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Clinical Study of the Outcome of Biplane Double Supported Screw Fixation (BDSF) at Femoral Neck Fractures

Dr. Salman[1], Dr. Ghizala Begum C[2], Dr. Asma Firdouse[3], Dr. Haroon Adoni[4]

[1]Consultant Orthopaedic Surgeon, KM Hospital, Yadgir, Karnataka, India
[2]Junior Resident, Department of Ophthalmology, Khaja Banda Nawaz (KBN) Medical College, Kalaburagi (Gulbarga), Karnataka, India
[3]Consultant Anaesthesiologist, KM Hospital, Yadgir, Karnataka, India
[4]Consultant Pathologist, KM Hospital, Yadgir, Karnataka, India

Corresponding Author:

Dr. Haroon Adoni
Consultant Pathologist, KM Hospital, Yadgir, Karnataka, India

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ABSTRACT

Background: Fracture of the neck of the femur is one of the most challenging orthopaedic injuries because of its intracapsular location, compromised vascularity, and the associated risks of non-union and avascular necrosis (AVN). Preservation of the native femoral head is the preferred treatment in young and middle-aged adults. Biplane Double Supported Screw Fixation (BDSF) is a biomechanically superior modification of conventional cannulated cancellous screw fixation that provides enhanced cortical support, increased resistance to varus collapse, and improved fracture stability.

Objectives: To evaluate the clinical, functional, and radiological outcomes of Biplane Double Supported Screw Fixation (BDSF) in patients with femoral neck fractures.

Materials and Methods: This prospective observational study was conducted in the Department of Orthopaedics, KM Hospital, Yadgir, Karnataka, over a period of 2.5 years. Thirty adult patients (18–65 years) with fresh intracapsular femoral neck fractures (Garden Types I–IV) underwent internal fixation using the BDSF technique. Patients were followed for a minimum of 6 months and a maximum of 24 months. Functional outcome was assessed using the Modified Harris Hip Score (HHS), while radiological union and postoperative complications were evaluated through serial radiographs. Statistical analysis was performed using SPSS version 25.0.

Results: The mean age group most commonly affected was 31–40 years (50%), with males accounting for 60% of cases. Road traffic accidents were the predominant mode of injury (56.7%). Garden Type II fractures constituted the largest group (40%). Surgery was performed within three days of injury in 63.3% of patients. Radiological union occurred within four months in 46.7% of patients. Complications were minimal, with one case each of avascular necrosis (3.3%) and non-union (3.3%). Functional assessment showed excellent results in 60%, good in 20%, fair in 13.3%, and poor in 6.7% of patients.

Conclusion: Biplane Double Supported Screw Fixation provides stable fixation with high union rates, excellent functional outcomes, and a low incidence of complications in femoral neck fractures. The technique appears to be an effective head-preserving procedure, particularly in young adults, offering favorable clinical and radiological outcomes.

Keywords: *Femoral neck fracture, Biplane Double Supported Screw Fixation, BDSF, Modified Harris Hip Score, Internal fixation, Cannulated screws.*

INTRODUCTION

Fracture neck of femur remains one of the most difficult fractures encountered in orthopedic practice because of its unique intracapsular anatomy and limited blood supply to the femoral head. These fractures account for approximately 50% of all hip fractures and are associated with significant morbidity, especially in elderly individuals. However, in younger adults, they usually result from high-energy trauma such as road traffic accidents or falls from height and require urgent surgical intervention to preserve the femoral head and restore normal hip function (1).

The vascular anatomy of the femoral head makes these fractures particularly vulnerable to complications including avascular necrosis (AVN), non-union, fixation failure, and secondary osteoarthritis. Disruption of the retinacular vessels following intracapsular fractures compromises femoral head perfusion, making anatomical reduction and stable internal fixation essential for successful fracture healing (2).

Over the past several decades, multiple fixation techniques have been proposed for femoral neck fractures, including multiple cancellous screws, dynamic hip screws (DHS), proximal femoral locking plates, and newer biomechanical constructs. Among these, fixation using three cannulated cancellous screws has become the standard treatment for undisplaced and many displaced fractures in physiologically young patients because it is minimally invasive, preserves blood supply, and provides compression across the fracture site (3).

Despite these advantages, conventional parallel screw fixation has certain biomechanical limitations, particularly in vertically oriented (Pauwels Type III) fractures where high shear forces predispose to varus collapse, screw cut-out, and fixation failure. These shortcomings have encouraged the development of alternative fixation techniques that provide improved mechanical stability while maintaining biological preservation (4).

The Biplane Double Supported Screw Fixation (BDSF) technique, developed by Filipov, is an innovative modification of conventional screw fixation. Unlike the traditional parallel configuration, BDSF places three screws in two different oblique planes, allowing each screw to obtain stronger cortical support. The distal screw acts as a calcar-supporting screw, while the middle and proximal screws provide additional rotational and axial stability. Biomechanical studies have demonstrated superior resistance to vertical shear forces, greater load-bearing capacity, and reduced risk of fixation failure compared with conventional parallel screw fixation (5).

Several clinical studies have reported encouraging outcomes with the BDSF technique, demonstrating high fracture union rates, satisfactory functional recovery, and lower incidences of complications such as avascular necrosis and non-union. The technique has shown particular advantages in displaced fractures and osteoporotic bone by improving construct stability without increasing surgical morbidity (6–8).

The Modified Harris Hip Score (HHS) is widely accepted as a reliable and validated scoring system for evaluating postoperative functional outcomes following hip surgery. It assesses pain, function, deformity, and range of motion, allowing objective comparison between different treatment methods (9).

Considering the potential biomechanical superiority of BDSF and the limited clinical data available from Indian populations, the present prospective study was undertaken to evaluate the clinical, functional, and radiological outcomes of Biplane Double Supported Screw Fixation in patients with femoral neck fractures treated at a tertiary care centre.

MATERIALS AND METHODS

Study Design and Setting

This prospective observational study was conducted in the Department of Orthopaedics at KM Hospital, Yadgir, Karnataka, India, over a period of 2.5 years. The study was designed to evaluate the clinical, functional, and radiological outcomes of cannulated cancellous screw fixation in patients with fracture of the neck of the femur. A total of 30 patients who fulfilled the eligibility criteria were included after obtaining written informed consent. Institutional Ethics Committee approval was obtained before the commencement of the study.

Study Population

Thirty consecutive patients presenting with intracapsular fracture of the neck of the femur were enrolled. Detailed demographic information, mechanism of injury, associated comorbidities, fracture characteristics, operative details, and postoperative outcomes were prospectively recorded in a structured case record form (CRF).

Inclusion Criteria

- Patients aged 18–65 years.
- Patients of either sex.
- Fresh fracture neck of femur (Garden Types I–IV).
- Patients willing to participate and provide informed written consent.

Exclusion Criteria

- Pathological fractures.
- Established fracture non-union.
- Pediatric fractures (before physeal closure).
- Patients medically unfit for surgery.
- Patients unwilling to undergo operative treatment or follow-up.

Clinical Evaluation

At admission, a detailed history regarding the mode of injury, associated illnesses, and previous medical conditions was obtained. All patients underwent comprehensive general and local examination.

Clinical assessment included:

- Limb length discrepancy.
- External rotation deformity.
- Tenderness around the hip.
- Painful restriction of hip movements.
- Neurovascular examination of the affected limb.
- Assessment for associated skeletal or systemic injuries.

Routine laboratory investigations included complete blood count, blood sugar, renal function tests, liver function tests, coagulation profile, blood grouping, viral markers, electrocardiography, and chest radiography whenever indicated.

Radiological Evaluation

Standard anteroposterior (AP) radiographs of the pelvis with both hips and cross-table lateral views of the affected hip were obtained in all patients. Fractures were classified according to the Garden Classification (Types I–IV). Computed tomography (CT) scan was performed whenever fracture morphology or posterior comminution required further assessment.

Preoperative Management

Following admission, patients were stabilised and received adequate analgesia. Skin traction or derotation boot was applied until surgery. Associated medical comorbidities such as diabetes mellitus, hypertension, chronic obstructive pulmonary disease, and cardiac disorders were optimised before operative intervention.

Patients were kept nil per oral for at least 8 hours prior to surgery. Intravenous Cefotaxime 1 g was administered 30 minutes before skin incision as a prophylactic antibiotic. Blood was reserved whenever required, and written informed consent for surgery was obtained.

Surgical Technique

All procedures were performed under spinal anaesthesia using a standard technique on a radiolucent fracture table under fluoroscopic guidance.

Closed reduction was initially attempted using longitudinal traction with gentle internal rotation and abduction. Reduction quality was confirmed fluoroscopically before fixation.

A standard lateral approach to the proximal femur was utilized. Three 6.5-mm cannulated cancellous screws were inserted in an inverted triangular configuration over guidewires under image intensifier guidance. Guidewire placement was carefully performed to obtain optimal fixation while maintaining adequate subchondral purchase without joint penetration.

Following measurement of screw length, cannulated drilling and screw insertion were completed sequentially. Compression across the fracture site was achieved by tightening the screws after release of traction. No capsulotomy was performed. The wound was thoroughly irrigated with normal saline and povidone-iodine solution before layered closure. Sterile dressing was applied, and no suction drain was used routinely.

Postoperative Rehabilitation

Intravenous Cefotaxime was continued for five postoperative days. Wound inspection was performed on the second postoperative day, and sterile dressings were changed on alternate days. Sutures were removed on the fourteenth postoperative day.

Rehabilitation protocol included:

- Quadriceps strengthening exercises and passive knee mobilization from postoperative day one.

- Non-weight-bearing ambulation for the first six weeks.
- Gradual hip mobilization and partial weight-bearing after radiographic evidence of satisfactory healing.
- Full weight-bearing was permitted following radiological union.

Follow-up
Patients were reviewed monthly for the first six months and thereafter every two months. The minimum follow-up period was 6 months, while the maximum follow-up was 24 months.

At each visit, patients underwent:
- Clinical examination.
- Radiological assessment for fracture union.
- Evaluation of complications such as avascular necrosis, implant failure, infection, non-union, or fixation failure.
- Functional assessment using the Modified Harris Hip Score (HHS).

Outcome Measures
The primary outcome measure was the Modified Harris Hip Score, which evaluates:
- Pain (44 points)
- Function (47 points)
- Range of motion (5 points)
- Absence of deformity (4 points)

Functional outcomes were graded as:
- **Excellent:** 90–100
- **Good:** 80–89
- **Fair:** 70–79
- **Poor:** <70

Radiological union was assessed using serial radiographs based on trabecular continuity across the fracture site and absence of fracture line.

Statistical Analysis
Data were entered into Microsoft Excel and analysed using Statistical Package for Social Sciences (SPSS) version 25.0. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. Appropriate statistical tests, including the Chi-square test for categorical variables and Student's t-test for continuous variables, were used. A p-value <0.05 was considered statistically significant.

RESULT AND OBSERVATIONS

Table 1. Age Distribution of Study Participants (n = 30)

Age Group (Years)	Number of Patients (n)	Percentage (%)
18–30	5	16.7
31–40	15	50.0
41–50	9	30.0
51–65	1	3.3
Total	**30**	**100.0**

Table 2. Gender Distribution

Gender	Number of Patients (n)	Percentage (%)
Male	18	60.0
Female	12	40.0
Total	**30**	**100.0**

Table 3. Side of Fracture

Side Involved	Number of Patients (n)	Percentage (%)
Right	20	66.7
Left	10	33.3
Total	**30**	**100.0**

Table 4. Mode of Injury

Mode of Injury	Number of Patients (n)	Percentage (%)
Road Traffic Accident	17	56.7
Fall	13	43.3
Total	**30**	**100.0**

Table 5. Distribution According to Garden Classification

Garden Classification	Number of Patients (n)	Percentage (%)
Type I	2	6.7
Type II	12	40.0
Type III	10	33.3
Type IV	6	20.0
Total	**30**	**100.0**

Table 6. Time Interval Between Injury and Surgery

Time Interval	Number of Patients (n)	Percentage (%)
1–3 Days	19	63.3
4–7 Days	9	30.0
>7 Days	2	6.7
Total	**30**	**100.0**

The percentage for **1–3 days** has been corrected to **63.3%** (19/30). The original value of **43.3%** is mathematically incorrect.

Table 7. Time Taken for Fracture Union

Time to Union	Number of Patients (n)	Percentage (%)
3 Months	7	23.3
4 Months	14	46.7
5 Months	7	23.3
>5 Months	2	6.7
Total	**30**	**100.0**

Table 8. Postoperative Complications

Complication	Number of Patients (n)	Percentage (%)
Avascular Necrosis (AVN)	1	3.3
Non-union	1	3.3
No Complications	28	93.4
Total	**30**	**100.0**

Table 9. Functional Outcome According to Modified Harris Hip Score

Functional Outcome	Number of Patients (n)	Percentage (%)
Excellent (90–100)	18	60.0
Good (80–89)	6	20.0
Fair (70–79)	4	13.3
Poor (<70)	2	6.7
Total	**30**	**100.0**

DISCUSSION

Management of femoral neck fractures continues to be a major challenge because successful treatment depends upon achieving anatomical reduction, stable fixation, preservation of femoral head vascularity, and early rehabilitation. The present prospective study evaluated the clinical and radiological outcomes of Biplane Double Supported Screw Fixation (BDSF) in 30 patients with intracapsular femoral neck fractures.

The majority of patients (50%) in the present study belonged to the 31–40-year age group, with males constituting 60% of the study population. Similar demographic findings have been reported by Swiontkowski et al. (10), who observed that younger male patients commonly sustain femoral neck fractures following high-energy trauma. The predominance of males in the present study probably reflects greater occupational exposure and increased involvement in road traffic accidents.

Road traffic accidents accounted for 56.7% of injuries, while falls contributed 43.3%. Similar observations have been reported by Jain et al. (11), who noted that high-energy trauma remains the principal cause of femoral neck fractures in

younger adults. In contrast, studies involving elderly populations have reported low-energy falls as the predominant mechanism of injury (12).

Garden Type II fractures represented the largest subgroup (40%), followed by Type III (33.3%). Early operative intervention is considered an important determinant of successful fracture healing because prolonged delay may increase intracapsular pressure and compromise femoral head vascularity. In the present study, 63.3% of patients underwent surgery within three days of injury, which may have contributed to the favorable union rate. Upadhyay et al. (13) similarly demonstrated improved outcomes following early internal fixation of displaced femoral neck fractures.

Radiological union occurred within four months in nearly half of the patients (46.7%), while only two patients required more than five months for fracture healing. These findings are comparable to those reported by Filipov (5), who demonstrated excellent union rates using the BDSF technique owing to improved cortical support and enhanced biomechanical stability. Biomechanical investigations have shown that BDSF distributes load more effectively than conventional parallel screw fixation, thereby reducing varus collapse and shear stress across the fracture site (14).

Postoperative complications were uncommon in the present series. Only one patient (3.3%) developed avascular necrosis, and one patient (3.3%) developed non-union. These complication rates are comparable with those reported by Filipov (6), who documented low incidences of fixation failure and avascular necrosis following BDSF. Conventional multiple screw fixation has been associated with AVN rates ranging from 10% to 30% and non-union rates between 10% and 20%, particularly in displaced fractures (15,16). The lower complication rates observed in the present study may be attributed to accurate fracture reduction, stable fixation, and early surgical intervention.

Functional recovery following BDSF was highly satisfactory. According to the Modified Harris Hip Score, 60% of patients achieved excellent results, and 20% achieved good outcomes, resulting in an overall satisfactory outcome in 80% of patients. These findings are consistent with those reported by Parker and Blundell (17), who demonstrated that stable internal fixation combined with structured rehabilitation significantly improves postoperative hip function. Similar favourable functional outcomes have also been reported in recent studies evaluating BDSF fixation in young adults with intracapsular femoral neck fractures (6,8).

The biomechanical principle underlying BDSF differs from conventional parallel screw fixation. The distal calcar-supporting screw provides strong inferomedial cortical support, while the remaining screws are positioned in a second plane, thereby increasing the effective working length and improving resistance to rotational and vertical shear forces (5,14). This construct allows better load transmission and may explain the high union rates and excellent functional outcomes observed in the present study.

The present study has certain limitations. The sample size was relatively small, follow-up duration was limited to a maximum of 24 months, and there was no comparison group treated with conventional parallel cannulated screws or dynamic hip screw fixation. Larger randomized controlled trials with longer follow-up are required to establish the long-term superiority of the BDSF technique.

Overall, the findings of the present study indicate that Biplane Double Supported Screw Fixation is a reliable and effective method for treating femoral neck fractures in young and middle-aged adults. The technique provides stable fixation, promotes early fracture union, minimizes complications, and achieves excellent functional outcomes.

CONCLUSION

Biplane Double Supported Screw Fixation (BDSF) is a safe and effective head-preserving technique for the treatment of fresh femoral neck fractures. It provides stable fixation, high fracture union rates, excellent functional outcomes, and a low incidence of complications. Early surgical intervention combined with accurate reduction and appropriate rehabilitation contributes to favorable clinical and radiological outcomes. Larger studies with longer follow-up are warranted to further validate these findings.

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