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Clinical and Radiological Outcomes of Hybrid Screw Fixation in Neck of Femur Fractures: A Prospective Study

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ABSTRACT

Background: Neck of femur fractures remain a clinical challenge in young and middle-aged adults due to high rates of non-union and avascular necrosis. The main objective was to evaluate the clinico radiological and functional outcomes of hybrid screw fixation, using two partially threaded and one fully threaded cannulated cancellous screw.

Methods: This prospective study was conducted at Assam Medical College, Dibrugarh, between June 2023 and May 2024 among 33 patients (18–65 years) with displaced or undisplaced fresh femoral neck fractures. Perioperative parameters, union rates, complications, and functional outcomes (Modified Harris Hip Score, HHS) were assessed at 1, 3, and 6 months.

Results: The mean age was 43.5 ± 16.7 years, with a male-to-female ratio of 1.3:1. Slip and fall (51.5%) and road traffic accidents (42.5%) were the leading causes. Mean surgery duration was 32.4 ± 6.3 minutes, blood loss 71.9 ± 27.7 ml, and hospital stay 5.2 ± 3.2 days. Union was achieved in 29 patients, while 4 experienced complications (2 fixation failures, 2 varus malreductions). Functional outcomes improved steadily with mean HHS scores of 78.3 at 1 month, 86.2 at 3 months, and 89.2 at 6 months.

Conclusion: Hybrid screw fixation provides stable fixation, encouraging union and functional outcomes in femoral neck fractures. The construct offers improved resistance to varus collapse and helps maintain fracture stability during healing, with relatively low complication rates observed in the present study. Larger comparative studies with longer follow-up are needed to validate these findings.

Key-words: Hybrid screw fixation, Neck of femur fractures, Functional outcome, Radiological outcome

INTRODUCTION

Fractures of the femoral neck continue to pose a major challenge in orthopaedic practice due to the risk of non-union, avascular necrosis, and long-term functional disability. Although numerous fixation methods and implants have been developed, there is still no consensus on the optimal fixation strategy, especially in younger adults, where preservation of the native hip joint is a priority. The incidence of femoral neck fractures is increasing worldwide, not only among the elderly due to osteoporosis, but also in younger populations following high-energy trauma such as road traffic accidents. In elderly patients with displaced fractures, arthroplasty remains the gold standard as it provides predictable pain relief and functional recovery. However, in younger patients (<65 years), joint-preserving fixation remains the preferred approach to avoid the limitations of arthroplasty, such as prosthetic wear, higher revision rates, and cost burden [1–3].

Cannulated cancellous (CC) screws are widely used because they are minimally invasive, technically straightforward, and cost-effective. However, fixation with partially threaded CC screws alone is often

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insufficient in cases with vertical fracture lines or reduction, and non-union [4]. To address this, hybrid fixation using a combination of partially threaded and fully threaded CC screws has been proposed. The fully threaded screw provides enhanced axial stability, resists collapse, and maintains compression, while the partially threaded screws allow controlled fracture compression.

Recent biomechanical and clinical studies suggest that hybrid screw fixation improves construct stability and reduces complications compared with conventional screw configurations [5–8]. Nevertheless, the available evidence remains limited, and further clinical studies are required to validate its role.

The present prospective study evaluates the clinicoradiological and functional outcomes of hybrid screw fixation (two partially threaded and one fully threaded CC screws) in fresh femoral neck fractures, with emphasis on union rate, complications, and functional recovery. To analyze the clinical, radiological and functional outcome following hybrid screw fixation in the fracture neck of the femur.

MATERIALS AND METHODS

Study Design and Setting- This was a hospital-based prospective study conducted in the Department of Orthopaedics, Assam Medical College and Hospital, Dibrugarh, from June 2023 to May 2024. Ethical clearance was obtained from the Institutional Ethics Committee (Human) of Assam Medical College. Written informed consent was obtained from all participants.

Participants- A total of 33 patients with displaced or undisplaced fresh femoral neck fractures (FNF) were included. The age range was 18–65 years.

Inclusion criteria- Age 18–65 years; fresh femoral neck fractures (<3 weeks duration); Garden and Pauwels types I–III fractures; patients providing informed consent.

Exclusion criteria- Open fractures; pathological fractures; associated fractures in the ipsilateral limb; contraindications to surgery or anaesthesia; skin infection at the surgical site.

Surgical Technique- All patients were operated on under spinal or general anaesthesia on a fracture table. Adequate reduction was confirmed under fluoroscopy. A 2–3 cm lateral incision was made at the level of the lesser trochanter, fascia lata and vastus lateralis split, and guidewires were inserted in an inverted triangular configuration. One partially threaded CC screw was placed inferocentrally, one anterosuperiorly, and one fully threaded screw posterosuperiorly. Washers were used when necessary. Wound closure was performed in layers.

Fig. 1: Configuration of hybrid screw fixation using two partially threaded and one fully threaded cannulated cancellous screws

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Postoperative Care and Mobilization- Patients were mobilized with tip-toe touch weight-bearing using axillary crutches within 3 days, partial weight-bearing at 1 week, and full weight-bearing walking by approximately 12 weeks, depending on union.

Outcome Measures- Patients were followed at 1, 3, and 6 months. Parameters included perioperative variables (operative time, blood loss, incision length, hospital stay), radiological outcomes (union, delayed union, malunion, non-union, implant failure), functional outcomes (Modified Harris Hip Score), and complications (fixation failure, varus collapse, shortening, osteonecrosis).

Statistical Analysis- Data were analyzed using SPSS software version (24th version). Continuous variables were expressed as mean±SD, and categorical variables as frequencies/percentages. Repeated measures ANOVA was used to compare functional outcomes over time, with $p<0.05$ considered significant.

Ethical approval- Ethical approval for the study was obtained from the Institutional Ethics Committee, Assam Medical College and Hospital, Dibrugarh, Assam, India.

RESULTS

A total of 33 patients were included, with a mean age of 43.5 ± 16.7 years. The majority of cases occurred in the 15–30 and 51–60-year age groups, while 15% were older than 60 years. Males accounted for 57.5% of the study population (Table 1).

Table 1: Baseline Characteristics of Patients (n=33)

Variable	Value
Mean age (years)	43.5 ± 16.7
Male: Female	19 (57.5%): 14 (42.5%)
Age > 60 years	15%

The mean time to radiological union was 12.6 ± 2.0 weeks. Early mobilization was achieved with tip-toe touch weight bearing at 3.2 ± 0.4 days, partial weight bearing at 1 week, and full weight bearing at 11.9 ± 1.0 weeks. Complications observed included fixation failure, varus tilt, and deformity (Table 2).

Table 2: Perioperative and Radiological Outcomes

Parameter	Mean ± SD
Time to radiological union (weeks)	12.58 ± 1.99
Tip-toe touch weight bearing (days)	3.20 ± 0.41
Partial weight bearing (weeks)	1.00 ± 0.00
Full weight bearing (weeks)	11.85 ± 0.99

Functional outcomes improved progressively with time. At 1 month, 15 patients had good, 14 had fair, and 4 had poor hip function, with a mean HHS of 78.3 ± 6.9. At 3 months, 15 patients demonstrated excellent outcomes, 10 good, 5 fair, and 3 poor, with a mean HHS of 86.2 ± 9.9. By 6 months, 23 patients had excellent outcomes, 6 good, 2 fair, and 2 poor, with a mean HHS of 89.2 ± 8.7 (Table 3).

Table 3: Functional Outcome by Harris Hip Score (HHS)

Follow-up	Excellent	Good	Fair	Poor	Mean HHS ± SD
1 month	-	15	14	4	78.3 ± 6.9
3 months	15	10	5	3	86.2 ± 9.9
6 months	23	6	2	2	89.2 ± 8.7

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Preoperative, immediate postoperative, and sequential follow-up radiographs demonstrating progressive fracture union and maintenance of fixation following hybrid screw fixation in a femoral neck fracture (Fig. 2).

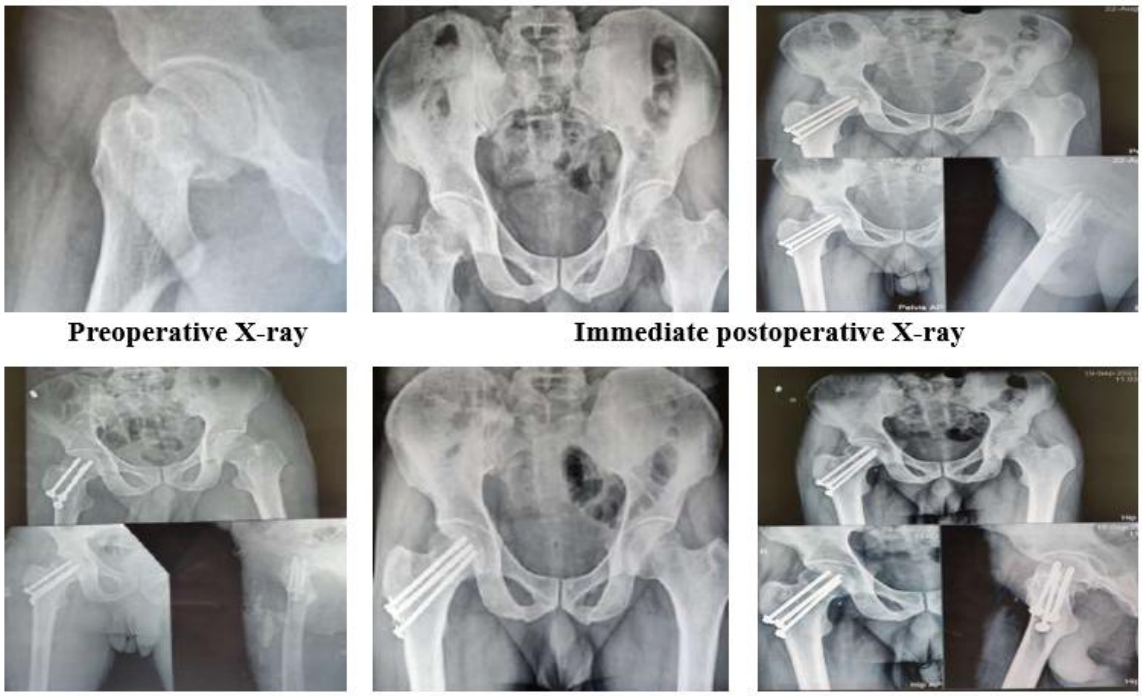

Fig. 2: Serial radiographs showing fracture union following hybrid screw fixation

Clinical photographs at follow-up demonstrating satisfactory functional recovery, hip range of motion, and independent weight-bearing following hybrid screw fixation (Fig. 3).

Fig. 3: Functional outcome at follow-up showing satisfactory hip mobility and weight

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DISCUSSION

This prospective study of 33 patients with femoral neck fractures, hybrid screw fixation using two partially threaded and one fully threaded cannulated cancellous screw, resulted in an overall union rate of 88%, with a mean time to union of 12.6 weeks. Functional outcomes, assessed by the Modified Harris Hip Score (HHS), showed progressive improvement from 78.3 at 1 month to 89.2 at 6 months. These findings suggest that hybrid screw fixation provides stable fixation with satisfactory early outcomes.

The mean union time in our study (12.6 weeks) is comparable to the results of Rawat *et al.* (16.5 weeks) and shorter than the 17.2 weeks reported by Upadhyay et al. in displaced fractures [1]. Our results indicate that hybrid fixation may accelerate fracture healing compared with conventional techniques. Fixation failure and varus malreduction occurred in 6% each of our cases. Duckworth *et al.* [3] reported fixation failure in up to 25% of young patients, while Filipov *et al.* [4] reported a non-union rate of 3.4% using biplane double-supported screw fixation. The relatively low complication rate in our series supports the hypothesis that fully threaded screws provide enhanced axial stability.

Functional recovery in our cohort was favorable, with 70% achieving excellent HHS at 6 months. This is comparable to Papanastassiou et al. (mean HHS 89.6) and higher than Zahid *et al.,* [6] with fibular graft augmentation (60% good-to-excellent results). Recent studies by Zhang *et al.* [7] and Ye *et al.* [8] also demonstrated superior outcomes with hybrid fixation compared to traditional constructs.

Hybrid screw fixation addresses the shortcomings of partially threaded screws by providing both compression and resistance to collapse. The addition of a fully threaded screw enhances construct stiffness and helps prevent varus tilt and shortening.

Recent evidence in the literature further supports the biomechanical and clinical advantages of hybrid and fully threaded screw constructs in femoral neck fractures. Jia et al. demonstrated that fully threaded cannulated screws significantly reduce femoral neck shortening and fixation failure compared with partially threaded screws [9]. Yuan *et al*. reported favorable union rates with lower postoperative complications using fully threaded cannulated compression screws in fresh femoral neck fractures [10]. Similarly, Samsami *et al*. observed improved resistance to varus collapse and mechanical failure with hybrid screw configurations [11]. Biomechanical studies by Stoffel et al. also confirmed enhanced construct stability and load distribution with modified screw fixation strategies [12]. These findings correlate well with the present study, where hybrid fixation provided satisfactory union rates, stable fixation, and progressive functional recovery.

LIMITATIONS

The present study is limited by its small sample size, lack of a control group, and relatively short follow-up (6 months), which precludes assessment of long-term complications such as avascular necrosis. Larger, multicenter randomized controlled trials are required to confirm these findings.

CONCLUSIONS

Hybrid screw fixation using a combination of partially and fully threaded cannulated cancellous screws provides stable fixation and demonstrates favorable clinicoradiological and functional outcomes in fresh femoral neck fractures. The construct offers improved anteroposterior stiffness and resistance to collapse, thereby reducing the risk of fixation failure and malreduction. While our results are encouraging, the study is limited by its small sample size, single-center design, and short follow-up duration. Further multicenter randomized trials with longer follow-up are required to validate the long-term advantages of hybrid fixation over conventional techniques

CONTRIBUTION OF AUTHORS

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