Section: Orthopaedics

Original Research Article

ASSESSMENT OF POSTOPERATIVE NECK-SHAFT ANGLE FOLLOWING SURGICAL FIXATION OF INTERTROCHANTERIC FEMORAL FRACTURES

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ABSTRACT

Background: Intertrochanteric fractures of the femur are frequently observed in elderly populations. These fractures often lead to alterations in the neck-shaft angle (NSA), which, if not properly corrected, may contribute to long-term functional impairment. This study aims to assess the immediate postoperative NSA in patients who underwent surgical fixation for intertrochanteric femoral fractures using either Dynamic Hip Screw (DHS) or Proximal Femoral Nail (PFN) systems, and to compare the outcomes with the NSA of the contralateral, uninjured hip.

Materials and Methods: A prospective observational study was conducted involving 24 adult patients (12 males and 12 females) with mature skeletal systems, who underwent surgical treatment for intertrochanteric fractures over the course of one year. Standardized anteroposterior radiographs of the pelvis with both hips internally rotated by 15 degrees were obtained post-surgery. All surgeries were performed using a traction table, with follow-ups scheduled at 6 weeks, 3 months, and 6 months.

Results: NSA was measured bilaterally using a digital radiographic system. The mean NSA on the non-fractured side was 136±4 degrees, whereas on the operated side it was 126±4 degrees. Union was achieved in all patients. Among complications, varus malunion was found in 2 cases, while 4 cases exhibited valgus alignment.

Conclusion: Postoperative assessment demonstrated that Proximal Femoral Nail (PFN) fixation achieved better restoration of the anatomical neck-shaft angle compared to Dynamic Hip Screw (DHS). Union was achieved in all patients, though malunion occurred in 24%, mainly due to implant-related constraints. These findings highlight the importance of implant selection, surgical precision, and population-specific designs to optimize outcomes in intertrochanteric fractures.

Keywords: Intertrochanteric fractures, neck-shaft angle, dynamic hip screw (DHS), proximal femoral nail (PFN), hip biomechanics.

INTRODUCTION

The femoral neck-shaft angle (NSA) represents the intersection between the axes of the femoral neck and shaft. This anatomical feature is critical for load transmission across the hip joint and is routinely restored during hip surgeries. Accurate assessment of NSA is vital for treatment planning and implant design tailored to specific population anatomies. Studies have explored the correlation between proximal femoral geometry[1] and fracture incidence, aiming to improve surgical outcomes through anatomically suitable implant designs [2]. Racial and ethnic variations in NSA also necessitate region-specific implant considerations.[1-5]

MATERIALS AND METHODS

The study was carried out over a 12-month period in the Department of Orthopedics at Rajarajeswari Medical College and Hospital, Bangalore. Twenty-four patients who met the inclusion criteria—adult individuals with isolated intertrochanteric fractures—were included. Sample size was determined using Fisher's formula:

$N = Z^2 \times P(1-P) / D^2$

Inclusion Criteria:

- Adults with recent, isolated intertrochanteric fractures requiring surgery.

Exclusion Criteria:

- Bilateral intertrochanteric fractures
- Prior surgeries on the proximal femur
- Anatomical deformities in the non-fractured hip (e.g., DDH, Perthes disease, AVN)

Radiographic Protocol: Postoperative pelvic X-rays in AP view were taken with both hips internally rotated at 15 degrees, film-to-focus distance of 100 cm, and beam centered on the pubic symphysis. Measurements were performed using digital imaging systems. Serial radiographs were taken at defined intervals to monitor healing, implant positioning and detect potential complications such as malunion or nonunion.

RESULTS

A total of 24 cases were evaluated radiologically and clinically. Radiological parameters included fracture union status, screw positioning using Tip-Apex Distance (TAD)[3], and morphological changes in the proximal femur Table 1 showing mean neck shaft angle by gender. Clinical evaluation was done using the Harris Hip Score (HHS). The average patient age was 58 years, with injuries primarily resulting from low-energy falls.Table 2 showing fracture union outcomes.

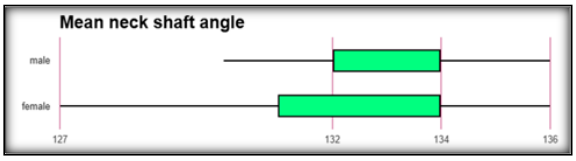
Table 1: showing mean neck shaft angle by gender.

Gender	Mean neck shaft angle
Male	133.1
Female	132.4

Table 2: showing union results

Outcome	Number of Patients	Percentage
Union (6 months)	24	100%
Delayed union	1	4%
Malunion	6	24%
Non-union	0	0%

Lag screw positioning plays a crucial role in surgical outcomes. Cases with satisfactory alignment and maintained cortical contact healed effectively without complications like screw migration, even in the absence of perfect anatomical reduction. This supports prior research by Bridle et al., emphasizing optimal screw placement[4].



Graph 1: Showing mean neck shaft angle in either gender

Figure 1

In our study, the DHS group often did not achieve anatomical NSA restoration, likely due to valgus alignment associated with the fixed angle of the 135° barrel plate. Conversely, PFN fixation allowed better NSA restoration due to its design flexibility in nail and screw positioning. These findings suggest the need for population-specific implant designs [5] that accommodate variations in femoral morphology observed among Indian and other Southeast Asian populations. graph 1 shows mean neck shaft angle in either gender.

DISCUSSION

The present study evaluated the postoperative neck-shaft angle (NSA) following surgical fixation of intertrochanteric femoral fractures and compared the results obtained with Dynamic Hip Screw (DHS) and Proximal Femoral Nail (PFN). The findings highlight that while union was achieved in all patients, there was a consistent reduction in the NSA on the operated side compared to the contralateral, uninjured hip, with a mean difference of approximately 10 degrees. Restoration of anatomical alignment is crucial because NSA directly influences hip biomechanics, load transmission, and long-term functional outcomes. Malalignment, particularly varus reduction, is associated with increased shear forces, higher risk of implant failure, and impaired mobility, whereas valgus alignment may alter joint loading and cause secondary degenerative changes.

In this study, DHS fixation often failed to restore the anatomical NSA, likely due to the inherent limitations of the fixed 135° barrel plate. Similar observations have been reported by Bridle et al., who emphasized that improper placement of the lag screw and mechanical constraints of DHS predispose patients to varus collapse and malunion. Conversely, PFN fixation demonstrated superior anatomical restoration of NSA, attributed to its intramedullary design, shorter lever arm, and ability to resist varus stresses more effectively. Previous randomized studies by Leung et al. and Liu et al. also support the biomechanical advantage of intramedullary devices in maintaining alignment, reducing blood loss, and facilitating early mobilization. Thus, the present findings reinforce the growing preference for PFN in unstable or osteoporotic fractures.

Union was achieved in 100% of cases, with only one case of delayed union, highlighting the effectiveness of both fixation methods in promoting fracture healing when proper surgical technique is followed. However, malunion was noted in 24% of patients, a complication that has important clinical implications. Malunion rates reported in the literature vary between 10–30%, depending on fracture pattern, implant choice, and intraoperative technique. In our cohort, valgus alignment was slightly more common than varus collapse, indicating the influence of implant geometry rather than biological factors. This further strengthens the argument for population-specific implant designs, as femoral morphology varies significantly across ethnic groups, and standard western-designed implants may not always match Indian anatomical norms.

Another significant observation is the role of lag screw positioning and Tip-Apex Distance (TAD) in determining outcomes. As highlighted in prior studies, maintaining a TAD of less than 25 mm reduces the risk of screw migration and cut-out. Our results confirm that patients with satisfactory cortical contact and optimal lag screw placement demonstrated favorable outcomes even in cases where perfect anatomical NSA restoration was not achieved. This underlines the importance of meticulous intraoperative technique, irrespective of implant selection.

The clinical relevance of NSA restoration also lies in its correlation with functional recovery, often assessed through Harris Hip Score (HHS). Although functional outcomes were not extensively detailed in this study, evidence suggests that even small deviations from the normal NSA can impact gait, abductor muscle strength, and long-term hip function. Therefore, strategies to minimize malalignment, whether through improved surgical training, adoption of intramedullary devices, or modification of implant designs tailored to regional populations, are warranted.

CONCLUSION

This study confirms that:

- DHS fixation often fails to restore the anatomical NSA due to the mechanical constraints of the implant.
- PFN fixation provides better anatomical restoration of NSA and may contribute to improved functional outcomes.
- Customized implant designs tailored to regional anatomical norms are recommended.

REFERENCES

1. Liu M, et al. (2010). A meta-analysis of Gamma nail and DHS in peri-trochanteric fractures. Int Orthop.
2. Yadav P, et al. (2013). Effect of femoral neck-shaft angles on hip force. 24th Int Society of Biomechanics Congress.
3. Leung KS, et al. (1992). Gamma nail vs DHS: A randomized study. J Bone Joint Surg Br.
4. Bridle SH, et al. (1991). Fixation of intertrochanteric fractures: Gamma vs DHS. J Bone Joint Surg Br
5. Koval KJ, Zuckerman JD. In: Rockwood and Green's Fractures in Adults. 5th ed.