RESEARCH PAPER

A Comparative Study Between Dynamic Hip Screw (DHS) and Biplane Double Supported Screw Fixation (BDSF) for Neck of Femur Fractures: A Prospective Study.

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ABSTRACT

Background

Femoral neck fractures are among the most challenging orthopaedic injuries because of their intracapsular location, disrupted vascularity, and high risk of complications such as non-union, implant failure, and avascular necrosis. Dynamic Hip Screw (DHS) fixation has been widely used for internal fixation; however, Biplane Double-Supported Screw Fixation (BDSF) has recently gained attention due to its improved biomechanical stability and enhanced cortical support.

Objective

To compare the functional, radiological, and intraoperative outcomes between DHS and BDSF fixation techniques in the management of femoral neck fractures.

Methods

A prospective comparative study was conducted among 60 patients with fracture neck of femur admitted to a tertiary care centre. Patients were equally divided into DHS (n=30) and BDSF (n=30) groups. Fractures were classified using Garden and Pauwels classification systems. Baseline demographic, anthropometric, and clinical characteristics were recorded. Intraoperative parameters including duration of surgery, blood loss, radiation exposure, and ease of reduction were analyzed. Functional outcomes were assessed using Harris Hip Score (HHS) and Nottingham Hip Score (NHS) at 4 weeks, 3 months, and 6 months follow-up. Radiological evaluation was performed using neck-shaft angle measurements. Postoperative complications were also documented and compared between groups.

Results

Baseline demographic characteristics, BMI distribution, comorbidities, and fracture classifications were comparable between the two groups ($p>0.05$). The mean operative duration was significantly longer in the BDSF group (88.53 ± 13.36 minutes) compared with the DHS group (72.60 ± 11.57 minutes) ($p<0.001$). Radiation exposure time was also significantly higher in the BDSF group ($p=0.021$), while intraoperative blood loss was comparable between groups ($p=0.062$).

Functional outcome analysis demonstrated significantly higher Harris Hip Scores and Nottingham Hip Scores in the BDSF group at all follow-up intervals (p<0.001). At 6 months, the mean HHS was 86.53 ± 4.49 in the BDSF group compared with 79.10 ± 5.55 in the DHS group. Radiological assessment showed significantly better maintenance of neck-shaft angle in the BDSF group throughout follow-up (p<0.001). Postoperative complications including implant failure, varus collapse, and non-union were lower in the BDSF group, although the overall complication rate was not statistically significant.

Conclusion

Biplane Double-Supported Screw Fixation demonstrated superior functional recovery and improved maintenance of radiological alignment compared with Dynamic Hip Screw fixation in femoral neck fractures. Despite requiring longer operative time and greater radiation exposure, BDSF appears to provide enhanced biomechanical stability and may serve as an effective alternative fixation method in selected patients with femoral neck fractures..

Keywords Femoral neck fracture; Dynamic Hip Screw; Biplane Double-Supported Screw Fixation; Harris Hip Score; Nottingham Hip Score; Neck-shaft angle; Internal fixation; Functional outcome; Radiological outcome.

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INTRODUCTION

Femoral neck fractures remain one of the most challenging injuries encountered in orthopaedic practice because of their intracapsular location, tenuous blood supply, and high risk of complications such as non-union and avascular necrosis. These fractures are associated with substantial morbidity, mortality, prolonged immobilization, and loss of functional independence, particularly among elderly individuals. Globally, the incidence of hip fractures is projected to increase dramatically from approximately 1.66 million cases in 1990 to nearly 6.25 million cases by the year 2050 due to increasing life expectancy, osteoporosis, and sedentary lifestyle patterns [1]. Osteoporotic fractures also contribute significantly to healthcare expenditure and disability-adjusted life years worldwide. Women are disproportionately affected because of accelerated postmenopausal bone loss, and the lifetime risk of sustaining a hip fracture is considerably higher in females compared to males [2].

Several epidemiological and clinical risk factors have been implicated in the development of femoral neck fractures. Advanced age, low bone mineral density, poor nutritional status, smoking, corticosteroid therapy, reduced physical activity, and low body mass index are recognized contributors to fracture susceptibility [3]. Most femoral neck fractures in elderly individuals occur following trivial trauma such as falls from standing height, whereas younger patients usually sustain these injuries following high-energy trauma. Kocher described the rotational and axial loading mechanisms contributing to femoral neck fracture propagation, emphasizing the role of external rotation and compressive stress across the femoral neck [4].

The primary aim of management in femoral neck fractures is to achieve stable fixation, restore anatomical alignment, preserve femoral head vascularity, and facilitate early mobilization. Dynamic Hip Screw (DHS) fixation has long been considered one of the standard surgical procedures for managing femoral neck fractures because of its ability to provide controlled compression across the fracture site [5]. The DHS system consists of a lag screw connected to a side plate, allowing sliding and dynamic compression during weight bearing. Several authors have demonstrated satisfactory outcomes with DHS fixation in stable fracture patterns [6,7]. Baumgaertner et al. emphasized the biomechanical advantages of DHS fixation, particularly in minimizing shear stress and improving stability in selected fractures [8]. Similarly, Larsson et al. reported that DHS fixation offers superior resistance to rotational instability when compared with certain conventional screw configurations [9].

Despite these advantages, DHS fixation is associated with important complications, especially in vertically oriented and unstable fractures. Implant cut-out, varus collapse, non-union, shortening, and avascular necrosis remain major concerns affecting postoperative outcomes [10]. Lu-Yao et al. observed that displaced femoral neck fractures continue to demonstrate high rates of fixation failure and compromised functional recovery despite advances in surgical techniques [11]. These limitations have encouraged the development of alternative fixation strategies aimed at improving biomechanical stability while preserving vascular integrity.

Biplane Double-Supported Screw Fixation (BDSF) is a relatively newer fixation technique introduced by Filipov for the management of femoral neck fractures [12]. The BDSF method employs three medially diverging cannulated screws positioned in two oblique planes, thereby enhancing cortical support and improving load distribution across the femoral neck. The distal screw is calcar-supported and engages stronger cortical bone, providing enhanced resistance against varus displacement and rotational forces. Biomechanical studies conducted by Filipov et al. demonstrated that BDSF constructs possess significantly greater axial and rotational stability compared with conventional parallel screw fixation systems [13]. Stoffel et al. further confirmed that biplane screw constructs improve fixation strength and reduce mechanical failure under cyclic loading conditions [14].

In addition to its biomechanical advantages, clinical studies have reported encouraging functional and radiological outcomes with BDSF fixation. Filipov and colleagues documented high union rates, improved maintenance of neck-shaft angle, and superior postoperative hip function following BDSF fixation in femoral neck fractures [15]. However, despite these promising findings, the technique remains technically demanding and has not been extensively evaluated in prospective comparative studies against DHS fixation.

Considering the increasing burden of femoral neck fractures and the need for improved fixation methods that optimize stability and functional recovery, the present study was undertaken to compare Dynamic Hip Screw fixation and Biplane Double-Supported Screw Fixation in terms of intraoperative parameters, radiological outcomes, functional recovery, and postoperative complications in patients with femoral neck fractures.

METHODOLOGY

This prospective comparative observational study was conducted in the Department of Orthopaedics at a tertiary care teaching hospital after obtaining approval from the Institutional Ethics Committee. The study was carried out over a period of 24 months among patients presenting with fracture neck of femur. A total of 60 patients fulfilling the inclusion criteria were enrolled in the study after obtaining written informed consent. The patients were equally divided into two groups consisting of 30 patients each. Group I patients underwent fixation using Dynamic Hip Screw (DHS), while Group II patients were managed using Biplane Double-Supported Screw Fixation (BDSF).

Patients aged above 18 years with intracapsular fracture neck of femur classified as Garden type I to IV were included in the study. Patients with pathological fractures, polytrauma, previous hip surgeries, open fractures, severe systemic illness unfit for surgery, and patients unwilling for follow-up were excluded from the study. Detailed demographic and clinical data including age, sex, height, weight, body mass index (BMI), limb length discrepancy, smoking history, alcohol consumption, diabetes mellitus, and hypertension were recorded for all patients at admission. Routine hematological and biochemical investigations were performed preoperatively. Standard anteroposterior and lateral radiographs of the hip joint were obtained in all cases, and fractures were classified according to Garden and Pauwels classification systems.

All patients underwent surgery under spinal or general anesthesia under strict aseptic precautions with the patient positioned supine on a fracture table. In the DHS group, fracture reduction was achieved under fluoroscopic guidance, followed by insertion of a guide wire centrally into the femoral head. Reaming was performed and the lag screw with side plate assembly was inserted to achieve controlled compression across the fracture site. In the BDSF group, fracture reduction was similarly achieved under image intensifier guidance, following which three cannulated cancellous screws were inserted in two different oblique planes according to the BDSF technique. The distal screw was positioned in a calcar-supported orientation to provide inferomedial cortical support, while the remaining screws were inserted divergently to improve axial and rotational stability. Special attention was given to restoration of anatomical alignment and maintenance of neck-shaft angle.

Intraoperative variables including duration of surgery, blood loss, radiation exposure time, and ease of reduction were recorded in all patients. Postoperatively, all patients received standard care consisting of intravenous antibiotics, analgesics, thromboprophylaxis when indicated, and supervised physiotherapy. Early mobilization was encouraged, and weight-bearing was gradually progressed according to fracture stability and radiological evidence of healing. Patients were followed up at 4 weeks, 3 months, and 6 months after surgery. Functional outcomes were assessed using Harris Hip Score (HHS) and Nottingham Hip Score (NHS), while radiological evaluation included assessment of neck-shaft angle, fracture union, implant position, and evidence of varus collapse or avascular necrosis. Postoperative complications including wound infection, implant failure, non-union, varus collapse, and avascular necrosis were documented and analyzed.

The collected data were entered in Microsoft Excel and statistically analyzed using Statistical Package for Social Sciences (SPSS) software version 25.0. Continuous variables were expressed as mean ± standard deviation and categorical variables were expressed as frequency and percentage. Independent sample t-test was used for comparison of continuous variables, while Chi-square test was used for comparison of categorical variables. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Table 1. Age Distribution Between DHS and BDSF Groups

Age Group (Years)	DHS Group (n=30)	BDSF Group (n=30)	Total	p-value
20–30	2 (6.7%)	1 (3.3%)	3 (5.0%)	
31–40	4 (13.3%)	5 (16.7%)	9 (15.0%)	
41–50	7 (23.3%)	6 (20.0%)	13 (21.7%)	
51–60	9 (30.0%)	10 (33.3%)	19 (31.7%)	
61–70	6 (20.0%)	7 (23.3%)	13 (21.7%)	
>70	2 (6.7%)	1 (3.3%)	3 (5.0%)	0.881
Mean ± SD	54.87 ± 11.42	56.13 ± 10.98	—	0.672

Table 2. Baseline Demographic and Anthropometric Characteristics

Variable	DHS Group (n=30)	BDSF Group (n=30)	p-value
Male	18 (60.0%)	17 (56.7%)	0.793
Female	12 (40.0%)	13 (43.3%)	0.793

Height (cm), Mean ± SD	165.40 ± 7.31	164.96 ± 6.84	0.811
Weight (kg), Mean ± SD	66.83 ± 9.42	68.10 ± 8.95	0.592
BMI (kg/m²), Mean ± SD	24.41 ± 3.52	24.98 ± 3.18	0.518
Limb Length Discrepancy (cm)	1.13 ± 0.42	1.06 ± 0.39	0.506

Table 3. BMI Distribution and Comorbidity Status

Variable	**DHS Group (n=30)**	**BDSF Group (n=30)**	**p-value**
BMI Category			0.731
Underweight (<18.5)	2 (6.7%)	1 (3.3%)	
Normal (18.5–24.9)	16 (53.3%)	15 (50.0%)	
Overweight (25–29.9)	9 (30.0%)	11 (36.7%)	
Obese (>30)	3 (10.0%)	3 (10.0%)	
Comorbidities			
Diabetes Mellitus	8 (26.7%)	7 (23.3%)	0.766
Hypertension	10 (33.3%)	11 (36.7%)	0.781
Smoking History	6 (20.0%)	5 (16.7%)	0.739
Alcohol Consumption	9 (30.0%)	10 (33.3%)	0.781

Table 4. Distribution of Garden and Pauwels Classification

Classification	**DHS Group (n=30)**	**BDSF Group (n=30)**	**Total**	**p-value**
Garden Classification				0.841
Type I	3 (10.0%)	2 (6.7%)	5 (8.3%)	
Type II	9 (30.0%)	10 (33.3%)	19 (31.7%)	
Type III	11 (36.7%)	12 (40.0%)	23 (38.3%)	
Type IV	7 (23.3%)	6 (20.0%)	13 (21.7%)	
Pauwels Classification				0.718
Type I	5 (16.7%)	4 (13.3%)	9 (15.0%)	
Type II	14 (46.7%)	15 (50.0%)	29 (48.3%)	
Type III	11 (36.7%)	11 (36.7%)	22 (36.7%)	

Table 5. Comparison of Intraoperative Parameters

Parameter	**DHS Group (n=30)**	**BDSF Group (n=30)**	**p-value**
Duration of Surgery (minutes)	72.60 ± 11.57	88.53 ± 13.36	<0.001*
Blood Loss (mL)	152.43 ± 28.54	165.80 ± 31.16	0.062
Radiation Exposure (seconds)	54.30 ± 10.27	61.47 ± 12.63	0.021*
Easy Reduction	22 (73.3%)	20 (66.7%)	0.573
Difficult Reduction	8 (26.7%)	10 (33.3%)	0.573

*Statistically Significant

Table 6. Functional Outcome Assessment Using Harris Hip Score and Nottingham Hip Score

Follow-up	**DHS Group**	**BDSF Group**	**p-value**
Harris Hip Score (HHS)			
4 Weeks	64.87 ± 4.90	70.50 ± 5.17	<0.001*
3 Months	75.00 ± 4.48	79.33 ± 3.97	<0.001*
6 Months	79.10 ± 5.55	86.53 ± 4.49	<0.001*
Nottingham Hip Score (NHS)			
4 Weeks	61.23 ± 5.42	67.44 ± 4.96	<0.001*
3 Months	71.56 ± 4.81	78.20 ± 4.33	<0.001*
6 Months	78.12 ± 5.14	85.63 ± 4.28	<0.001*

*Statistically Significant

Table 7. Radiological Outcome and Postoperative Complications

Variable	**DHS Group (n=30)**	**BDSF Group (n=30)**	**p-value**
Neck–Shaft Angle (degrees)			
4 Weeks	126.13 ± 4.84	131.87 ± 3.92	<0.001*
3 Months	123.96 ± 5.11	130.24 ± 4.10	<0.001*
6 Months	121.72 ± 5.64	128.90 ± 4.36	<0.001*
Complications			0.488
Wound Infection	4 (13.3%)	2 (6.7%)	
Implant Failure	3 (10.0%)	1 (3.3%)	
Varus Collapse	4 (13.3%)	1 (3.3%)	
Non-union	2 (6.7%)	1 (3.3%)	
Avascular Necrosis	1 (3.3%)	0 (0%)	
Overall Complication Rate	6 (20.0%)	4 (13.3%)	

*Statistically Significant

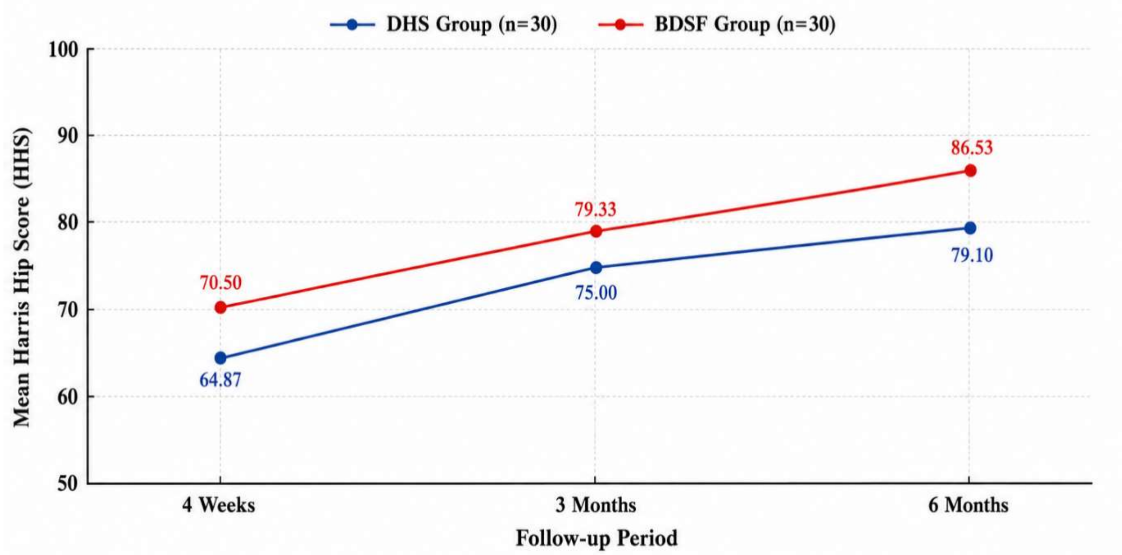


Image 1. Comparison of Harris Hip Score (HHS) Over Time
A Comparative Study Between DHS and BDSF for Neck of Femur Fractures

The line graph shows that the BDSF group achieved significantly higher HHS at all follow-up intervals compared to the DHS group ($p < 0.001$ at all intervals).

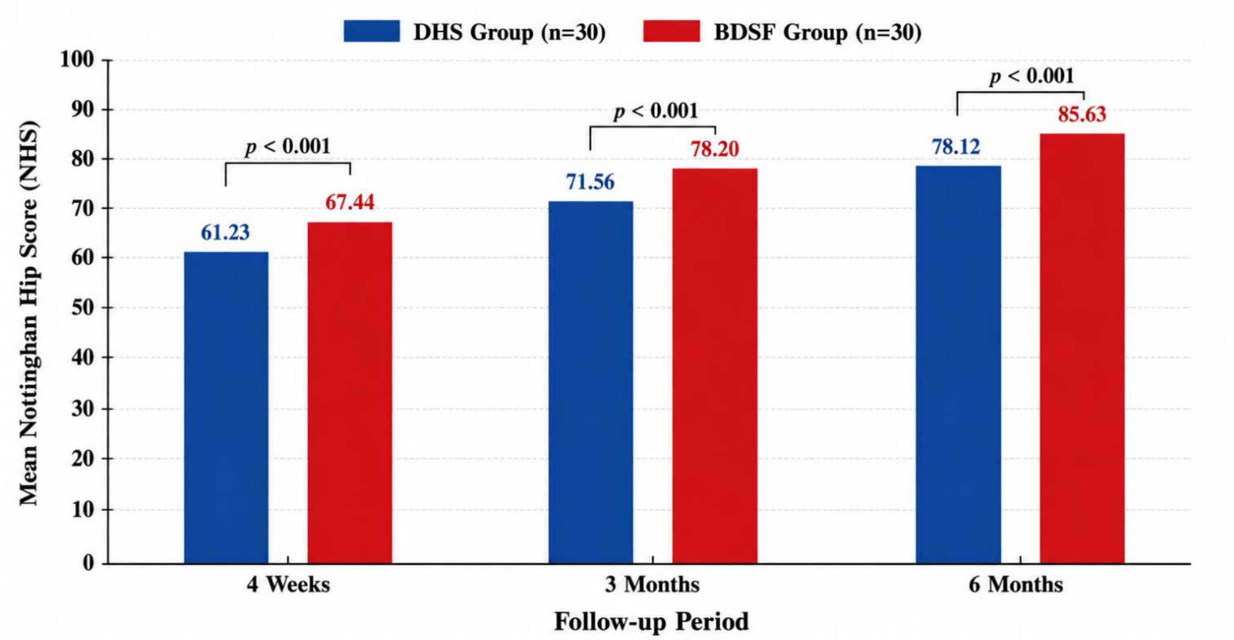
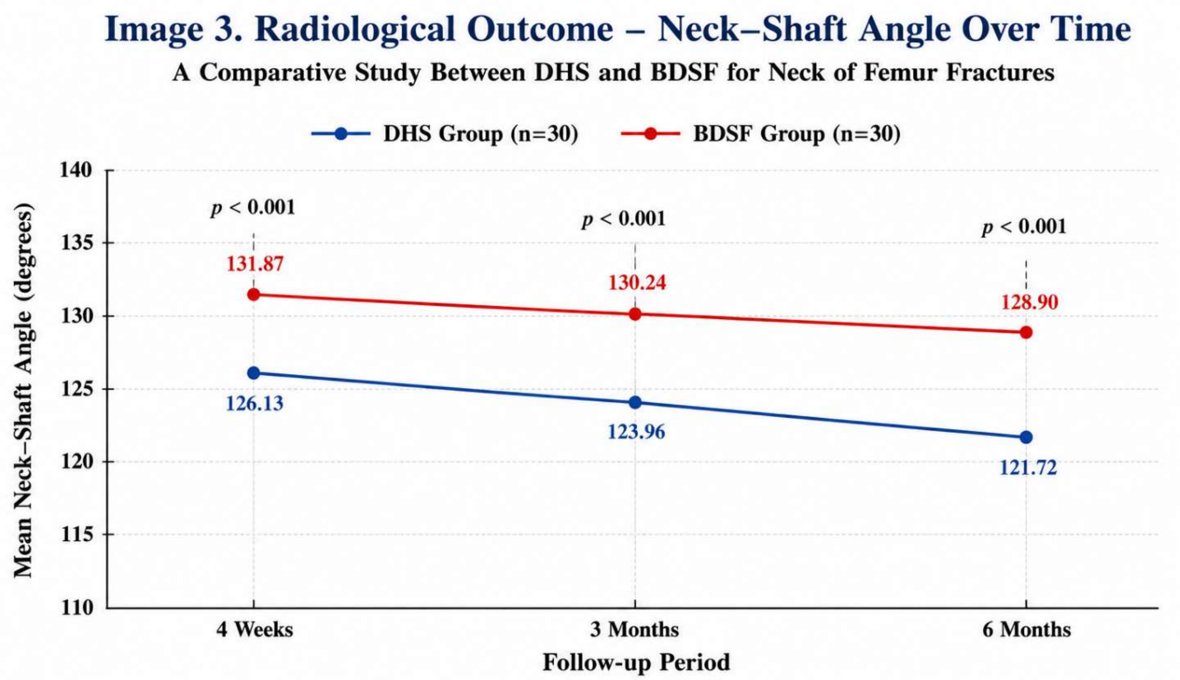
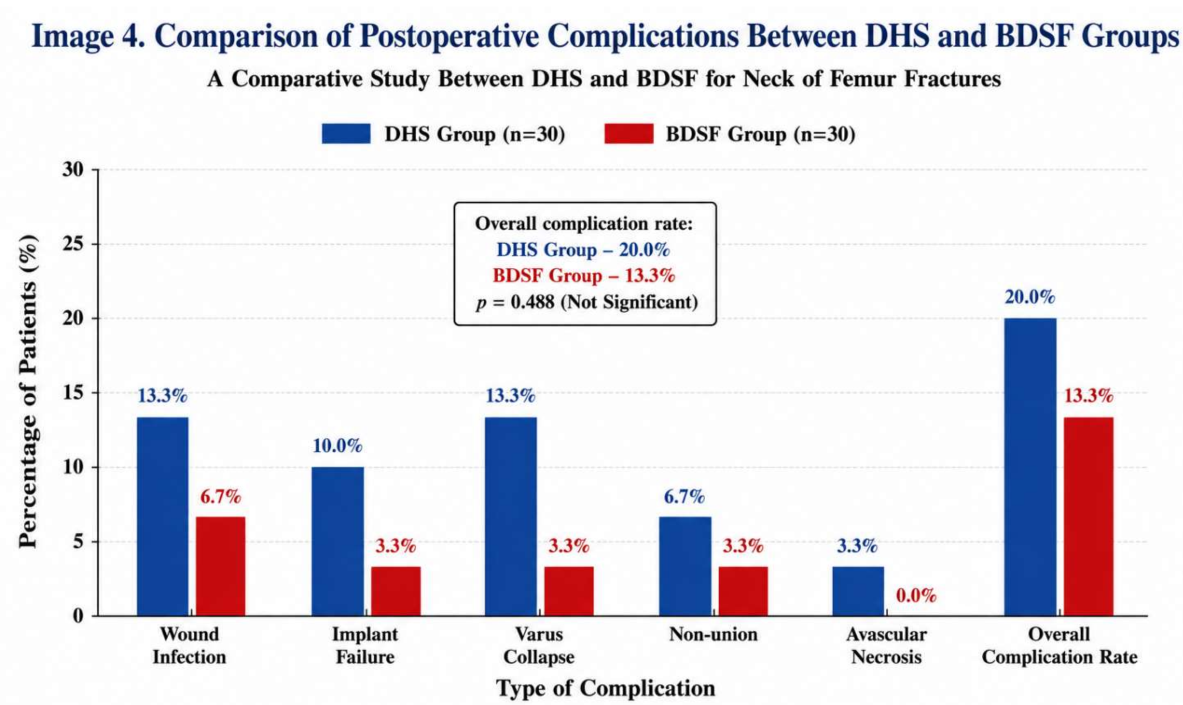


Image 2. Comparison of Nottingham Hip Score (NHS) Over Time
A Comparative Study Between DHS and BDSF for Neck of Femur Fractures

The bar diagram demonstrates that the BDSF group had significantly higher Nottingham Hip Scores (NHS) at 4 weeks, 3 months, and 6 months follow-up compared to the DHS group ($p < 0.001$ at all intervals).



The line graph shows that the BDSF group maintained a significantly higher neck–shaft angle at all follow-up intervals compared to the DHS group ($p < 0.001$ at all intervals).



The bar diagram shows comparison of postoperative complications between the two groups. Although complication rate was lower in the BDSF group, the difference was not statistically significant ($p < 0.488$).

DISCUSSION

Femoral neck fractures continue to represent one of the most difficult injuries in orthopaedic practice because of their intracapsular location, limited vascularity, and high risk of complications such as non-union and avascular necrosis [16]. Restoration of anatomical alignment, preservation of femoral head blood supply, and achievement of stable fixation are the principal goals of management. The present prospective comparative study evaluated the clinical and radiological outcomes between Dynamic Hip Screw (DHS) fixation and Biplane Double-Supported Screw Fixation (BDSF) in patients with femoral neck fractures and demonstrated superior functional and radiological outcomes with BDSF fixation despite a longer operative duration.

In the present study, the mean age of patients in the DHS and BDSF groups was 54.87 ± 11.42 years and 56.13 ± 10.98 years respectively, with no statistically significant difference between the groups (p=0.672). Male predominance was observed in both groups. These findings are consistent with anatomical and biomechanical studies demonstrating increasing susceptibility of the femoral neck to fractures with advancing age and reduced bone quality [17-20]. Baseline anthropometric parameters, BMI distribution, and comorbidity status were comparable between groups, suggesting appropriate matching of the study population and reducing selection bias.

The vascular anatomy of the femoral head plays a crucial role in fracture healing and postoperative prognosis. Crock described the extracapsular arterial ring and ascending cervical vessels as the major vascular supply to the femoral head and neck [21]. Weitbrecht identified the retinacular vessels coursing along the femoral neck beneath the synovial folds, while Chung further demonstrated the importance of the subsynovial intra-articular arterial ring in maintaining femoral head perfusion [22,23]. Claffey subsequently reported that disruption of these vascular channels in displaced femoral neck fractures significantly increases the risk of avascular necrosis [24]. Howe et al. emphasized that the artery of the ligamentum teres alone is insufficient to maintain femoral head viability after fracture displacement [25]. Sevitt further demonstrated that vascular disruption following medial femoral neck fractures is directly associated with impaired fracture healing and osteonecrosis [26]. Thompson also reported that traumatic interruption of femoral head circulation is one of the major causes of postoperative avascular necrosis after intracapsular fractures [27].

In the present study, Garden type III fractures constituted the majority of cases in both groups, followed by Pauwels type II fractures. No significant difference in fracture distribution was observed between groups. Garden classification remains clinically important in assessing displacement and fracture severity [16]. Pauwels described the biomechanical significance of fracture inclination angle and demonstrated that vertically oriented fractures are exposed to greater shearing forces, increasing the risk of fixation failure and varus collapse [28]. The comparable fracture distribution in both study groups ensured reliable comparison of fixation outcomes.

The present study demonstrated significantly longer operative duration in the BDSF group (88.53 ± 13.36 minutes) compared with the DHS group (72.60 ± 11.57 minutes) (p<0.001). Radiation exposure was also significantly higher in the BDSF group (p=0.021). However, blood loss was comparable between the groups. These findings may be explained by the technically demanding nature of BDSF fixation, which requires precise placement of screws in multiple oblique planes to achieve optimal cortical support. Protzman and Burkhalter highlighted the importance of stable fixation constructs in younger and active patients with femoral neck fractures, emphasizing that biomechanical stability is essential for successful fracture healing [29].

Functional outcome analysis in the present study demonstrated significantly superior Harris Hip Scores (HHS) and Nottingham Hip Scores (NHS) in the BDSF group at all follow-up intervals. At 6 months, the mean HHS was 86.53 ± 4.49 in the BDSF group compared with 79.10 ± 5.55 in the DHS group. Similarly, NHS at 6 months was significantly higher in the BDSF group (85.63 ± 4.28 versus 78.12 ± 5.14). These findings indicate improved postoperative mobility, pain reduction, and earlier functional recovery in patients treated with BDSF fixation. The superior functional outcome observed with BDSF may be attributed to enhanced inferomedial cortical support, greater rotational stability, and improved load distribution across the femoral neck.

Radiological assessment in the present study demonstrated significantly better maintenance of neck-shaft angle in the BDSF group at all follow-up intervals. At 6 months, the mean neck-shaft angle was 128.90 ± 4.36° in the BDSF group compared with 121.72 ± 5.64° in the DHS group (p<0.001). Preservation of neck-shaft angle is important in preventing varus collapse, shortening, altered gait biomechanics, and secondary osteoarthritis. Pauwels emphasized that biomechanical constructs resisting shearing forces are essential for maintaining fracture alignment and preventing collapse [28]. The improved radiological outcomes observed in the BDSF group in the present study support the concept of enhanced biomechanical stability with biplane screw fixation.

Postoperative complications were lower in the BDSF group, although the difference was not statistically significant (p=0.488). Varus collapse, implant failure, non-union, and avascular necrosis occurred more frequently in the DHS group. One patient in the DHS group developed avascular necrosis, whereas no cases were reported in the BDSF group. Singh et al. demonstrated that osteoporosis and altered trabecular architecture significantly reduce fixation stability and increase the risk of mechanical failure in proximal femoral fractures [30]. The improved complication profile observed with BDSF fixation in the present study may therefore be related to stronger cortical purchase and better resistance against varus deformity in osteoporotic bone.

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