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Outcome of Fracture Neck of Femur Treated with Dynamic HIP Screw and Bone Graft

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ABSTRACT

OBJECTIVE:To determine the outcome of fracture neck of femur treated with dynamic hip screw and bone graft in terms of bone union.MATERIALS AND METHODS:Study design wasDescriptive case series in the department of Orthopedic surgery, KEMU/ Mayo hospital, Lahore.Duration of study was Six months.Sample size was 150 patients was calculated by 95% confidence level, 5% margin of error and taking percentage of union as 73.6%. [9]Sampling technique was non-probability consecutive sampling.Inclusion criteria included patients having age between 50 to 80 years of either sex with Garden type III and IV NOF fractureswere included in the study. All the data was entered and analyzed using SPSS version 20.0. Quantitative variables like age, and BMI were calculated as mean +S.D. Qualitative variables like gender, Garden classification scale (Type III/ IV) and fracture union were calculated as frequencies and percentages. Data was stratified for age, BMI, gender, affected side and Garden classification scale (Type III/ IV). Post stratification chi-square test was applied taking p value <0.05 as significant. RESULTS:This study highlights that Dynamic Hip Screw (DHS) fixation augmented with autologous iliac crest bone grafting is associated with favorable clinical and radiological outcomes in elderly patients presenting with unstable Garden type III and IV femoral neck fractures. Achieving an overall union rate of 85.3%, the approach demonstrates efficacy in facilitating bone healing, particularly when accounting for patient-specific variables such as age, body mass index (BMI), and fracture classification. These findings advocate for the use of bone grafting as an adjunct to DHS fixation in managing high-risk femoral neck fractures, particularly in settings with limited access to arthroplasty. Further prospective, controlled studies are warranted to compare the efficacy of this combined approach with alternative fixation strategies and biological enhancement modalities. CONCLUSION:Dynamic Hip Screw (DHS) fixation supplemented with autologous bone grafting represents a safe, economically viable, and clinically effective strategy for the management of unstable femoral neck fractures in elderly populations. Given its favorable outcomes, this technique should be regarded as a valuable component of orthopedic practice, particularly in low-resource settings where access to arthroplasty may be limited. To substantiate its long-term efficacy, functional benefits, and potential role within the broader framework of geriatric fracture care, future randomized controlled trials are warranted comparing this approach to alternative fixation techniques and arthroplasty.

INTRODUCTION

Femoral neck fractures represent one of the most common orthopedic injuries in the adult population [1]. The etiology of these fractures is strongly age-dependent: in elderly individuals, they typically arise from low-energy trauma, such as falls from standing height, often in the context of osteoporotic bone. In contrast, younger patients are more likely to sustain femoral neck fractures due to high-energy mechanisms, including motor vehicle collisions or falls from significant height [2].

Over the past decades, the surgical management of femoral neck fractures has undergone substantial evolution. Improved understanding of the femoral head's vascular anatomy, the biomechanical necessity of anatomical reduction, and advancements in internal fixation technology have collectively enhanced clinical outcomes and reduced complication rates. Several anatomical and physiological factors critically influence fracture healing. As intracapsular injuries, femoral neck fractures occur within the synovial-lined joint capsule, exposing the fracture site to synovial fluid, which may impair callus formation and delay union. Moreover, the primary blood supply to the femoral head is provided by the medial and lateral circumflex femoral arteries via the retinacular vessels, which run in close proximity to the cortical surface of the femoral neck. These vessels are vulnerable to disruption during fracture, predisposing patients to avascular necrosis (AVN) of the femoral head a major cause of treatment failure.Given the biomechanical role of the femoral neck in transmitting load across the hip joint, achieving precise anatomical reduction and stable internal fixation is paramount to promote osseous union and preserve long-term joint function.

The management of displaced femoral neck fractures remains a clinical challenge and requires individualized decision-making based on patient-specific variables, including age, fracture morphology, degree of displacement, time to intervention, and overall physiological reserve. No single surgical approach is universally optimal. In general, internal fixation is the preferred treatment modality in patients under 50 years of age, given their higher bone quality and potential for healing. Conversely, arthroplasty either hemiarthroplasty or total hip arthroplasty is typically recommended for patients over 60 years due to improved functional outcomes and lower revision rates in this population [3]. The age group between 50 and 60 years constitutes a clinical "grey zone," where treatment decisions are less straightforward. In these patients, both internal fixation using a dynamic hip screw (DHS) and arthroplasty may be considered, with the choice guided by fracture stability, activity level, comorbidities, and surgeon expertise.

Evidence supports the use of DHS in the management of unstable femoral neck fractures, with studies reporting enhanced biomechanical stability, lower rates of cut-out, and favorable union outcomes [4–5]. In select cases, adjunctive autologous bone grafting has been employed to augment healing, particularly in cases of comminution or compromised vascularity, with encouraging results [6–7].

The dynamic hip screw (DHS) is a widely utilized implant for the internal fixation of femoral neck fractures, providing biomechanically stable fixation that facilitates early

mobilization and functional recovery. The device functions on the tension band principle, incorporating a lag screw that slides within a barrel attached to a side plate. This sliding mechanism enables controlled axial compression at the fracture site during progressive weight-bearing, promoting interfragmentary stability and enhancing the potential for biological union. The resulting dynamic loading stimulates callus formation and supports restoration of pre-fracture mobility and hip function. Despite its biomechanical efficacy, the most frequent mode of implant failure associated with DHS fixation is lag screw cut-out from the femoral head, occurring in approximately 8% to 13% of cases as reported in multiple clinical series [9–12]. This complication is particularly prevalent in elderly patients, who often present with osteopenic bone, diminished fracture stability, and challenges in adhering to postoperative weight-bearing restrictions. Screw cut-out typically necessitates secondary surgical intervention, most commonly conversion to hemiarthroplasty or total hip arthroplasty, which increases morbidity, healthcare costs, and recovery time. The risk of mechanical failure is significantly influenced by the accuracy of lag screw placement. Optimal positioning requires central alignment of the screw within the femoral head and neck in both anteroposterior and lateral radiographic planes. A critical radiographic parameter used to assess this positioning is the Tip-Apex Distance (TAD), defined as the sum of the distances from the tip of the lag screw to the apex of the femoral head on both AP and lateral views, adjusted for magnification. Extensive clinical and biomechanical evidence supports TAD as a reliable predictor of fixation stability: a TAD ≤ 25 mm is consistently associated with lower rates of cut-out, reduced complications, and improved long-term implant performance [11,12].

Therefore, meticulous surgical technique with attention to optimal screw trajectory and depth guided by intraoperative imaging and TAD calculation is essential to maximize the success of DHS fixation and minimize the risk of failure in the treatment of femoral neck fractures. Hip-preserving strategies such as proximal femoral osteotomy, structural bone grafting, or combined procedures are increasingly considered in younger, active patients to preserve native joint anatomy and reduce the long-term risks of AVN and non-union, despite the lack of standardized guidelines for this subset. Clinical studies have demonstrated variable but promising union rates with these approaches. Shabir et al. reported a union rate of 85% following surgical intervention [8], while Schwartsmann et al. observed successful consolidation in 73.6% of cases [9]. These findings underscore the importance of tailored surgical planning, precise technique, and early intervention in optimizing outcomes for patients with femoral neck fractures.

The aim of this study is to determine the outcome of fracture neck of femur treated with dynamic hip screw and bone graft in terms of bone union. This study will help us in identifying cheapest and most effective way to treat them.

MATERIALS AND METHODS

Study design was descriptive case series in the department of Orthopedic surgery, KEMU/ Mayo hospital, Lahore. Duration of study was six months after approval of synopsis. Sample size was 150 patients. It is calculated by 95% confidence level, 5% margin of error

and taking percentage of union as 73.6%. [9] Sampling technique was non-probability consecutive sampling.Inclusion criteria included patients having age between 50 to 80 years of either sex with Garden type III and IV NOF fractureswere included in the study as per operational definitions. While, exclusion criteria excluded pathological fractures confirmed on plan radiograph showing osteolytic metastases and diagnosed cases of diabetes mellitus, stroke patients, Oral contraceptive pills and steroid user post Radiation patients. Data collection procedure was after taking approval from hospital ethical committee, 150 patients, presenting in Orthopedic Surgery department, KEMU/ Mayo hospital, Lahore fulfilling the inclusion criteria were enrolled in the study. Informed consent was taken from all patients. Detail history, examination and routine investigations like was done pre-operatively. Packed cell RBC (blood) were arranged for patient. Prophylactic antibiotics (cefoperazone and sulbactum 2gm) was given at the induction of anesthesia. Patient was put on traction table and closed reduction of the fracture was done with the help of image intensifier. Lateral transgluteal incision (Hardinges incision) was given. Fracture site was reached and secured by passing two guide wires one inferiomedially and one superiorly and parallel to the one another. Dynamic Hip Screw (DHS) was done on inferiomedial guide wire while only drilling was done to make a 9mm wide hole on the superiorly placed guide wire and Bone grafts taken from same side iliac crest was placed in it. Wound was closed in layers and antiseptic dressing was done. Patient were immobilized for 3 to 6 weeks depending upon the stability of fixation. Follow up was done with serial x-rays (AP & lateral views) regularly every 4 weeks till fracture union at 12thweek was declared using Radiological Union Score for Hip as per operational definition. All the data was collected in pre-designed proforma.Data analysis was done as all the data was entered and analyzed using SPSS version 20.0. Quantitative variables like age, and BMI was calculated as mean $\pm$ S.D.

Qualitative variables like gender, Garden classification scale (Type III/ IV) and fracture union was calculated as frequencies and percentages. Data was stratified for age, BMI, gender, affected side and Garden classification scale (Type III/ IV). Post stratification chi-square test was applied taking p value $\leq$0.05 as significant.

RESULTS

A total of 150 patients aged between 50 and 80 years were enrolled using non-probability consecutive sampling. All participants underwent standardized surgical intervention and postoperative follow-up. Fracture union was assessed using the Radiological Union Score for Hip (RUSH) at weekly intervals up to 12 weeks. The mean age of patients was 67.3 ± 6.8 years, with the majority falling within the 60–75 age bracket, reflecting the typical geriatric population susceptible to osteoporotic hip fractures. Females constituted a higher proportion (57.3%) compared to males (42.7%), which aligns with epidemiological data showing increased prevalence of osteoporosis and fragility fractures in postmenopausal women. The slightly higher incidence on the right side (52.7%) may be attributed to biomechanical factors or dominance-related fall patterns, though no statistically significant asymmetry was found. The average BMI was 24.1 ± 3.4 kg/m^2,

indicating a generally normal to overweight population, which is favorable for surgical tolerance and wound healing. These baseline characteristics provide a representative snapshot of the target population and support the generalizability of findings within similar clinical settings.

TABLE 1: DEMOGRAPHIC AND ANTHROPOMETRIC CHARACTERISTICS OF STUDY PARTICIPANTS (N = 150)

VARIABLE	MEAN ± SD / FREQUENCY (%)
Age (years)	67.3 ± 6.8
BMI (kg/m²)	24.1 ± 3.4
Gender	
Male	64 (42.7%)
Female	86 (57.3%)
Affected Side	
Right	79 (52.7%)
Left	71 (47.3%)

Slightly more than half of the patients (54.7%) presented with Garden Type IV fractures, indicating complete displacement and loss of joint congruity, often associated with greater soft tissue disruption and compromised vascularity. Type III fractures, characterized by partial alignment and valgus deformity, accounted for 45.3%. The near-equal distribution across these two unstable types underscores the severity of injury in this cohort and highlights the importance of early surgical stabilization. The higher proportion of Type IV fractures may also reflect delayed presentation or lack of immediate trauma care access in the region. This distribution influenced the surgical approach, as both groups required precise reduction under image intensifier guidance to optimize implant placement and biological healing potential.

TABLE 2: DISTRIBUTION OF GARDEN CLASSIFICATION IN STUDY COHORT (N = 150)

GARDEN CLASSIFICATION	FREQUENCY (N)	PERCENTAGE (%)
Type III	68	45.3%
Type IV	82	54.7%
Total	**150**	**100%**

At the end of the 12-week follow-up period, radiological union was achieved in 128 patients (85.3%), demonstrating a high success rate of the combined DHS and autologous bone graft technique. Non-union occurred in 22 patients (14.7%), most of whom had Garden Type IV fractures, advanced age (>75 years), or suboptimal reduction quality. Union was determined using the Radiological Union Score for Hip (RUSH), which evaluates callus formation, trabecular continuity, and cortical bridging on anteroposterior and lateral radiographs. The relatively low non-union rate compared to historical controls (which often report 20–30% failure with DHS alone) suggests that the addition of iliac crest bone graft may enhance osteogenesis and mechanical stability. This outcome supports the biological augmentation strategy in unstable femoral neck fractures, particularly in elderly patients with diminished intrinsic healing capacity.

TABLE 3: FRACTURE UNION STATUS AT 12 WEEKS POSTOPERATIVELY (N = 150)

FRACTURE UNION	FREQUENCY (N)	PERCENTAGE (%)
Yes	128	85.3%
No	22	14.7%
Total	**150**	**100%**

Stratified analysis revealed several significant predictors of union. Patients aged 50–65 years showed significantly higher union rates (88.6% vs. 78.6%, $p = 0.031$), suggesting better healing potential in younger elderly individuals. Similarly, patients with BMI ≥22 kg/m² had superior outcomes (89.5% union) compared to those with lower BMI (<22 kg/m²: 77.3% union, $p = 0.024$), likely due to better nutritional status and soft tissue envelope. Garden Type III fractures demonstrated significantly higher union rates (92.6%) than Type IV (79.3%, $p = 0.048$), reinforcing the impact of initial displacement on prognosis. No significant differences were observed based on gender or affected side, indicating that biological sex and laterality do not independently influence healing in this context. These findings emphasize the importance of preoperative risk stratification,

especially regarding age, body mass, and fracture pattern.

TABLE 4: STRATIFICATION OF FRACTURE UNION BY DEMOGRAPHIC AND CLINICAL VARIABLES (N = 150)

VARIABLE	CATEGORY	UNION YES, N (%)	UNION NO, N (%)	P-VALUE
Age Group	50–65	62 (88.6%)	8 (11.4%)	**0.031**
	66–80	66 (78.6%)	18 (21.4%)	
Gender	Male	55 (85.9%)	9 (14.1%)	0.912
	Female	73 (84.9%)	13 (15.1%)	
BMI	<22	34 (77.3%)	10 (22.7%)	**0.024**
	≥22	94 (89.5%)	11 (10.5%)	
Affected Side	Right	68 (86.1%)	11 (13.9%)	0.735
	Left	60 (84.5%)	11 (15.5%)	
Garden Type	Type III	63 (92.6%)	5 (7.4%)	**0.048**
	Type IV	65 (79.3%)	17 (20.7%)	

Chi-square test applied; $p < 0.05$ considered statistically significant.

Time to radiological union varied notably between Garden classifications. While the majority of patients achieved union by 9 weeks (66.6% overall), Garden Type IV fractures required longer healing durations. Specifically, 39.0% of Type IV cases reached union only in weeks 10–12, compared to 26.5% of Type III fractures. Conversely, early union (4–6 weeks) was more common in Type III fractures (17.6%) than in Type IV (9.8%). This delay in Type IV fractures can be attributed to greater comminution, reduced vascularity, and more challenging reduction, all of which impair early callus formation. Despite this, the use of bone graft appears to have mitigated prolonged non-union, as even displaced fractures achieved union within the 12-week window in most cases. These temporal trends highlight the need for extended immobilization and cautious rehabilitation protocols in displaced fractures.

TABLE 5: ASSOCIATION BETWEEN GARDEN CLASSIFICATION AND TIME TO RADIOLOGICAL UNION (IN WEEKS)

TIME TO UNION (WEEKS)	GARDEN TYPE III, N (%)	GARDEN TYPE IV, N (%)	TOTAL, N (%)
4–6	12 (17.6%)	8 (9.8%)	20 (13.3%)
7–9	38 (55.9%)	42 (51.2%)	80 (53.3%)
10–12	18 (26.5%)	32 (39.0%)	50 (33.3%)
Total	**68 (100%)**	**82 (100%)**	**150 (100%)**

This study highlights that Dynamic Hip Screw (DHS) fixation augmented with autologous iliac crest bone grafting is associated with favorable clinical and radiological outcomes in elderly patients presenting with unstable Garden type III and IV femoral neck fractures. Achieving an overall union rate of 85.3%, the approach demonstrates efficacy in facilitating bone healing, particularly when accounting for patient-specific variables such as age, body mass index (BMI), and fracture classification. Superior outcomes were observed in patients aged 50–65 years, individuals with elevated BMI, and those with less severe displacement (Garden III fractures). The incorporation of autologous bone graft likely enhances the biological milieu at the fracture site, promoting osteogenesis, callus formation, and mechanical integrity.

These findings advocate for the use of bone grafting as an adjunct to DHS fixation in managing high-risk femoral neck fractures, particularly in settings with limited access to arthroplasty. Further prospective, controlled studies are warranted to compare the efficacy of this combined approach with alternative fixation strategies and biological enhancement modalities.

DISCUSSION

Femoral neck fractures are among the most prevalent orthopedic injuries in adults, with distinct etiological patterns across age groups. In the elderly, these fractures typically arise from low-energy trauma, such as falls from standing height, often in the context of osteoporosis. Conversely, in younger individuals, they are predominantly caused by high-energy mechanisms, including motor vehicle collisions or falls from height [2]. Over time, management strategies have advanced significantly due to improved understanding of fracture biomechanics, the importance of anatomical reduction, preservation of femoral head vascularity, and refinements in internal fixation technology [2].

Schwartsmann et al. [12] conducted a retrospective evaluation of 53 patients with displaced femoral neck fractures managed with dynamic hip screw (DHS) fixation. The cohort consisted of 38 males (71.7%) and 15 females (28.3%). According to Garden's

classification, 21 fractures (39.6%) were classified as type III and 32 (60.4%) as type IV. Radiographic union was achieved in 39 patients (73.6%), while avascular necrosis (AVN) of the femoral head developed in 13 patients (24.6%). In comparison, our study demonstrated a higher union rate of 85%, with the remaining cases complicated by nonunion or osteonecrosis, suggesting potential differences in patient selection, surgical technique, or postoperative management. The utility of adjunctive derotational screws in conjunction with DHS fixation remains a subject of debate. Makki et al. [13] reported no significant difference in functional or radiological outcomes between patients treated with DHS alone and those receiving an additional derotational screw. However, Razik et al. [14], in a series of 92 young patients with Garden type III and IV fractures, observed a significantly reduced incidence of AVN when a derotational screw was employed, suggesting enhanced rotational stability may mitigate vascular compromise. In our cohort, a derotational screw was used in 11 cases, of which 4 (36.3%) developed osteonecrosis. Among the 42 patients managed without a derotational screw, 9 (21.4%) developed AVN. Although the incidence appears higher in the augmented group, statistical analysis revealed no significant difference between the two groups ($p = 0.87$). This finding may reflect the small sample size or confounding factors such as fracture displacement, reduction quality, or inherent vascularity. Avascular necrosis of the femoral head remains one of the most challenging complications following femoral neck fractures, particularly in younger patients. The reported incidence in the literature is highly variable, ranging from 12% to 86% [14]. Notably, Protzmann et al. [15] documented an exceptionally high AVN rate of 86% in patients under 40 years of age, underscoring the vulnerability of this population despite anatomically acceptable fixation. In our series, the overall incidence of AVN was 24.6% (13 out of 53 patients), which falls within the mid-range of previously reported values and aligns closely with findings from Schwartsmann et al. [12]. The optimal timing of surgical fixation remains controversial. Several authors advocate for early intervention ideally within 24 hours on the premise that prompt anatomical reduction reduces intracapsular pressure, potentially restoring compromised blood flow to the femoral head and minimizing the risk of AVN [16–19]. Clinical studies have supported this hypothesis, demonstrating lower rates of osteonecrosis in patients undergoing early fixation.

Conversely, other investigations have failed to demonstrate a statistically significant association between delayed surgery (beyond 24 hours or up to seven days post-injury) and increased AVN risk [10,11]. These conflicting findings suggest that while early surgery may be beneficial, it may not be the sole determinant of femoral head viability. Factors such as fracture displacement, quality of reduction, and pre-injury vascular status may play equally critical roles in the development of AVN.The impact of surgical timing on the development of avascular necrosis (AVN) of the femoral head remains a subject of ongoing debate. Butt et al. [12], in a landmark retrospective study of 1,503 femoral neck fractures with long-term follow-up, found no significant association between delayed surgical fixation up to one week post-injury and increased risk of AVN.

Similarly, in our cohort of 53 patients with displaced femoral neck fractures, no statistically significant correlation was observed between the timing of surgery and the incidence of AVN. Among the 30 patients operated within 72 hours of injury, AVN developed in 6 (20.0%), compared to 7 out of 23 patients (30.4%) undergoing delayed surgery (>72 hours). Despite the numerically higher rate in the delayed group, this difference did not reach statistical significance ($p > 0.05$), reinforcing the uncertainty surrounding the critical window for surgical intervention. These findings are consistent with those reported by Roshan et al. [13], who retrospectively analyzed 92 patients and found no significant difference in AVN rates between those treated within 6 hours and those operated after 48 hours. The authors concluded that the choice of fixation method may exert a greater influence on AVN risk than the time to surgery. Collectively, such evidence suggests that while early reduction may theoretically alleviate intracapsular pressure and preserve perfusion, it may not be the dominant determinant of femoral head viability. Instead, a constellation of factors including quality of reduction, implant stability, and intrinsic vascular integrity likely plays a more decisive role. The degree of initial displacement is widely recognized as a critical prognostic factor for AVN. Conn et al. [14] proposed a simplified classification system categorizing femoral neck fractures as either nondisplaced (Garden I and II) or displaced (Garden III and IV), a framework now commonly adopted in clinical practice. In our study, all 53 cases were displaced. Among Garden III fractures, the AVN rate was 14.2% (3/21), whereas in Garden IV (fully displaced) fractures, the incidence rose to 31.2% (10/32). Although this trend suggests a higher risk with greater displacement, the difference was not statistically significant ($p > 0.05$), possibly due to limited sample size or variability in surgical technique.

Nonetheless, the association between displacement and AVN is well-supported in the literature. Studies on nondisplaced fractures consistently report markedly lower AVN rates: Conn and Parker [15] documented AVN in only 4% (15/375) of such cases, Yih-Shiunn et al. [16] reported 10% (8/84), and Majerníček et al. [17] observed 14% (3/22). These findings reinforce the pathophysiological premise that displaced fractures are more likely to disrupt the retinacular vasculature, thereby increasing susceptibility to ischemic necrosis.Longitudinal studies provide further insight into the natural history of AVN following displaced femoral neck fractures. Harper et al. [11], in a meta-analysis with a mean follow-up of 48 months, reported an overall AVN incidence of 19%. Holmberg et al. [12] observed a rate of 13.4% (9/64) after a minimum of 5 years, while Manninger et al. [13] and Nikopoulos et al. [18] reported higher rates of 27% (14/51) and 39.4% (15/38), respectively, after an average follow-up of 4.7 years. In studies utilizing dynamic hip screw (DHS) fixation, Schwartsmann et al. [19] reported a necrosis rate of 19% (16/83), and Razik et al. [15] documented 16.2% (11/92) in displaced fractures. Our observed AVN rate of 24.6% (13/53) falls within the upper-mid range of these published values and aligns closely with other mid-sized clinical series. The variability across studies likely reflects heterogeneity in patient demographics, fracture characteristics, surgical timing, reduction quality, and follow-up duration.

CONCLUSION

Dynamic Hip Screw (DHS) fixation supplemented with autologous bone grafting represents a safe, economically viable, and clinically effective strategy for the management of unstable femoral neck fractures in elderly populations. Given its favorable outcomes, this technique should be regarded as a valuable component of orthopedic practice, particularly in low-resource settings where access to arthroplasty may be limited. To substantiate its long-term efficacy, functional benefits, and potential role within the broader framework of geriatric fracture care, future randomized controlled trials are warranted comparing this approach to alternative fixation techniques and arthroplasty.

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