



APPRAISAL OF CLINICAL OUTCOME OF BIPLANE DOUBLE SUPPORTED SCREW FIXATIONS (BDSF) FOR 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 37 patients (15 males, 22 females) with a mean age of 75.97 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) and Garden Index. **Results:** After BDSF the union was achieved in 89.18% (33) patients. The mean HHS was 91.027 points and a garden index of 161-170 was achieved in 56.76% (21) patients at one year of follow up. The majority of patients had good to excellent functional outcomes. The average time of clinico-radiological union was 9.3 weeks. **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

INTRODUCTION

Primary hip arthroplasty has become the popular choice amongst orthopaedic surgeons for intracapsular fracture neck of femur in the geriatric hip. The two main complication of this fracture are non-union and avascular necrosis are nullified by arthroplasty. Conventional osteosynthesis of femoral neck fractures by parallel screws is the procedure of choice in younger population to help them return to full function but this procedure is still associated with high complication rate of non-union and avascular necrosis eventually requiring re-operation. Internal fixation of femoral neck fractures has been practiced for several decades and parallel oriented cannulated screws are frequently used but such a fixation is associated with poor outcomes in up to 46% of the clinical cases¹⁻⁴.

The neck of femur in severe osteoporosis can be likened to a hollow cylinder⁵ with loss of compression and tensile trabeculae where parallel screws will fail to hold the reduction till biological healing. **Fillipov O** (2013)⁵ described the novel method of osteosynthesis by biplane double-supported screw fixation BDSF which offers an increased stability by buttressing two or three medially diverging cannulated screws on the inferior neck cortex by biplanar fixation. Biomechanically, the most effective component of this fixation is the third, inferior obtuse screw, supported along considerable distance on both the inferior and posterior cortices of the femoral neck following its spiral anterior curve. Thus, BDSF achieves greater infero-posterior cortical support of the implants, allowing immediate full weight bearing for older patients.

On the basis of recent clinical evidence and experimental results, BDSF by implementation of an innovative biomechanical concept was seen to be associated with up to 44% higher axial fixation strength in vitro compared with conventional parallel screw fixation CFIX and a bone union rate of up to 96.6% in the clinical practice⁷, being much higher compared with the latter.

The BDSF method neutralises the shearing and torsional forces to which screws are subjected than what conventional triangular parallel configuration fixation can do and hence prevent fixation failure.

AIMS AND OBJECTIVES

- To manage the femoral neck fractures by biplane double supported screw fixation (BDSF) and follow them prospectively.
- Functional and radiological outcomes were studied and reviewed.

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 September 2018 to August 2020.

Study Design: Prospective observational study

Inclusion Criteria:

- The indications for BDSF are same as those for traditional multiple screw fixation for fracture neck of femur, moreover the indication of BDSF extends even to osteoporotic bone in which the traditional screw fixation cannot be considered.
- All elderly population in whom primary arthroplasty not planned
- All osteoporotic intracapsular fracture neck of femur whether displaced or undisplaced Garden stage 1 to 4 where conventional parallel screw fixation cannot be performed
- Osteoporotic fracture medically unsuitable for hemi/total hip arthroplasty

Exclusion Criteria:

- Patients presenting late >3 weeks; as fracture cannot be reduced
- Patients suffering from pathological fractures
- Significant comminution of calcar
- Basicervical fractures, as they were treated using different modality of treatment
- Subcapital fractures were not fixed using BDSF technique due to unavailability of suitable implant.

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° 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.

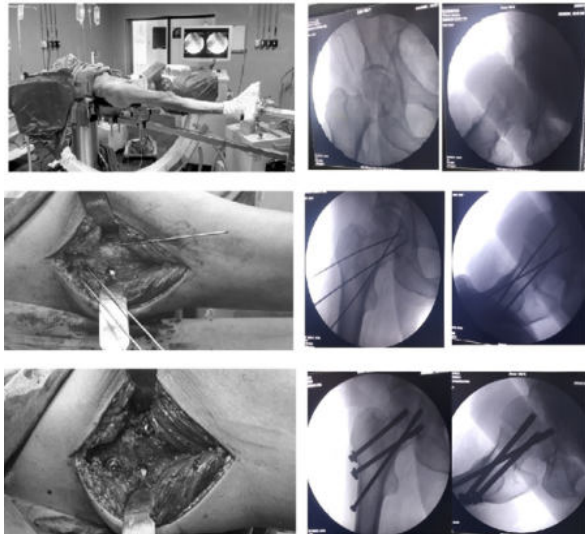


Figure 1 : Intraoperative Picture And C-arm Image

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° 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 1-2cm 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”.

After Care:

Partial weight bearing was allowed at 6-8 weeks with walker / crutch support, progressing gradually to full weight bearing as the union advances.

Follow Up Protocol:

Xray of all patients were done on subsequent follow up at 6th week, 3rd month, 6th month and 1 year after surgery to assess the integrity of the implant and garden index was measured and compared with immediate post-op and pre op x-ray.

Final Functional Outcomes:

Final assessment was done in accordance with Harris hip score.

RESULTS AND OBSERVATION

In our study during a period from September 2018 to August 2020 a total number of patients were included as per inclusion criteria and underwent surgical fixation.

The result of study was analysed and observation of this study are as follow:-

1. Age and Gender : The study comprised 15 males(40.55%) and 22 females(59.45%), the youngest patient was 56 years in age and the oldest patient was 92 years old, the mean age being 75.97 years. Most of the patients(78.37%) were in their eighth and ninth decade, 2(5.41%) patients(male 1,female 1) in 51-60 years age group, 5(13.52%) in 61-70 group(males 2,females 3), 18(48.64%) in 71-80 group(males 8,females 10), 11(29.73%) in 81-90 group(males 4,females 7). Their was only 1 female patient (2.70%) in 91-100 age group.

Table-1: Distribution Of Patients On The Basis Of Age And Gender

Age(years)	Male	Female	Total	Percentage
51-60	1	1	2	5.41%
61-70	2	3	5	13.52%
71-80	8	10	18	48.64%
81-90	4	7	11	29.73%
91-100	0	1	1	2.70%
Total	15	22	37	100%

2. Mode of Injury : In this study majority of fractures 27(72.98%) were sustained due to trivial injury whereas 10(27.02%) fractures were sustained in road accidents.

3. Side of fracture: In this study, 21(56.75%) fractures were on left side and 16(43.25%) were on right side.

4. Type of fracture: The skiagrams in the antero-posterior and lateral projections were done to classify the Garden staging.Classification of these fractures give better understanding about it's stability.

Table-2: Distribution Of Patients According To Garden's Staging

Garden's staging	No. Of patients	Percentage
I	1	2.70
II	2	5.40
III	27	72.98
IV	7	18.92
Total	37	100

In this study, out of 37 cases seen, 27 cases (72.98 %) were of stage III, 7 cases (18.92%) were of stage IV, 2 cases (5.4%) were of stage II while 1 case (2.7%) of stage I.

5. Type of Reduction: In present study, type of reduction accepted were anatomical and slight valgus. 25 patients (67.56%) had anatomical reduction while 12 patients (32.44%) had slight valgus reduction.

6. Singh's Index : Singh's (1970)¹² grading ,although criticized to have inter-observation variance, was used to grade the osteoporosis in each fracture and their gender affiliation taking antero-posterior skiagram of the contra lateral hip .

In present study, 2 patients belong to 51-60 years's age group out of which 1(2.7%) in grade 4,1 (2.7%) in grade 5. Five (5) patients belong to 61-70 years age group out of which 2(5.4%) in grade 3, 2(5.4%) in grade 4,1(2.7%) in grade5. The71-80 years age group had 18 patients out of which 2 (5.4%) in grade3,10 (27%) in grade 4 and 6(16.22%) in grade 5. The 81-90 years age group had 11 patients out of which 2 (5.4%) in grade 3,6(16.22%) in grade 4 and 3(8.11) in grade 5. The last 91-100 years age group had only 1 patient which belong to grade 3.

Table-3: Age Distribution And Grades Of Osteoporosis (singh's Index).

Grading	51-60(Yrs.)	61-70(Yrs.)	71-80(Yrs.)	81-90(Yrs.)	91-100(Yrs.)
Grade 1	0	0	0	0	0
Grade 2	0	0	0	0	0
Grade 3	0	2	2	2	1
Grade 4	1	2	10	6	0
Grade 5	1	1	6	3	0
Grade 6	0	0	0	0	0
Total	2	5	18	11	1

7.Garden Index : In present study, pre reduction and post reduction Garden index was calculated on Anterio-Posterior skiagram and it was observed that 14 patients (37.84%) had Garden index between 141-150, 20 patients (54.06%) had Garden index between 151-160 while the remaining 3 pateints (8.10%) had Garden index between 161-170 .

Table-4: Relation Between Garden Index And No Of Patients

Garden index	No of patients	
Pre – reduction Garden index	141-150	14
	151-160	20
	161-170	3
Post – reduction Garden index	151-160	16
	161-170	21

Similarly in post reduction, 16 patients (43.24%) had Garden index between 151-160 while the remaining 21 patients (56.76%) had Garden index between 161-170.

8.Harris Hip score : In this study, Harris Hip Score evaluated at 6th month was 83.027 points while at maximum follow up (1 year) averaged 91.027 points with maximum score being 99 and the minimum score being 55. Overall, 24 patients (64.86%) achieved excellent result, 8 patients (21.62%) achieved good result, 3 patients (8.11%) achieved fair result and 2 patients (5.41%) achieved poor result.

Table-5: Harris Hip Score At Maximum Follow Up (1 Year)

Grade	HHS	No. of patients	Percentage
Excellent	90-100	24	64.86%
Good	80-89	8	21.62%
Fair	70-79	3	8.11%
Poor	<70	2	5.41%
Total		37	100%

9. Complications : In present study , 4 patients had Non-union, 2 patients had superficial infections while one patient had screw pull-out.

DISCUSSION

Femoral neck fracture in elderly pose a great challenge in their treatment and rehabilitation. In order to avoid complications associated with non-ambulatory treatment, internal fixation of these fractures has been accepted as the standard procedure. Osteopenia, age, general health status, delay in surgical treatment due to financial and social reasons , varus collapse, implant cutout in head region, intraarticular penetration remains the major causes of unacceptable outcome in failures. The present study “Appraisal of clinical outcome of biplane double supported screw fixations (BDSF) for femoral neck fractures” is a prospective control study including 37 displaced intracapsular neck of femur fractures fixed after reduction with 7.3 mm self tapping cannulated screw .

The mean age of patients in the present study was 75.97 years which is in close proximity with the average age reported by Filipov O et al⁵ in which the average age was 76.9 while in Tidermark J et al¹³ the average age was 80 years.

Females outnumbered males with 59.45% of female patient and 40.55% were male in the present study . Similar results were seen in the study of Filipov O et al⁵ and Garden RS et al⁸ which reported 69.32% and 82% respectively, attributing this to lesser amount of muscles in females.

Trivial trauma in the domestic setup was the most common mode of trauma in the present study accounting for 70.27% of cases. Most of the authors in literature viz Filipov O et al⁵ and Satish BRJ et al¹¹ have reported trivial trauma to be the commonest cause of femoral neck fracture . The high incidence of patients with trivial fall in the present study indicates the sample size to be comprising of predominantly of osteoporotic fractures.

The average operating time was 60 min. with a range of 45-90 min. in the present study which was compared with Filipov O et al⁵ and Tidermark J et al¹³ in which average duration of surgery was 39 min. and 20 min. respectively. The variation in operating time was mainly influenced by whether the patient was operated by a trainee resident or a consultant.

Union was achieved in 89.18% patient in the present study. Similar results was seen in study of Filipov O et al⁵, Blomfeldt R et al⁶ and Garden RS et al⁸ which reported 98.86 % , 86.67% and 81% union rate.

The average time to clinicoradiological union in present study was 9.3 weeks with a range of 8 to 14 weeks with was comparable to that

studied by Satish BRJ et al¹¹ and Guruswami K et al⁹ which reported 10 weeks and 14.2 weeks.

Functional evaluation of studied patient on basis of Harris hip score was done at 3rd month , 6th month and 12th month. The average HHS in present study was 91.02 at 12th month with 64.86 % of total patient in excellent grade , 21.62% in good grade , 8.11% were in fair grade and 5.41% in poor grade . Similar results were reported by Filipov O et al⁵ and Lee YS et al¹⁰ in which mean HHS was 84.26 and 86.6 point respectively.

Most of the cases in the present study were unstable and osteoporotic in which the outcome of anatomical and deliberate valgus reduction in femoral neck fractures was analysed to have diminished rates of screw cut-out and facilitate consolidation. Hence, we advocate anatomical and valgus reduction in femoral neck fractures to achieve reliable functional and radiological outcomes.

SUMMARY AND CONCLUSIONS

- A total of 37 skeletally mature patients of femoral neck fractures were internally fixed with 7.3 mm cancellous cannulated screw to evaluate the clinical outcome of BDSF.
- The average age of the patients in the present study was 75.97 years with significant preponderance of female patients (59.45%). Left sided fractures (56.75%) outnumbered right sided fractures (43.25%) in the present study.
- Most of the patients were having associated medical illnesses (59.45%). No significant incidence of associated injuries was present in present study. Most common mode of injury in the present study was fall on a level surface (70.27%).
- The average time between injury and surgery in the present study was 5.2 days.
- The average operating time in present study was 60 minutes.
- Union was achieved in 33 (89.18%) patients in the present study.
- The average Harris hip score in present study was 91.027 points, with 64.86% of total patients in excellent grade, 21.62% in good grade, 8.11% were in fair grade while 5.41% in poor grade. So, majority of patients had good to excellent functional outcomes.
- BDSF method used in femoral neck fracture fixation has given very good results in my study.
- Difficulty in achieving distal screw fixation can be overcome by experience.
- Though anatomical reduction is crucial, BDSF-method ensures reliable fixation, early rehabilitation and good functional outcome especially in elderly.

Illustrative Case

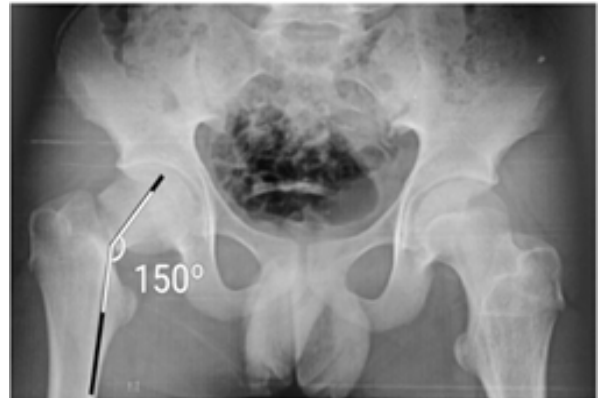


Figure-2: Pre-operative Xray Showing Low Transcervical, Garden Type III Fracture Right Side



Figure-3: Immediate Post – Operative AP And Lateral Skiagram

Shown After Fixation By BDSF

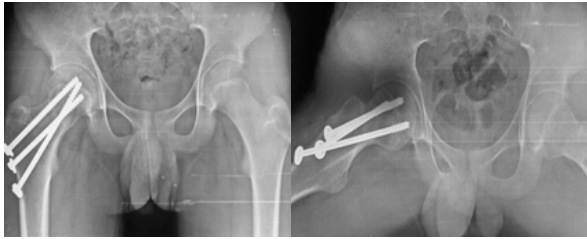


Figure-4: Follow-up Skiagram At 12 Months After Union Showing Intact Position Of Implant



Figure-5: Follow-up At 12 Months In Which Patient Had Regained Reasonable Squatting And Sitting Crossed Leg Capacity (HHS-89)

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