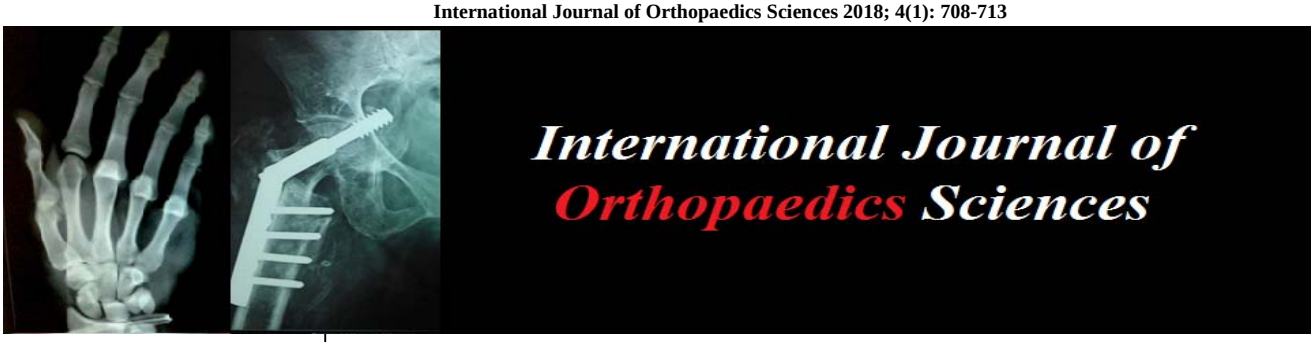

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Comparative study between proximal femoral nail and bipolar prosthesis in intertrochanteric fracture femur

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Abstract
Objective: To evaluate the clinical outcome and compare the advantages, disadvantages and possible complications associated with fixation of intertrocantric fractures with proximal femoral nail (PFN) and hemiarthroplasty.
Introduction: Surgery in trochanteric fractures is important in elderly patients for prevention of complications associated with conservative treatment like pressure sores, pulmonary infection, malunion etc, and aimed at early rehabilitation and mobilization. Internal fixation does provide immediate fracture fixation.
The present study was undertaken to compare outcomes of reduction of intertrochanteric fractures using internal fixation with the use of PFN and bipolar hemiarthroplasty (BPH) in elderly patients. This study compares bipolar hemiarthroplasty with proximal femoral nail (PFN) in ambulatory elderly patients, focusing on functional results and return to premorbid level of activity. Treatment modality like DHS is time tested but with availability of better hemiarthroplasty techniques and implant, mortality and morbidity can be reduced. This study was undertaken to compare clinical outcomes of intertrochanteric fractures treated with PFN compared to bipolar hemiarthroplasty (BPH) in elderly patients
Methodology: A Prospective Comparative Study was conducted in 20 elderly patients who were admitted and operated between November 2013 to November 2015 and had fulfilled the inclusion /exclusion criteria. They were allocated into two groups 10 patients each for PFN and BIPOLAR PROSTHESIS as group A and group B respectively. Harris hip score was used for assessment of the results of surgery. The results thus obtained was analysed and compared.
Results: 8 of the 10 patient treated with PFN and 9 of the 10 patient treated with Bipolar regained their pre injury walking ability at the fourth month of follow-up. Patients treated with PFN had a significantly lower pain score at the sixth month of follow up. The outcomes of the stable fractures treated with either Bipolar or PFN were similar. Unstable comminuted fractures treated with Bipolar showed significantly better outcomes with all patients having good results.

Keywords: PFN, harris hip score, intertrochanteric fractures

Introduction
Intertrochanteric fractures are a major cause of morbidity and mortality in elderly population. The incidence of all hip fractures is approximately 80 per 100,000 persons. Intertrochanteric fracture makes up 45% of all hip fractures [1]. Intertrochanteric fractures in elderly patients are associated with high rates of morbidity and mortality [2] although the results have improved with the use of internal fixation. In these patients however, comminution, osteoporosis, and instability often preclude the early resumption of full weight bearing [3]. Hence it is necessary to choose an appropriate treatment modality so that they could be mobilized early and return to their respective activities early. The surgical treatment for trochanteric fracture remains a challenge to a surgeon in terms of modality of treatment which gives the elderly patients early mobilization and rehabilitation, as the same are more prone to complications than the younger age group. This present study compares clinical outcomes of intertrochanteric fractures treated with PFN to bipolar hemiarthroplasty (BPH) in elderly patients.

Materials & Methods
Study Area: Kadimi hospital, Hyderabad

Study Population: All Male\Female patients aged 60 or more admitted in the hospital.

Sample size: 20 patients who were admitted and operated between November 2013 to November 2015 and had fulfilled the inclusion criteria, were enrolled for this study. 10 Patients operated with PFN were allocated to Group A and 10 patients operated with Bipolar Prosthesis were allocated to Group B according to randomized tables.

Study Type: Prospective study.

Inclusion criteria

- Cases of fracture IT Femur of Age group above 60 years.
- IT fractures without comminution were operated with PFN, IT fractures with comminution were operated with bipolar
- All types of fractures under Boyd and Griffith classification are considered.
- Closed Fracture.

Exclusion criteria

- Patients with Intertrochantric fractures less than 60 years of age
- Seriously ill patients and Patients unfit for surgery.
- Fracture due to tumor or any other pathological cause.
- Compound Fractures

Radiology follow-up chart for cases treated with Bipolar and PFN:

Period	Loss of reduction	Screw cut out	Excess sliding	Callus formation	Implant failure
3 wks					
6 Wks					
12 Wks					
6 months					

Radiology follow-up chart for cases treated with cemented Bipolar :

Period	Signs of loosening	Peri prosthetic fractures	Signs of protrusion	Heterotropic ossification	Dislocation
3 wks					
6 Wks					
12 Wks					
6 months					

Harris Hip assessment tool

I. Pain (44 possible)

A) None or ignores it 44

B) Slight, occasional, no compromise in activities 40

C) Mild pain, no effect on common activities, rarely moderate pain with unusual activity, may take simple pain medication 30

D) Moderate pain, tolerable, accepts limitations caused by pain. Some limitation of common activities or work. Occasionally takes pain medication stronger than aspirin 20

E) Pronounced, serious limitation of activities 10

F) Totally disabled, crippled, pain in bed, bedridden 0

II. Function (47 possible)

A. Gait (33possible)

1. Limp

a) None11

b) Slight 8

c) Moderate 5

d) Severe 0

2. Support

a) None 11

b) Cane for long walks 7

c) Cane most of the time 5

d) One crutch 3

e) Two canes 2

f) Two crutches 0

g) Not able to walk 0

(specify reason:_____)

3. Distance walked

a. Unlimited 11

b. 6 blocks 8

c. 2-3 blocks 5

d. Indoors only 2

e. Bed and chair 0

B. Activities (14 possible)

1. Stairs

a) Normally without using a railing 4

b) Normally using a railing 2

c) In any manner 1

d) Unable to do stairs 0

2. Shoes and socks

a) With ease 4

b) With difficulty 2

c) Unable 0

3. Sitting

a) Comfortably in ordinary chair one hour 5

b) On a high chair for one half hour 3

c) Unable to sit comfortably in any chair 0

4. Enter public transportation 1

III Absence of deformity points (4) are given if the patient demonstrates:

A) Less than 30º fixed flexion contracture

B) Less than 10º fixed adduction

C) Less than 10° fixed internal rotation in extension

D) Limb length discrepancy less than 3.2 centimeters

IV. Range of motion (index values are determined by multiplying the degrees of motion possible in each arc by the appropriate index)

A. Flexion

0—45 degrees X 1.0

45—90° X 0.6

90—110° X 0.3

B. Abduction

0—15° X 0.8

15—20° X 0.3

over 20° X 0

C. External rotation in extension

0—15 X 0.4

over 15° X 0

D. Internal rotation in extension

any X 0

E. Adduction

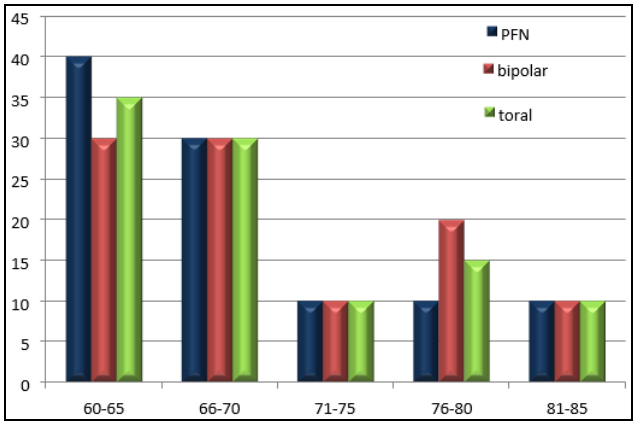
0—15° X 0.2

To determine the overall rating for range of motion, multiply the sum of the index values X 0.05. Record Trendelenburg test as positive, level or neutral.

Results

Table 1: Age Distribution

Age (Years)	Method of fixation		Total
	PFN	Bipolar	
60-65 YEARS	4(40%)	3(30%)	7(35%)
66-70	3(30%)	3(30%)	6(30%)
71-75	1(10%)	1(10%)	2(10%)
76-80	1(10%)	2(20%)	3(15%)
81-85	1(10%)	1(10%)	2(10%)
TOTAL	10(100%)	10(100%)	20(100%)

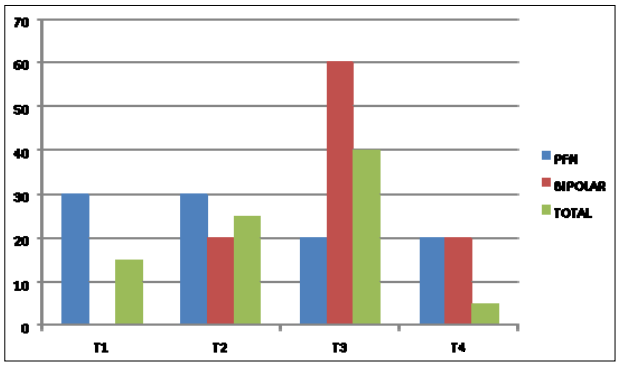


Graph 1: Age Distribution

Type of fracture with method of fixation

Type of Fracture	Method of Fixation		Total
	PFN	Bipolar	
T1	3(30%)	0	3(15%)
T2	3(30%)	2(20%)	5(25%)
T3	2(20%)	6(60%)	8(40%)
T4	2(20%)	2(20%)	4(20%)
TOTAL	10(100%)	10(100%)	20(100%)

Type of fracture with method of fixation

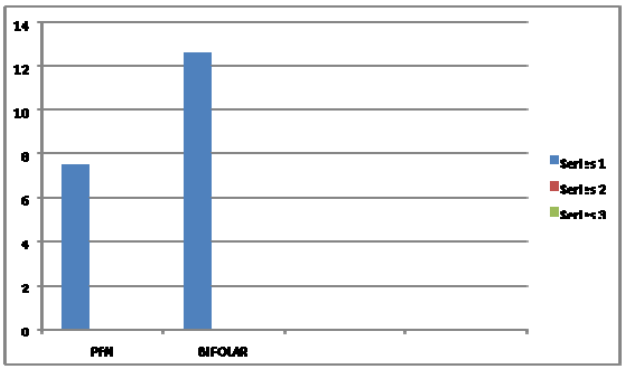


Intra operative variables
Length of incision

Length of incision	Method Of Fixation	
	PFN	Bipolar
Mean	7.5±1.3540	12.6±1.2649
Total	10	10

P<0.001, HS

Intra operative variables



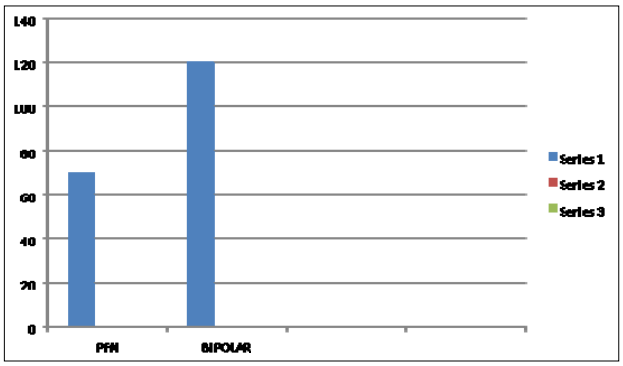
P<0.001, HS

Duration of surgery

Duration of surgery	Method Of Fixation	
	PFN	Bipolar
MEAN(MIN)	70±8.16	120±10.80
TOTAL	10	10

P<0.001, HS

Duration of surgery



Blood Loss

Blood loss (ml)	Method of fixation	
	PFN	Bipolar
Mean	131.5±31.97	214.5±31.48
Total	10	10

P=0.001, HS

Post-operative complications

Post-Operative	Method of Fixation		Total
	PFN	Bipolar	
Malunion	0(0%)	0(0%)	0(0%)
Wound Infection	2(13.33%)	1(6.67%)	3(10%)
Screw Backout	1(6.67%)	0(0%)	1(3.33%)

P=1.00, NS

Post-Operative Pain

Post-Operative Pain	Method of Fixation		Total
	PFN	Bipolar	
1	2(20%)	2(20%)	4(20%)
2	5(50%)	5(50%)	10(50%)
3	3(30%)	3(30%)	6(30%)
Total	10(100%)	10(100%)	20(100%)

P=.000, NS

1. No pain±
2. Mild pain not affecting ambulation
3. Moderate pain affecting ambulation requires analgesics
4. Severe pain, even at rest, requires stronger analgesics

Post-operative mobility score

Method		Mean +SD	T Value	P Value	Total
PFN	Pre-operative	1.2±0.41	2.061	0.049	10
	Post-operative	1.6±0.63			
Bipolar	Pre-operative	1.07±0.26	6.375	<0.001 HS	10
	Post-operative	2.33±0.72			

P<0.01 HS

Post-operative shortening

Method	Mean +SD	T Value	Total
PFN	100±8.16	4.583	10
Bipolar	100±5.16		10

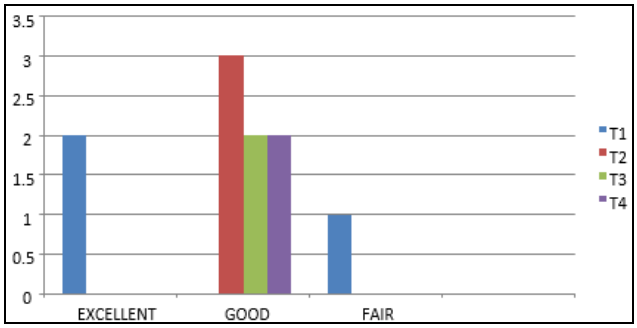
Post-operative rom

Method	Rom	Total
	Mean +SD	
PFN	100±8.164	10
Bipolar	86±5.16	10

Functional outcome Vs type of fracture

Outcome	Type of fracture				
	T1	T2	T3	T4	T5
Excellent	2(66.7)	0(0%)	0(0%)	0(0%)	2(20%)
Good	0(0%)	3(100%)	2(100%)	2(100%)	7(70%)
Fair	1(33.3%)	0(0%)	0(0%)	0(0%)	1(10%)
Total	3	3	2	0	10

Functional outcome vs type of fracture



Functional outcome versus method of fixation: bipolar

Results	Type Of Fracture				Total
	T1	T2	T3	T4	
Excellent	0	0(0.00%)	2(33.3%)	1(50%)	3(30%)
Good	0	2(10.71%)	1(50%)	1(50%)	4(40%)
Fair	0	0(0.00%)	3(50%)	0(0%)	3(30%)
Total	0	2	6	2	10

Discussion

The age of the patient ranged from 60 to 85 years with an average of 72.5 years. In case of bipolar fixation it was 71 years and in cases of proximal femoral nailing it was 69 years White and colleagues [47] did a study of rate of mortality for elderly patients after fracture of the hip in the 1980's and they concluded that the average age for trochanteric fractures is 75.4 years.

Our series consisted of 8 stable and 12 unstable intertrochanteric fractures as classified according to Boyd and Griffin classification. The distribution of stable and unstable fractures in both groups was similar. Out of the 8 stable fractures, 2 were in the bipolar group and 6 in the PFN group. Out of the 12 unstable fractures, 8 were in the bipolar group and 4 in the PFN group.

The preinjury walking ability was similar in both groups of patient with Bipolar or PFN. 93 percent of patients in the bipolar group and 80 percent of the patient in the PFN group were walking without support prior to the injury. 14% of patients in the study had grade 2 walking ability prior to fall. This is explained in the fact that intertrochanteric fracture occurs in elderly patient.

The length of the incision in the bipolar group ranged from 12cms to 16cm with a mean of 14cm as compared to mean of only 8cm in the PFN group. The smaller incision in the PFN group meant that there was less intra operative blood loss. This was comparable to the study conducted by Baumgaertner *et al*. [49]

The duration of surgery in the bipolar group ranged from 90 minutes to 120 minutes with a mean of 105 minutes. The duration of surgery in the PFN group ranged from 60 minutes to 80 minutes with a mean of 70 minutes. The difference in the operative times in both groups was found to be highly significant and we attributed this difference to the smaller incisions in the PFN group.

The Bipolar patients had more blood loss intra-operative compared to PFN group (average 220ml). Blood loss was calculated by number of mops used and post op drain.

Complication: We did not encounter any intraoperative complication in this study. The only complications we encountered in this series were screw back out and wound infection. The fracture union in case of PFN was seen in 12-15 weeks.

In our series 2 patients of the Bipolar group had wound infections as compared to single patient in the PFN group, which was not statistically significant. We attributed the higher number of wound infections in the Bipolar group to the longer incisions and subsequently more soft tissue handling in this group as compared to the PFN group. However all were only superficial wound infections and healed without any further surgical intervention.

In this study the average limb length shortening of patient in bipolar group was 1cm as compared to 2cm in PFN group which was significant. This could be due to better calcar reconstruction and use of bone cement in osteoporotic bones in bipolar group compared to the PFN[52]. 3 of the ten patients in Bipolar with fair results had 1 cm or more shortening, while 4 patients in PFN with fair result had 2cm or more shortening.

One patient (10 percent) in our study had a hip screw back out. This was seen in The PFN group involving an unstable intertrochanteric fracture. However these patients were relatively mobile and hence re-operation was not necessary. There was no implant cut out in the PFN group

Post op pain: In this study there was no significance difference in post op pain, in fact it was similar in both groups with 2patients in each group showing pain score 1, 5patients showing pain score 2, 3pateints showing pain score 3.

The average range of motion the hip joint was 80 degree in the bipolar group and 90 degree in the PFN group at 6 months of follow up. Hence, in our study the patients in the PFN group regained a significantly better range of motion as compared to those in the Bipolar group (p=0.002).

Functional Outcome: The overall functional outcome of patient treated PFN was significantly better compared to Bipolar (P=0.152). However when we compared the stable and unstable fractures separately, there was no significant difference in the outcomes of the stable fractures in the two groups (p=0.198). While comparing the unstable fractures in the two groups we found that the functional outcome of the patients in the PFN group was significantly better than the outcome of the patients in the bipolar group with good results for 87.5% of the unstable fractures treated with PFN compared to only fair and poor results for 90% of the unstable fractures with comminution treated with bipolar.

There is some amount of shortening seen in the bipolar group which can be explained as due to significantly greater impaction of the fracture in the bipolar group. The smaller incisions, shorter operative times, relatively less blood loss and less postoperative pain with the PFN indicate that the PFN has an advantage over the Bipolar even in the treatment of stable intertrochanteric fractures where the functional outcomes are similar. however, with unstable intertrochanteric the bipolar has a definite advantage over the PFN in terms of less limb length shortening, earlier restoration of pre-injury walking ability and a better overall functional outcome

Harris hip score

Series	Year	Bipolar (%)	Unipolar (%)
Carl Johan Hedbeck	2010	79.3	70.4
Cadler	1996	72	70
Nottage	1990	85	77
Meyer	1981	77	55
Drinker and Murray	1979	77.5	76.4

All were assessed according to Harris Hip Score and graded as Excellent, Good, Fair, Poor and Failure. We got 65.3% excellent result with bipolar group and 60.9% with PFN group. The mean HHS was 90.03 in Bipolar and 84.4 in PFN group. Distribution of result is statically similar in both groups (p=0.3283) but the mean score is statistically more associated with patients with bipolar prosthesis.

Yamagata *et al*, in their classical study of, reviewed 1001 cases of hip hemiarthroplasty; there were 682 unipolar and 319 bipolar cases. Patients undergoing Bipolar exhibited higher hip score and lower acetabular erosion rates compared to unipolar patients [54].

Bochner *et al* reported their experience with bipolar arthroplasties in a consecutive series of 120 hemiarthroplasties. In this group, 90 patients were followed for at least 2 years, with 91% being pain free and 92% demonstrating satisfactory power and motion [55].

Lestrange reviewed496 patients with bipolar replacements for displaced femoral neck fractures and compared them with patients having fixed-head prosthesis. He found that the bipolar prosthesis offered advantages over one-piece designs in terms of stability, decreased acetabular erosion, and improved function [56].

In 1988, Cornell *et al*, reported no differences in functional outcome in a small study including 48 patients with a six-month follow-up [57].

Calder *et al* published the results of a study including 250 patients, all aged 80 years or more, with a 1.5–2-year follow-up. A higher proportion of patients returning to their preinjury condition was found in the unipolar HA group, but no other differences were found [58].

In 2001, Davison *et al* presented the results from the same study for the 187 patients aged 65–79 years with a minimum two-year follow-up. No differences between randomization groups were reported, but the interpretation is limited by the fact that 18% of the patients were lost to follow-up [12].

According to Ong BC, there was no significant differences were found between the unipolar and bipolar groups [20].

Finally, in 2003, Raia *et al* reported the results of a study including 115 patients randomized to a more modern cemented unipolar HA or Bipolar HA with identical stems. At the one-year assessment there were no significant differences between the groups in terms of surgical complications, functional outcome [61].

Conclusion

- Both modalities, PFN and Bipolar hemiarthroplasty have shown good surgical and functional outcome
- All Intertrochantric fractures treated with PFN showed union by 12-16 weeks.
- Unstable comminuted Intertrochantric fractures treated with hemiarthroplasty with bipolar prosthesis showed minimal and acceptable shortening of 1cm.
- Early mobilization of the patient was achieved with hemiarthroplasty, thus avoiding complications of prolonged immobilization.
- Patients treated with PFN showed better range of mobility, thus proving the fact that biological union and retaining the original head of the femur gives better results, however quality of the bone in the form of density and texture dictates the treatment. Activities of daily living involving squatting and sitting cross-legged are better achieved by biological union.
- Early mobilization and return to active independent life style despite certain shortcomings like not able to squat and sit cross-legged are the highlights of hemiarthroplasty.

Summary

- Majority of the patient in present study were between 60-85 years with a mean age of72.5 years.
- Stable fracture constituted 40% of the cases; unstable fractures 60 percent.
- The PFN required shorter incisions, less blood loss and operative times.
- Bipolar was found to be implant of choice in unstable comminuted intertrochantric fractures, there was less shortening and early post op mobility and no use of fluoroscopy in bipolar cases.
- 8 of the 10 patient treated with PFN and 9 of the 10 patient treated with bipolar regained their pre injury walking ability at the fourth month of follow up.
- Patients treated with PFN had a significantly lower pain score at the sixth month of follow up.
- The outcomes of the stable fractures treated with either Bipolar or PFN were similar.
- Unstable comminuted fractures treated with bipolar showed significantly better outcomes with all patients having good results.

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