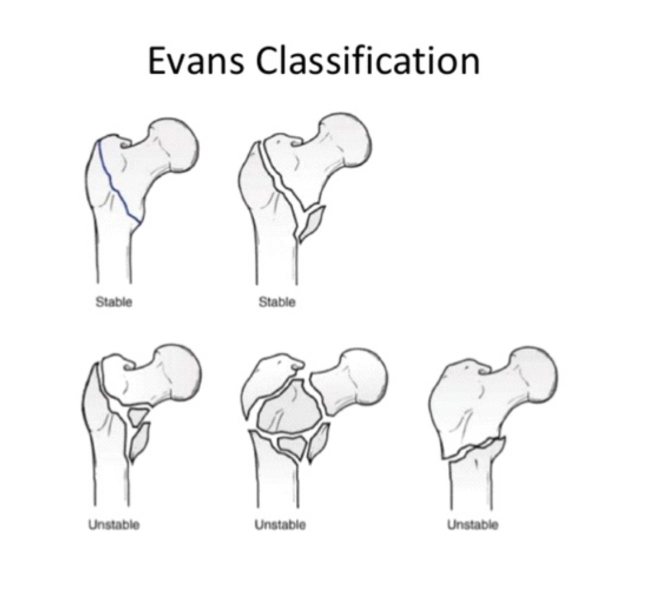

Figure 5: Evans Classification

Figure 6: IT Fracture Fixed Using DHS

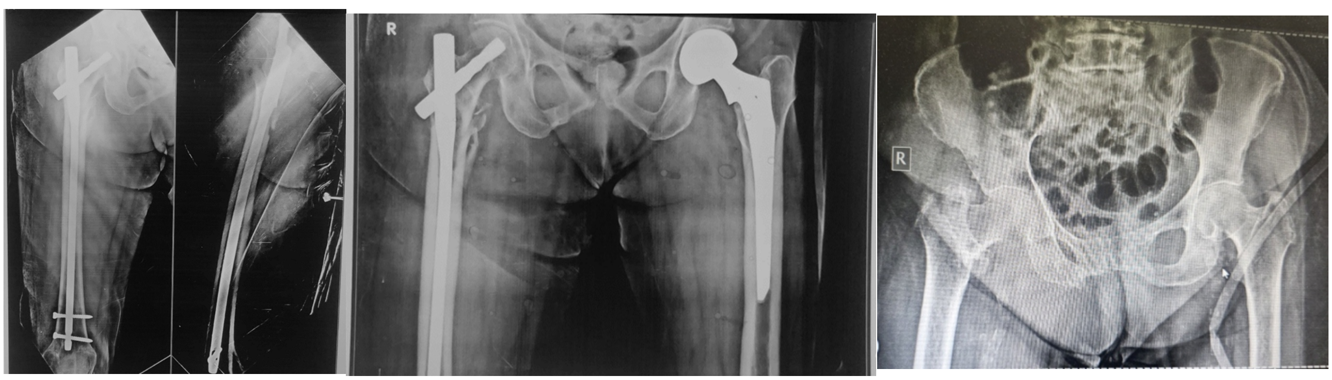

Figure 7.1: Augmented Fixation

Type I
• Description: Simple, two-part intertrochanteric fracture along the intertrochanteric line
• Characteristics:
o Minimal or no comminution
o Stable after reduction
• Clinical Relevance:
o Good prognosis
o Typically managed with Dynamic Hip Screw (DHS)

Type II
• Description: Comminuted intertrochanteric fracture with multiple fragments
• Characteristics:
o Posteromedial cortex often disrupted
o Loss of calcar support
• Clinical Relevance:
o Unstable fracture
o Higher risk of varus collapse
o Often requires intramedullary fixation (PFN/PFNA)

Type III
• Description: Fracture extending into the subtrochanteric region
• Characteristics:
o Combination of intertrochanteric and subtrochanteric components
o Increased mechanical stress
• Clinical Relevance:
o Highly unstable
o Best managed with intramedullary devices

Type IV
• Description: Fractures involving the trochanteric region with extension into the femoral shaft
• Characteristics:
o Severe comminution
o Associated with high-energy trauma
• Clinical Relevance:
o Very unstable pattern

Figure 7.2: Augmented Fixation with Cement

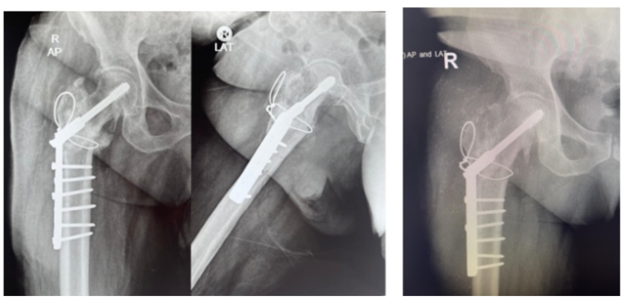

Figure 9: IT fracture with GT fragment fixed with SS wire cerclage

o Requires strong fixation (long PFN / IM nail)

Evans Classification of Intertrochanteric Femur Fractures

The Evans classification (1949) is a widely used and clinically relevant system for intertrochanteric fractures. It is based primarily on the concept of fracture stability, particularly the integrity of the posteromedial cortex and the ability to achieve and maintain reduction.

Evans Classification (Figure 5)

Type I – Stable Fractures

•Description:
o Two-part fractures
o Posteromedial cortex intact or re-constructible
• Key Feature:
o After reduction, the fracture is stable
• Biomechanics:
o Medial buttress preserved → prevents varus collapse
• Management:
o Dynamic Hip Screw (DHS) is usually sufficient
• Prognosis:
o Good outcomes

Type II – Unstable Fractures

• Description:
o Comminuted fractures

Figure 8: IT fracture with lateral wall communition

Figure 10: PFNA2 fixation in intertrochanteric femur fracture

o Posteromedial cortex is disrupted and not re-constructible
• Key Feature:
o The fracture remains unstable even after reduction
• Biomechanics:
o Loss of medial support → varus collapse tendency
• Management:
o Intramedullary fixation (PFN / PFNA) preferred
• Prognosis:
o Higher complication and failure rates

Modified Evans Classification

To improve clinical applicability, Evans classification is often expanded into:

Stable Fractures

• Intact posteromedial cortex
• Minimal comminution
• Good cortical contact after reduction

Unstable Fractures
Include:
• Posteromedial comminution
• Reverse obliquity fractures
• Subtrochanteric extension
• Lateral wall fractures

Concept of Stability
Fracture stability plays a decisive role in treatment planning:
• Stable fractures → intact posteromedial cortex
• Unstable fractures include:
o Posteromedial comminution
o Reverse obliquity
o Lateral wall fractures [6]
• Clinical Presentation and Investigations
• Patients present with hip/groin pain, inability to bear weight, limb shortening, and external rotation deformity. Prominence of the greater trochanter may be noted. [7]

Imaging:
• Standard: Anteroposterior (AP) pelvis and cross-table lateral radiographs of the hip
• CT scan: Useful for complex patterns, assessing comminution and lateral wall integrity
• MRI: For occult fractures in osteoporotic patients with negative plain films

Treatment Principles
Goals of Treatment
• Restore anatomical alignment
• Allow early mobilization
• Prevent complications such as DVT and pneumonia [2]

Flowchart 1: Initial Management
• Patient with suspected IT fracture
• ↓
• Clinical examination + X-ray (AP + lateral)
• ↓
• Is the fracture confirmed?
• ↓ YES
• Assess stability (AO / Evans)
• ↓
• Stable Unstable
• ↓ ↓
• DHS fixation PFN / IM Nail
• ↓
• Early mobilization

• **Flowchart 2: Decision-Making**
•
• Intertrochanteric fracture
• ↓
• Assess patient factors
• (Age, bone quality, mobility)
• ↓
• Assess fracture pattern
• ↓
• ----------------------------------
• | Stable fracture
• | → DHS
• ----------------------------------
• | Unstable fracture
• | → PFN / PFNA / IM Nail
• ----------------------------------
• | Reverse obliquity
• | → Intramedullary device
• | Non-ambulatory / high risk
• | → Conservative
• ---------------------------------

Surgical Options
1. Dynamic Hip Screw (DHS) (Figure 6)
Dynamic hip screw is Ideal for stable fractures and works on the principle of controlled collapse however risk of varus collapse, especially if stability is compromised [8]

2. Proximal Femoral Nail (PFN)
Preferred for unstable fractures as it acts as a load-sharing device and compensate for posteromedial fragment.
Advantages:
Shorter lever arm and better biomechanical stability helps in union [9]
Short PFNA-II – When to Use
Best for simple, stable patterns around the trochanteric region
Indications:
Stable intertrochanteric fractures (e.g., AO 31-A1)
Minimally comminuted A2 fractures
Fractures confined to proximal femur only
Normal femoral shaft
Elderly patients where shorter surgery time is preferred
Long PFNA-II – When to Use
Preferred when you need more stability or protection of the entire femur
Indications:
Unstable intertrochanteric fractures (A2 with comminution, A3) Subtrochanteric extension, Reverse oblique fractures, Segmental fractures, Pathological fractures, Osteoporotic bone with risk of future shaft fractures, Associated femoral shaft pathology, Previous implant failure (Figure 7.1)

3. Augmented Fixation (Figure 7.1)
Augmented Fixation with Cement (Figure 7.2)

• Cement augmentation
• Use of locking plates in selected cases [10]

4. 95 Degree Condylar Blade Plate Fixation
• The condylar blade plate is a bone-preserving implant, primarily utilized for nonunion and revision surgeries of proximal femoral fractures, and is rarely used for fixing unstable fractures. In elderly patients with unstable intertrochanteric fragility fractures, the fixed angled condylar blade plate seems to be a better choice than dynamic

hip screws. It prevents rotation of the proximal femoral head fragment and allows for fracture
compression. It buttresses the lateral wall as the placement of the plate at a higher level, giving support to the lateral wall, eliminating the need for additional procedures to address the lateral wall. A recent study has shown that 95-degree condylar blade plate fixation is a reliable and effective treatment for trochanteric fractures. The surgical technique and final implant position also influence the results in unstable trochanteric fractures. Ideal implant positioning involves placing the blade tip in the lower half of the femoral head, passing the blade below the superior cortex of the neck

Decision-Making Approach
Management depends on a combination of:
• Patient factors (age, bone quality, mobility)
• Fracture pattern
• Stability
General Approach
• Stable fractures → DHS
• Unstable fractures → PFN / PFNA / IM nail
• Reverse obliquity → Intramedullary fixation only
• Non-ambulatory or high-risk patients → Conservative management [6,9]

Role of the Lateral Wall (Figure 8)
The integrity of the lateral wall is crucial:
Intact lateral wall → DHS provides adequate stability
Comminuted lateral wall →
DHS alone is insufficient leads to uncontrolled collapse and fixation failure.
Intramedullary devices (PFN/PFNA) are preferred [11]
Adjuncts may include:
• Cerclage wire, Trochanteric buttress plate
• Cement augmentation

When to Specifically Fix the Greater Trochanter Fragment (Figure 9)
• Large fragment affecting abductor lever arm
• Fragment interferes with implant stability (e.g., PFNA/ DHS)
• Causes persistent displacement after nail insertion
Risk of nonunion leading to chronic limp
Fixation options: Cerclage wiring, Tension band wiring, Suture anchors (in select cases)
Integrated fixation with PFNA-II

Flowchart 3: Implant Selection
Fracture pattern ↓
Stable (A1) → DHS ↓
Unstable (A2/A3) ↓
Check:
- Lateral wall integrity
- Posteromedial support ↓
Compromised → PFN / PFNA ↓
Reverse obliquity → IM Nail ONLY
Lateral Wall Communinition in IT Fracture
Patient with Intertrochanteric Fracture
↓
Assess Lateral Wall (X-ray / CT)
↓

| Is lateral wall intact? |

↓ YES ↓ NO (Comminuted)

----------------------------------- ---------------------------------------
| Stable fracture pattern | | Unstable fracture pattern |
| (AO 31A1 / some A2) | | (A2 with LW comminution / A3) |
----------------------------------- ---------------------------------------
↓ ↓
DHS (Dynamic Hip Screw) Avoid DHS alone ✖
↓ ↓
Good lateral buttress prevents excessive collapse Loss of lateral support → uncontrolled collapse & failure
↓ ↓
Early mobilization Choose Intramedullary device (PFN / PFNA / IM nail)
↓
Consider adjuncts:
- PFN with Trochanteric buttress plate
- PFN with Trochanteric buttress plate with cerclage
-PFN with CC Screws
- PFN with Cerclage

Biomechanics of Fixation
The hip joint transmits forces 5–7 times body weight [4] Intramedullary nails reduce bending moments. DHS depends heavily on lateral cortex support.Integrity of the calcar femorale is essential for stability [3, 8] Intertrochanteric fractures differ from femoral neck fractures in that they have better vascularity but poorer mechanical stability [3, 4].
Key Take away- Stability Determines Treatment. Posteromedial cortex is critical, Its loss leads to varus collapse [6]

2. DHS vs PFN

• Feature	• DHS	• PFN
• Indication	• Stable fractures	•Unstable fractures
• Biomechanics	•Load-bearing	•Load-sharing
• Failure risk	• Higher (varus collapse)	•Lower

3. Why PFN is Preferred in Unstable Fractures (Figure 10)
Shorter lever arm
Reduced bending stress
Superior performance in osteoporotic bone [9]

Conclusion
Intertrochanteric fractures remain a significant orthopaedic challenge. Successful management requires a thorough understanding of fracture biomechanics, classification, and implant selection. Stable fractures can be effectively managed with DHS, whereas unstable patterns demand intramedullary fixation. Additional fixation with plate or cerclage wire is mandatory to improve the results in a compromised lateral wall. Above all, early surgical intervention and mobilization are key to improving patient outcomes

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

Conflict of Interest: None, **Source of Support:** None

References

1. Neer CS. Displaced proximal humeral fractures. I. Classification and evaluation. J Bone Joint Surg Am. 1970;52(6):1077–1089.
2. Neer CS. Displaced proximal humeral fractures. II. Treatment of three-part and four-part displacement. J Bone Joint Surg Am. 1970;52(6):1090–1103.
3. Court-Brown CM, Caesar B. Epidemiology of adult fractures: a review. Injury. 2006;37(8):691–697.
4. Hertel R, Hempfing A, Stiehler M, Leunig M. Predictors of humeral head ischemia after intracapsular fracture of the proximal humerus. J Shoulder Elbow Surg. 2004;13(4):427–433.
5. Rockwood CA Jr, Matsen FA III, Wirth MA, Lippitt SB, Fehringer EV, Sperling JW. Rockwood and Matsen's The Shoulder. 5th ed. Philadelphia: Elsevier; 2016.
6. Bucholz RW, Heckman JD, Court-Brown CM, Tornetta P III, McQueen MM, Ricci WM. Rockwood and Green's Fractures in Adults. 9th ed. Philadelphia: Wolters Kluwer; 2020.
7. Handoll HH, Ollivere BJ, Rollins KE. Interventions for treating proximal humeral fractures in adults. Cochrane Database Syst Rev. 2012;(12):CD000434.
8. Olerud P, Ahrengart L, Ponzer S, Saving J, Tidermark J. Internal fixation versus nonoperative treatment of displaced 3-part proximal humeral fractures in elderly patients: a randomized controlled trial. J Shoulder Elbow Surg. 2011;20(5):747–755.
9. Boileau P, Watkinson DJ, Hatzidakis AM, Hovorka I. Neer classification revisited for proximal humerus fractures. J Shoulder Elbow Surg. 2001;10(3):224–230.
10. Brorson S, Rasmussen JV, Frich LH, Olsen BS, Hróbjartsson A. Benefits and harms of locking plate osteosynthesis in displaced 4-part proximal humerus fractures: a systematic review. BMJ Open. 2012;2(5):e001691.
11. Cuff DJ, Pupello DR. Comparison of hemiarthroplasty and reverse shoulder arthroplasty for treatment of proximal humeral fractures in elderly patients. J Bone Joint Surg Am. 2013;95(22):2050–2055.
12. net D, Ohl X, Decroocq L, Dib C, Valenti P, Boileau P. Is reverse shoulder arthroplasty justified for complex fractures of the proximal humerus in elderly patients? Orthop Traumatol Surg Res. 2009;95(6):442–449.

How to Cite this Article

Kale S, NKamat N, Pai S, Shyam A, Sharma G, Makhija N | Comprehensive Management of Proximal Humerus Fractures in Adults: A Practical Clinical Review and Decision-Making Framework | January-June 2026; 12(1): 49-55 | https://doi.org/10.13107/ti.2026.v12.i01.90