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REVIEW: Closed Versus Limited Open Reduction in the Treatment of Subtrochanteric Femoral Fractures: A Narrative Review

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ABSTRACT

Subtrochanteric femoral fractures are difficult to reduce because powerful muscular forces displace the short proximal fragment into flexion, abduction, and external rotation, while the predominantly cortical fracture zone is exposed to high bending stresses. Cephalomedullary nailing is the preferred fixation strategy, but the optimal method of obtaining reduction remains debated. This narrative review compares closed reduction with limited open reduction in adults undergoing intramedullary fixation. Closed reduction preserves the fracture hematoma and periosteal envelope and is generally associated with shorter operations and less blood loss. Nevertheless, repeated manipulations, prolonged fluoroscopy, or acceptance of varus alignment and a residual medial gap may negate these advantages. Limited open reduction permits direct or clamp-assisted restoration of length, rotation, and medial cortical continuity; selected simple or long-oblique patterns may also benefit from percutaneous cerclage. Contemporary observational evidence does not show a consistent increase in deep infection or nonunion after a carefully performed limited exposure, although superficial infection, transfusion, and operative time may increase. Across studies, the quality of reduction appears more important than the label of the reduction technique. A pragmatic closed-first strategy is therefore appropriate, with timely conversion to limited open reduction when acceptable alignment cannot be obtained efficiently. The decision should be individualized according to fracture morphology, soft-tissue condition, surgeon experience, and the ability to restore the medial buttress without extensive periosteal stripping. High-quality prospective comparative studies using standardized reduction criteria and patient-reported outcomes are still required.

Introduction

Subtrochanteric femoral fractures are commonly defined as fractures whose principal line lies between the inferior border of the lesser trochanter and 5 cm distally. They occur after high-energy trauma in younger adults, low-energy falls in older adults, and occasionally as atypical or pathological fractures. The region combines thick cortical bone, comparatively vulnerable blood supply, and some of the highest bending stresses in the skeleton. These characteristics explain the persistent risks of delayed union, nonunion, implant fatigue, and reoperation (1-4).

The deforming forces are predictable but difficult to control. The iliopsoas flexes the proximal fragment, the hip abductors abduct it, and the short external rotators produce external rotation; the distal fragment is commonly adducted and shortened. Cephalomedullary nailing offers a load-sharing construct close to the mechanical axis and is widely regarded as the fixation method of choice (1,2). However, nail insertion cannot compensate for an unreduced fracture. Varus malalignment, sagittal angulation, distraction, and absence of medial cortical support increase bending at the fracture site and the implant (3-6).

Reduction may be achieved by traction and indirect maneuvers without opening the fracture, or by a limited exposure that allows manipulation with clamps, hooks, joysticks, or cerclage. The biological attraction of a closed technique is clear, yet an imperfect closed reduction may be mechanically inferior to an anatomically aligned limited open reduction. This review summarizes current evidence and proposes a practical decision framework for choosing between the two approaches.

Material and Methods

A focused narrative search was conducted for English-language publications available through August 2026. PubMed/MEDLINE and reference lists of relevant reviews and comparative studies were searched using combinations of "subtrochanteric femur fracture," "closed reduction," "open reduction," "limited open reduction," "intramedullary nail," "cerclage," "malreduction," and "nonunion." Priority was given to adult clinical cohorts directly comparing reduction strategies, studies evaluating reduction quality or nonunion, and contemporary technical or consensus papers. Femoral-shaft and intertrochanteric studies were used only when they clarified general biological or technical principles. Because the literature was heterogeneous and predominantly retrospective, no quantitative pooling was attempted. Findings were synthesized according to perioperative burden, reduction quality, union, complications, and functional recovery.

Reduction Quality

Reduction quality is the central determinant linking surgical technique to healing. In a cohort of 35 subtrochanteric fractures, every fracture with malreduction greater than 10° developed delayed union or nonunion, whereas no nonunion occurred among adequately reduced fractures (5). In another series of 74 patients, postoperative varus, lack of medial cortical support, and early nail autodynamization were the only significant predictors of nonunion; the nonunion rate rose from 2.9% with no risk factor to 100% when all three were present (6). Residual displacement and distraction have likewise been associated with return to theatre (7).

These observations do not prove that open reduction is superior. They show that biological preservation must be balanced against mechanical adequacy. The operative target should be restoration of the neck-shaft relationship, correction of sagittal deformity, adequate cortical contact, particularly medially, and avoidance of distraction. A perfectly anatomic reduction is not mandatory in every comminuted fracture, but varus and a persistent medial gap should not be accepted merely to preserve a closed label.

Closed Reduction

Closed reduction usually begins on a traction table with longitudinal traction, controlled rotation, and adjustment of hip flexion or abduction. Percutaneous tools may extend the closed strategy: a Schanz pin can act as a joystick in the proximal fragment, while a ball-spike pusher, bone hook, collinear clamp, femoral distractor, or strategically placed percutaneous clamp can correct translation and angulation (1,2,8,18). The starting point and guidewire trajectory must be established only after satisfactory alignment; eccentric entry or reaming across an unreduced fracture may worsen varus or create comminution.

The principal advantages are preservation of fracture hematoma, minimal periosteal disturbance, a smaller wound, and usually less blood loss. Recent comparative cohorts report shorter operative time and lower estimated blood loss with closed reduction, although selection bias is substantial because simpler patterns are more likely to reduce closed (9,10,19). Disadvantages include repeated manipulation, increased fluoroscopy, occult malrotation, and the temptation to accept a residual deformity after prolonged attempts. Closed reduction should therefore be considered a means to obtain alignment, not an end in itself.

Limited Open Reduction

Limited open reduction is distinct from wide exposure and circumferential stripping. Through a short lateral incision centered on the dominant fracture line, the surgeon can clear only interposed tissue necessary for reduction and use pointed clamps, a collinear clamp, bone hook, or temporary unicortical fixation. The periosteal sleeve and muscular attachments should be preserved whenever possible. In long-oblique or spiral configurations, one or two percutaneously passed cerclage cables may maintain reduction and restore the medial column before nail insertion (7,11-15,20,22,25).
Direct visualization improves control of translation, rotation, and cortical apposition and may shorten an otherwise prolonged sequence of unsuccessful closed maneuvers. The trade-offs are additional soft-tissue dissection, blood loss, wound morbidity, and operative time. Panteli et al., in 523 fractures, found open reduction associated with superficial infection, transfusion, and operations longer than 120 minutes, but not with increased deep infection, nonunion, mortality, or overall reoperation (11). Within the open group, cerclage-assisted reduction was associated with a lower risk of nonunion than clamp-assisted reduction alone. These findings support selective limited exposure, but confounding by fracture complexity prevents causal conclusions.

Table 1. Representative comparative evidence

Study	Design / n	Comparison	Main findings	Key limitation	Clinical message
Hoskins et al. (7)	Retrospective; 134	Closed, open, open + cerclage	Cerclage improved displacement and angulation; no cerclage case returned to theatre.	Nonrandom allocation; mixed patterns	Escalate when closed alignment is inadequate; use cerclage selectively.
Codesido et al. (12)	Retrospective elderly cohort	Open + cerclage vs closed	Better reported quality-of-life/clinical outcomes in the cerclage group; complications assessed.	Elderly population; selection bias	Limited open reduction may be safe in selected unstable patterns.
Mehta et al. (13)	Retrospective; 49	Closed vs open + cerclage	Open cerclage group achieved better reduction in irreducible patterns without a clear penalty in union or major complications.	Small sample; group imbalance	Reduction quality may outweigh the theoretical biological cost.
Knauf et al. (14)	Retrospective; 77	Open vs closed	No higher overall complication rate with open reduction; early mobility favored open reduction.	Single center; retrospective	Open reduction is not intrinsically harmful when exposure is controlled.
Panteli et al. (11)	Retrospective; 523 fractures	Open vs closed; cerclage subgroup	Open: more superficial infection, transfusion, and longer surgery; no increase in deep infection/nonunion. Cerclage subgroup had lower nonunion odds.	Residual confounding; broad definition of open	Use closed first, but do not preserve it at the cost of alignment.
Seabra et al. (10)	Retrospective; 190	Open vs closed	Closed reduction reduced operative burden; acceptable reduction, rather than approach alone, was central to healing.	Recent single-center cohort	Set explicit reduction thresholds before choosing or converting technique.

Comparative Evidence

Direct evidence remains observational and heterogeneous. Studies differ in the definition of “open,” fracture classification, cerclage use, implant design, reduction criteria, and follow-up. Consequently, the apparent effect of a technique often reflects the fracture that required it. Complex fractures, diaphyseal extension, and failed initial reduction disproportionately enter the open group

The most defensible synthesis is therefore conditional rather than absolute. Closed reduction has perioperative advantages when it achieves acceptable alignment efficiently. Limited open reduction becomes favorable when mechanical goals cannot otherwise be met. Cerclage is not required for every open reduction and should not be used to convert comminution into a rigidly stripped construct; it is most useful in reducible spiral or long-oblique patterns where a cable can restore cortical continuity with minimal exposure. Recent comparative cohorts and evidence syntheses similarly suggest that cerclage can improve reduction quality and may shorten time to union in selected patterns, but it may increase operative time and blood loss; heterogeneity and confounding preclude routine use in every fracture (20,23,24,28,30).

Practical Decision-Making

Table 2. Proposed intraoperative decision framework for adult subtrochanteric fractures treated with cephalomedullary nailing.

Decision point	Preferred action	Conversion trigger	Rationale
Preoperative planning	Assess AP/lateral views, traction view when useful, fracture line, medial comminution, and diaphyseal extension.	Pattern predicts blocked reduction or unstable long-oblique fragment.	Anticipates instruments, incision site, and possible cerclage.
Initial reduction	Traction, rotation, limb positioning, then percutaneous joystick/pusher/clamp as needed.	Persistent varus, sagittal deformity, translation, or distraction after efficient attempts.	Avoids prolonged manipulation and radiation without progress.
Acceptability check	Confirm coronal and sagittal alignment, rotation, length, and medial cortical contact before reaming.	>10° deformity, obvious malrotation, or clinically important medial/lateral gap.	Malreduction and loss of medial support predict delayed/nonunion.
Limited exposure	Short targeted incision; clamp or hook reduction; preserve periosteal attachments.	Reduction still unstable or lost during reaming/nail passage.	Provides controlled alignment without wide biological disruption.
Cerclage selection	Use one or two percutaneous cables for suitable spiral/oblique patterns.	Avoid in highly comminuted fragments that require extensive stripping.	Maintains medial continuity while limiting devascularization.
Final verification	Check nail entry, neck-shaft angle, fracture gap, cortical support, rotation, and implant position.	Revise before leaving theatre if mechanical goals remain unmet.	The index operation is the best opportunity to prevent nonunion.

Special Clinical Considerations

Fracture morphology should drive escalation. Simple transverse fractures may require direct control because the proximal fragment is short and strongly deformed. Spiral and long-oblique patterns can often be held with percutaneous clamps or cerclage. Highly comminuted fractures may be better treated with indirect restoration of length and alignment rather than aggressive pursuit of anatomic reconstruction. Diaphyseal extension predicts a higher likelihood of open reduction and should lower the threshold for preparing limited-open instruments (11,16-18,26,29). In atypical subtrochanteric fractures, reduction quality also remains strongly associated with time to union, reinforcing the need to correct varus and cortical gapping (21).

Patient and system factors also matter. In frail older patients, avoiding prolonged anesthesia and blood loss is important, favoring an efficient closed attempt but also timely conversion rather than extended manipulation. In high-energy trauma, soft-tissue condition and associated injuries may restrict exposure. Surgeon experience, fluoroscopic access, table setup, and availability of percutaneous reduction tools influence what can genuinely be achieved through a closed technique. A method that is minimally invasive in name but prolonged and traumatic in execution may be less biological than a short, purposeful exposure. The high mechanical demand of the subtrochanteric region and reported modes of cephalomedullary nail fatigue further support achieving stable load sharing at the index procedure (27).

Limitations of Evidence

Most available studies are retrospective and vulnerable to confounding by indication: the fractures selected for open reduction are usually more displaced and complex. Definitions of limited open reduction and acceptable alignment are inconsistent, and cerclage is variably grouped with clamp-assisted exposure. Functional scores, time-to-union definitions, and weight-bearing protocols differ. Several studies are small or limited to older adults, and surgeon learning curves are rarely reported. Recent studies strengthen the evidence base but do not replace randomized or well-designed prospective comparisons. Accordingly, numerical estimates should inform discussion rather than serve as universal thresholds. Even recent meta-analyses combine subtrochanteric and reverse-oblique intertrochanteric patterns, so their pooled estimates should not be interpreted as fracture-specific causal effects (20,28).

Conclusion

Closed and limited open reduction are complementary strategies rather than competing doctrines. Closed reduction should usually be attempted first because it preserves local biology and reduces operative burden when successful. However, persistent varus, sagittal deformity, malrotation, distraction, or loss of medial cortical support is a stronger threat to union than a carefully performed limited exposure. Timely conversion to targeted clamp-assisted or selective cerclage-assisted reduction is therefore justified when acceptable alignment cannot be achieved efficiently. Current evidence suggests that reduction quality is the decisive variable, while limited open reduction does not inherently increase deep infection or nonunion. Future prospective studies should standardize fracture morphology, reduction criteria, cerclage technique, and patient-reported outcomes.

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