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Clinico-radiological evaluation of results of biplane double supported screw fixation (BDSF) in femoral neck fractures

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Abstract
Background: Over the years, primary hip arthroplasty has become a popular choice of management modality for intra-capsular fracture neck of femur in geriatric hip. Although the complication of nonunion and avascular necrosis (AVN) is nullified by arthroplasty, the probability of re-operation and high surgical stress is substantially high as compare to osteosynthesis. The aim of this study was to determine the clinical outcome of biplane double supported screw fixation (BDSF) for femoral neck fracture.
Material and Methods: A total of 32 patients (12 males, 20 females) with a mean age of 58.78 years underwent BDSF for femoral neck fracture and were followed up for a period of 10-12 months. They were assessed on the basis of improvement in Harris Hip Score (HHS).
Results: After BDSF the union was achieved in 89.18% (29) patients. The mean HHS was 87.44 points at one year of follow up. The majority of patients had good to excellent functional outcomes. The average time of clinico-radiological union was3-3.5 months.
Conclusion: BDSF method used in femoral neck fracture fixation has given very good results in this study. Though anatomical reduction is crucial, BDSF method ensures reliable fixation, early rehabilitation and good functional outcome especially in elderly.

Keywords: BDSF, HHS, AVN, biplane double supported screw fixation

Introduction
One of the most frequent fractures in the elderly is the neck of the femur. Orthopaedic surgeons have traditionally found it difficult to treat these fractures. With an increase in osteoporosis cases, aging-related eyesight loss, impaired neuromuscular coordination, lifestyle changes, sedentary behaviors, and extended life expectancy, neck of femur fractures are becoming more common [1,2]. In patients with displaced fractures and patients in the younger population, the femoral head's blood supply, which passes through the femoral neck, is a crucial factor to take into account [3-5]. Avascular necrosis is the most frequent side effect in individuals who get treatment with open reduction internal fixation [6-13]. The aim of therapy for these fractures is function restoration without morbidity, although there is an ongoing debate on how to handle older patients with fractures to the neck of the femur. Insufficient reduction, insecure fixation, and poor-quality osteoporotic bone are the main causes of treatment problems. Three parallel cannulated screws are used in the current traditional approach for fixing femoral neck fractures, although this does not always offer adequate fixation strength [14-15]. This is especially true if osteoporosis is present, as it may lead to subpar outcomes in 2007, Filipov's innovative technique for biplane double-supported screw fixation (BDSF) has demonstrated remarkable levels of consistency during its standardized surgical procedure. Three cannulated screws can be positioned at steeper angles to the diaphyseal axis to enhance their beam function and cortical support thanks to the novel idea of biplane screw arrangement [16-21]. Because of high complication rates with traditional screw fixation a new concept of “Biplane double supported screw fixation (BDSF)” was developed in 2007 in the Department of Geriatric Orthopaedics, Vitosha Hospital, and Sofia, Bulgaria, to improve the stability of screw fixation in osteoporotic fracture neck femur [22-26].

The present study was done to evaluate the clinical and radiological outcome of biplane double-supported screw fixation (BDSF) in the management of intracapsular fracture neck of the femur in terms of fracture stability and union.

Aims and Objectives

To evaluate the clinical and radiological outcome of biplane double-supported screw fixation (BDSF) in the management of intracapsular fracture neck of femur in terms of fracture stability and union.

- To evaluate the complications encountered during and after the procedure.
- To compare the results of BDSF in terms of stability of fixation with conventional screw fixation in the neck of femur fracture.

Material and Method

The present study was conducted in the Department of Orthopedics Surgery at Chatrapati Shivaji Subharti hospital affiliated to N.S.C.B Subharti medical college of Swami Vivekanand university, Meerut, during a period from August 2020 to July 2022.

Study design: Prospective and Retrospective observational study

Inclusion criteria

- All skeletally mature patients with fresh (< 3 weeks) intracapsular fracture neck of femur planned for closed reduction and internal fixation.
- Patients previously operated for intracapsular fracture neck of the femur by closed reduction and fixation by BDSF technique in CSSH hospital during last 2 years.

Exclusion criteria

- Patients presenting late > 3 weeks; those fractures where satisfactory reduction can not be achieved by closed means.
- Patients suffering from pathological fractures.
- Patients suffering from concomitant ipsilateral limb fractures and pelvic fractures.

Technique of BDSF the "F" technique [6]

After appropriate anesthesia, the patient was laid supine on the fracture table and fracture was reduced under fluoroscopy. Longitudinal incision starting from the base of greater trochanter extending distally about 5-8 cm on lateral aspect of thigh. The first entry portal is made for the distal most screw with a guide wire about 5-7cm distally from the base of trochanter in the anterior 1/3rd of the diaphysis directed proximally at an angle of 150-165^{0} towards the diaphyseal axis proceeding proximally in an anteroposterior direction in such a way that once the guide wire touches the curve of distal portion of the neck the wire then should go in the posterior half of the head of femur in the lateral view.

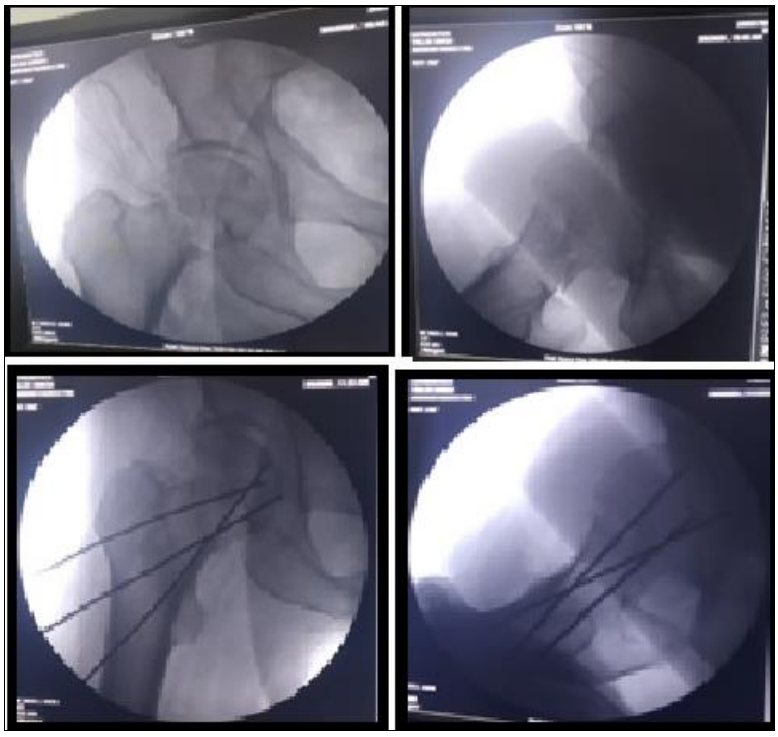

Fig 1: C-arm images

The second entry portal is made for the middle screw with a guide wire about 2-4cm proximal from the distal screw entry portal in posterior 1/3rd of the diaphysis directed proximally at an angle of 135-140^{0} towards the diaphyseal axis proceeding proximally in a postero-anterior +direction in such a way that once the guide wire touches the curve of distal portion of the neck the wire then should go in the anterior 1/3rd of the head of femur in the lateral view while in AP view it remains in the inferior quadrant of the head of femur; The third entry portal is made for the proximal most screw with a guide wire about 1-2 cm proximal from the middle screw entry portal in posterior 1/3rd of the diaphysis close to the base of trochanter and parallel to the middle guide wire proceeding proximally in a way that it should lie in the anterior 1/3rd of the head of femur in the lateral view while in AP view it remains in the superior quadrant of the head of femur;

The length of all the three screws is ascertained with the help of reverse measuring guide and then drilling is performed with 5.0mm cannulated reamer, by this method all three screws are placed in two vertical oblique planes in lateral

view, the distal most screw is placed in posterior dorsal oblique plane while the middle and the proximal screws are placed in anterior ventral oblique plane this is the concept of biplane positioning.
In an AP view with leg in internal rotation the distal screw appears crossing the middle and the proximal screws that resembling the shape of an alphabet letter "F" hence this technique has also been crowned as "F-Technique".

Post-operative protocol
Patients were allowed mobilization and protected ambulation with walker support from the second post-operative day, gradually progressing to full weight bearing at around 6 weeks to 3 months as the union advances.

Follow-up protocol: All patients were evaluated clinico-radiologically at the 1st, 3rd, 6th, 9th, and 12th month after surgery to assess the progress of union, any sign of failure of fixation or nonunion and avascular necrosis. At the time of follow-up, the functional outcome was assessed using a harris hip score after the radiological union.

Final functional outcome
final assessment was done in accordance with Harris hip score.

Observation & Results
The mean HARRIS HIP SCORE was 87.44±6.23 (62-94).
Maximum value of Harris HIP Score at 3-4 months were 88 and Minimum value were 62.
Maximum Value of Harris Hip score at 6-7 months were 90 and Minimum value were 66.
Maximum value of Harris Hip Score at 9-12 months were 94 and Minimum value were 68.

Table 1: Harris Hip Score among study population at Maximum follow up

	Minimum	Maximum	Mean	Std. Deviation
Harris hip score	62.00	94.00	87.44	6.23

Fig 2: Follow-up at 12 months in which patient had regained reasonable squatting and sitting crossed leg capacity (HHS-92)

Table 2: Distribution of study population according to functional outcome

Functional outcome	Frequency	Percentage
Poor	2	6.3%
Fair	2	6.3%
Good	11	34.4%
Excellent	17	53.1%

Excellent Results were found among 17 (53.1%), Good among 11 (34.4%), and Fair and Poor among 2 (6.3%) subjects.

Discussion
Nearly half of all hip fractures are femoral neck fractures, and the majority of these cases affect older individuals following straightforward falls. Only 3%-10% of neck of femur fractures do occur in younger adults.[65] The routine use of hip replacement surgery for low-demand elderly patients with displaced femoral neck fractures is highly favored due to improved short- and long-term hip function and lower re-operation rates with hip arthroplasty as compared to internal fixation [66, 67].
Young people should prioritize maintaining their native hip anatomy and mechanics because replacement operations are not an option for them due to their high functional demands [68]. For the femoral head to be preserved while reducing non-union and osteonecrosis rates, anatomic reduction and stable internal fixation are crucial [69].
The current study examined the clinical and radiological results of biplane double-supported screw treatment for the neck of femur fractures (BDSF). The distal screw, which is positioned at an obtuse angle and supported on a significant portion of the distal and posterior cortex of the femoral neck along with its spiral anterior curve, is the most novel and efficient fixation technique in this method in terms of fixation strength. As a result, the fixation construct receives the strongest possible distal and posterior cortical support thanks to BDSF. Additionally, the medial cortical supporting points of the two calcar-buttressed screws are separated from one another, distributing the weight-bearing load over roughly 50% of the length of the femoral neck cortex without focusing stress in a single area. Increased varus resistance and easier screw sliding are both a result of the steeper screw orientation, which also helps to prevent cut-outs and maintain higher fixation strength. Moreover, the nonparallel orientation of the screws does not stop their sliding in the femoral neck, which biomechanically represents a hollow cylinder.

Summary and Conclusion
The study findings can be summarized as follows:
- The mean age of the study population was 59.22±10.40 with a range of 39-83 years with the majority belonging to the 51-60 years age group followed by 61-70 years, 40-50 years, and above 70 years.
- There were 18 (50.0%) males and 18 (50.0%) females in the study population.
- Among the study population, the right side was affected among 14 (38.9%) subjects and the left side among 22 (61.1%) subjects.
- The reason for injury was Fall from height among 11.1%, Slip and fall among 38.9% and RTA among 50.0% cases.
- The co-morbidities among the study population were Anemia (5.6%), Hypertension (11.1%), Type 2 DM (16.7%), and Type 2 DM + Hypertension (8.3%).
- As per Pauwel staging, there were stage 1 among 16 (44.4%) and Stage 2 among 20 (55.6%) cases.
- Garden type II was found among 2 (5.6%), type III among 21 (58.3%), and type IV among 13 (36.1%) patients.
- The time of presentation was 12 hours among 19.4%, 24 hours among 41.7%, 36 hours among 19.4%, and 48 hours among 19.4%.
- The Time of Surgery was 2-4 days among 58.3%, 5-6

days among 13.9%, 8-10 days among 22.2% and > 10 days among 5.6% of cases.
- The Time of Radiological Union was 3-3.5 months among 25.0%, 4-4.5 months among 41.7%, and 5-5.5 months among 33.3% of cases.
- The mean HARRIS HIP SCORE was 87.44±6.23 (62-94).
- There was no significant difference in mean Haris Hip Score between Pauwel Staging.
- There was no significant difference in mean Haris Hip Score between various Garden stages.
- Excellent Results were found among 15 (41.7%), Good among 18 (50.0%), Fair among 2 (5.6%), and Poor among 1 (2.8%) subjects.
- Non-union, Screw pullout, surgical site infection, and Varus malunion were reported among 1 (2.8%) patient each.

Conflict of Interest
Not available

Financial Support
Not available

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