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Mechanism of Unstable Inter-trochanteric Fractures in the Elderly

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

The aim of this prospective comparative study is to analyse the short term follow-up results of unstable inter-trochanteric fractures in the elderly treated with Bipolar hemi-arthroplasty and Dynamic hip screw fixation done in our institution from March 2017 to October 2018. Proximal femoral fractures in the elderly individuals have a tremendous impact on both the health care system and society. Upon treatment of inter-trochanteric factures with conservative management, it usually unites with a mal-union, non-union and with shortening, but the problem of non –union in trochanteric fractures has less incidence. Because of complications associated with prolonged recumbency and its associated morbidities. Primary hemiarthroplasty in these patients provides for adequate fixation and early mobilization. It alleviates pain and improves function. It also prevents post-operative complications such as pneumonia, lung atelectasis and pressure sores. From our clinical observation we would suggest that unstable intertrochanteric fractures in elderly result most frequently from accidental fall (52.5%), being the most common described mechanism of injury.

Keywords: Inter-trochanteric fractures; osteoporosis; hemiarthroplasty.

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1. INTRODUCTION

Proximal femoral fractures in the elderly individuals have a tremendous impact on both the health care system and society. It occurs with both mild and moderate trauma [1,2]. During an impact, the large amount of energy that is released is absorbed by the skin, fat, and muscles which surrounds the hip. There was an increased incidence of hip fractures with aging due to decrease in muscle mass around the hip [2] and osteoporosis. This is becoming more common as the proportion of elderly people in the population has been steadily increasing [3].

Upon treatment of inter-trochanteric factures with conservative management, it usually unites with a mal-union and with shortening, but the problem of non –union in trochanteric fractures has less incidence [4]. Because of complications associated with prolonged recumbency and its associated morbidities.

Trochanteric hip fractures in the elderly patients have been benefited from advances in internal fixation. In the last 2 decades these newer implants have been helping in early mobilization and thereby preventing complications of recumbency. The failure after internal fixation has been due to the initial fracture pattern, communition, sub-optimal fracture fixation and poor bone quality [5]. The problems associated with fixation of these fractures are aloss of fixation, avarus collapse and implant cut-out of the lag screw [6]. As a result there is profound functional disability and pain [7]. In these patients treatment with primary bipolar hemi-arthroplasty decreases the post-operative complications due to prolonged immobilization or implant failure and also quickly returns the patients to their pre-injury activity level [8,9].

Our study shall aim to evaluate the clinical, functional and radiological outcomes of bipolar hemi-arthroplasty and compare them to those treated by dynamic hip screw fixation, for communited, osteoporotic, displaced trochanteric fractures in the elderly population.

1.1 Aim

The aim of this prospective comparative study is to analyse the short term follow-up results of unstable inter-trochanteric fractures in the elderly treated with Bipolar hemi-arthroplasty and Dynamic hip screw fixation done in our institution from March 2017 to October 2018.

2. MATERIALS AND METHODS

This study was conducted at Sree Balaji Medical College and Hospital, Chrompet, Chennai from March 2017 to October 2018 on 40 elderly osteoporotic patients with unstable inter-trochanteric fractures who were divided into two groups with Group A - bipolar prosthesis (20 cases approximately) and Group B – DHS (20 cases approximately). The recruitment of patients was from March 2017 to February 2018 [12 months], so that there would be a minimum follow-up of 8 months [range: 8 to 20 months].

2.1 Inclusion Criteria [10,11]

1. Both female and male in the age group of 56 to 75 were included.
2. Unstable inter-trochanteric fracture sAO [A2.1 TO A2.3] alone were included.
3. Osteoporotic fractures, meeting the above criteria were also included.
4. Cases were included only if they are within a 2 week window from the time of injury.

2.2 Exclusion Criteria [12,13]

1. Age less than 56 years and above 75 were excluded.
2. Patients with stable intertrochanteric fractures AO [A1 and A3] were excluded.
3. Patients with pathological fractures were excluded.
4. Patients with associated fractures of the ipsilateral lower limbs were excluded.

3. RESULTS

In our study, of the total 40patients recruited, most of them were in the age group of 56 to 60 (40%). Females out-numbered males in both the groups,60% in group A and 55% in group B. Together in both groups put together the females were 57.5%.

- Eight patients were in the age group of 56 to 60, of these 3 were male and 5 were female patients.
- Six patients were in the age group of 61 to 65, of these 3 were male and 3 were female patients.
- Three patients in the age group of 66 to 70, of these 1 was male and 2 were female patients.

There was one male and 2 female patients in the age group of 71 to 75 years.

Table 1. Age and sex distribution

Age (in years)	Group A (BPHA group) Sex and 'n'		Group B (DHS group) Sex and 'n'		Sample Size'n' Group A + Group B	% age of patients in the total sample
	Male 'n'	Female 'n'	Male 'n'	Female 'n'		
56 - 60	3	5	5	3	16	40
61 - 65	3	3	1	4	11	27.5
66 - 70	1	2	1	1	5	12.5
71 - 75	1	2	2	3	8	20
Total	8	12	9	11	40	100
% age in total	20	30	22.5	27.5	Net total	100%
% age within group	8/20 (40%)	12/20 (60)	9/20 (45%)	11/20 (55%)		

Group A:

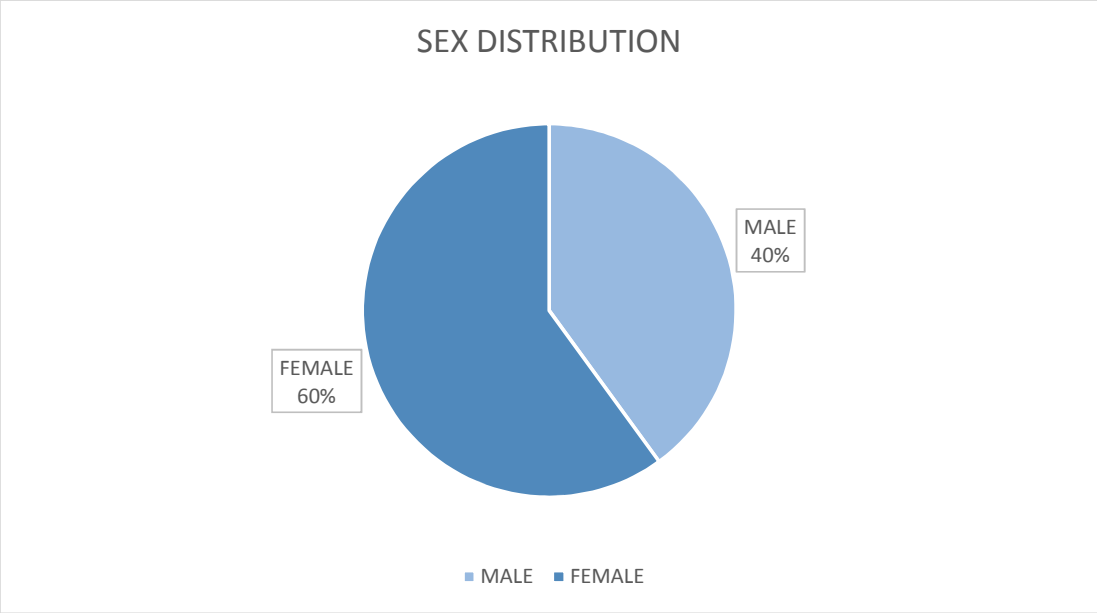

Fig. 1. Sex distribution in Group A (BPHA Group)
In group A (BPHA), among the 20 patients, there were 8 male (40%) and 12 female (60%)

Among the 20 patients, there were 9 male (45%) and 11 female (55%) patients as far as group B (DHS group) was concerned.

- Eight patients were in the age group of 56 to 60, of these 5 were male and 3 were female patients.
- Five patients were in age group of 61 to 65, of these1 was male and 4 were female patients.
- Two patients were in the age group of 66 to 70, of these 1 was a male and 1 was a female patient.

Five patients were in the age group 71 to 75, of these 2 were males and 3 were female patients.

3.1 Sidedness of the Injury

Of the 20 patients in group A (BPHA group) 13 patients had fracture on their right side and 7 patients on left side.

Of the 20 patients in group B (DHS group), 15 had fracture on their right side and 5 patients on left side.

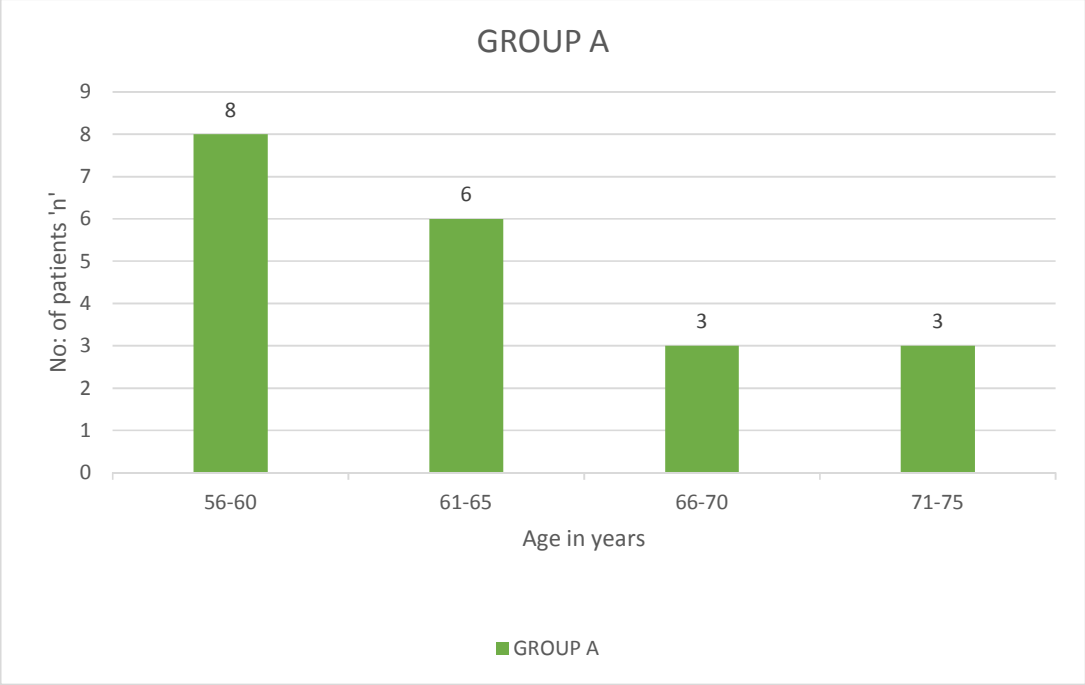

Fig. 2. Age distribution in Group A (BPHA Group)

Group B:

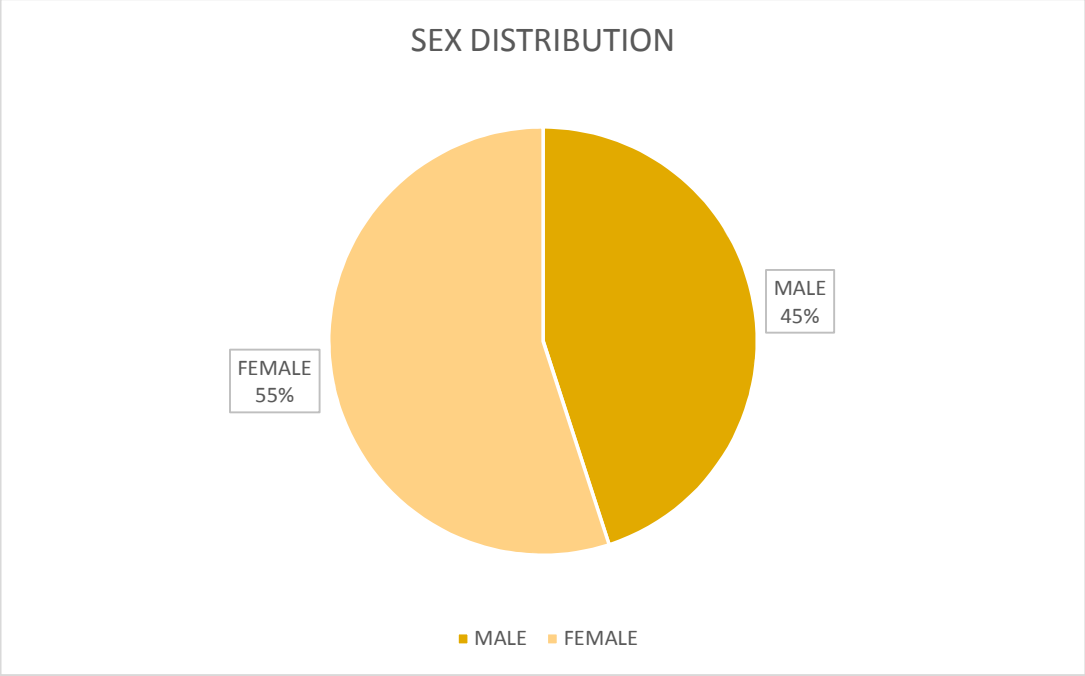

Fig. 3. Sex distribution in Group B (DHS Group)

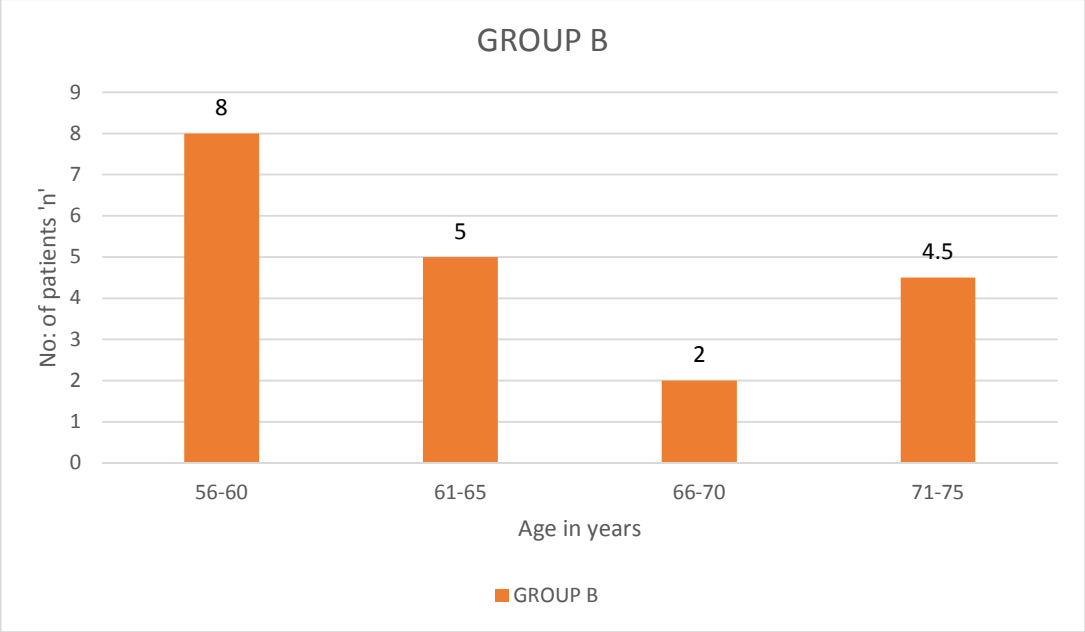

Fig. 4. Age distribution in Group B (DHS Group)

Table 2. Group A

Side	No. of patients
Right	13
Left	7

Table 3. Group B

Side	No. of patients
Right	15
Left	5

Table 4. Type of fracture (Classification of AO-OTA)

Classification	AO Type			Total
Types	**A2.1**	**A2.2**	**A2.3**	
Group A (BPHA GROUP)	03	11	06	20
Group B (DHS GROUP)	05	10	05	20

Table 5. Mechanism of injury distributiontable

Mode of injury	Male		Female		Nettotal 'n' % age
	Group A (BPHA) 'n'% age	Group B (DHS) 'n'% age	Group A (BPHA) 'n'% age	Group B (DHS) 'n'% age	
RTA	03	02	02	03	10(25%)
Trivial trauma	01	01	04	03	9(22.5%)
Accidental fall and others	04	06	06	05	21(52.5%)
Total	8(40%)	9(45%)	12(60%)	11(55%)	40(100%)

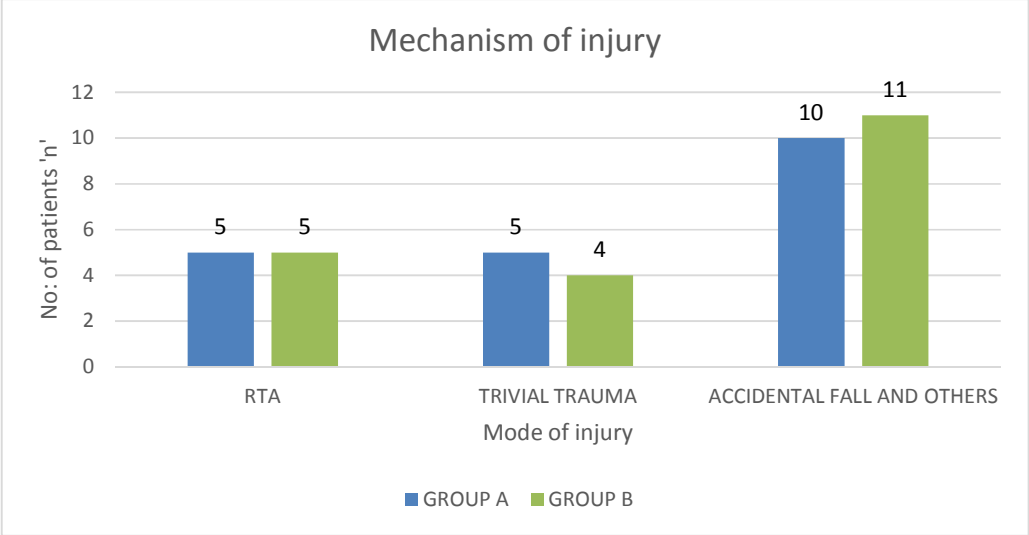

Fig. 5. Mechanism of injury distribution

In group A (BPHA group), according to AO classification type A2.2 was more common in 11 patients (55%), type A2.3 in 6 patients (30%) and type A 2.1 in 3 patients (15%).

In group B (DHS group), according to AO classification type A2.2 again was more common in 10 patients (50%), type A2.3 in 5 patients (25%) and type A2.1 in 5 patients (25%).

In group A (BPHA group),

- 10 patients had accidental fall of which there were four male and six female patients.
- 5 patients had road traffic accident of which there were three male and two female patients.
- 5 patients had trivial trauma of which there were one male and four female patients.

In group B (DHS group),

- 11 patients had accidental fall of which there were six male and five female patients.
- 5 patients had road traffic accident of which there were two male and three female patients.
- 4 patients had trivial trauma of which there were one male and three female patients.

In both the groups, grade 3 was more common in 13 patients. Six patients had grade 2 in group A and seven patients in group B. Grade 1 osteoporosis was seen in one patient in group A.

Surgical Approach:

Group A (BPHA group):

- Lateral –14.
- Posterior -06.

Group B (DHS group):

- Lateral – 20.

Table 6. Time elapsed from injury to surgery

Time Interval From Injury To Surgery(In Days)	No. of Patients 'n'	
	Group A (BPHA group) 'n' (% age)	Group B (DHS group) 'n' (% age)
0-4	6(30%)	7(35%)
5-9	8(40%)	9(45%)
10-14	6(30%)	4(20%)
Total	20(100%)	20(100%)

The mean time elapsed from injury to surgery was 7 days in the group A (BPHA) and 6.25 days in the group B (DHS)

Osteoporosis Evaluation:

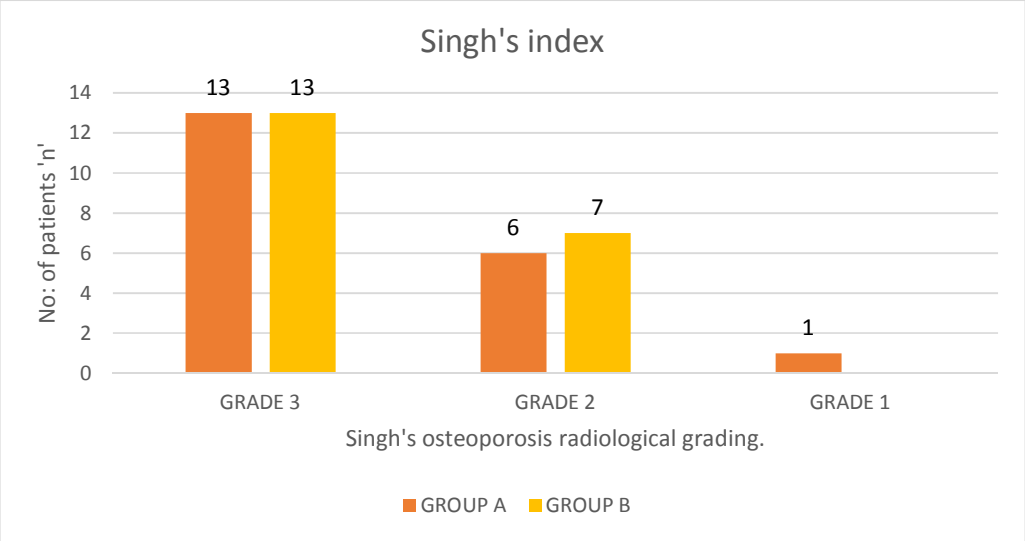

Fig. 6. Singh's index

Comorbid Conditions:

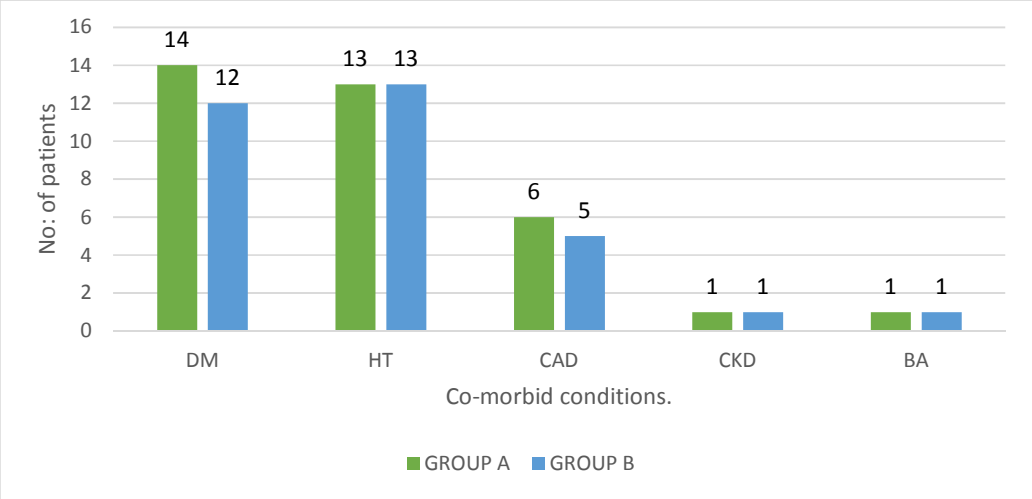

Fig. 7. Co-morbid conditions

Key: DM: Diabetes mellitus, HT: Hypertension, CAD: Coronary artery disease, CKD: Chronic kidney disease, BA: Bronchial asthma

Table 7. Operative time distribution chart

Operative Time (mins)	Group A (BPHA) 'n' (no. of patients)	Group B (DHS) 'n' (no. of patients)
61-90	6	4
91-120	12	15
121-150	2	1
Total	20	20

Average surgical time in Group A (BPHA) = 99.5 minutes.
Average surgical time in Group B (DHS) = 101 minutes.
P value: 0.0004

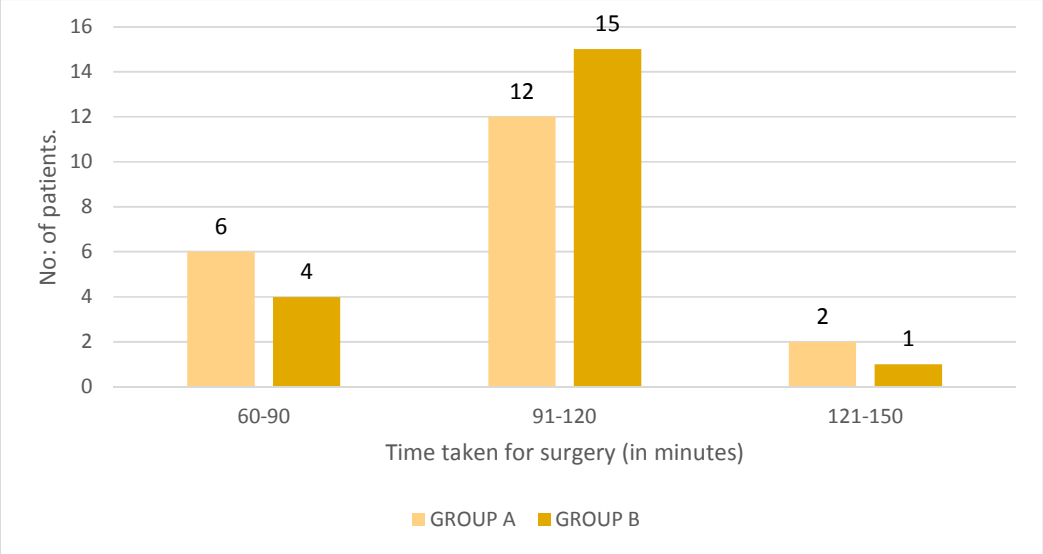

Fig. 8. Graphical representation of surgery conditions

Table 8. Blood loss evaluation chart

Blood loss (in ml)	Group A (BPHA) 'n' (no. of patients)	Group B (DHS) 'n' (no. of patients)
81 – 100	07	00
101-120	04	03
121-140	06	12
141-160	03	05
Total	20	20

P value: 0.0310.
Mean blood loss for Group A(BPHA group): 111 ml.
Mean blood loss for Group B(DHS group): 148 ml

Table 9.Transfusion distribution chart

Blood transfusion(as units)	Group A (BPHA) (no. of patients) 'n'	Group B (DHS) (no. of patients) 'n'
0	4	1
1	14	16
2	2	3

P value: 0.0276.
Mean for Group A(BPHA group): 1.4.
Mean for Group B(DHS group): 1.9

Table 10. Hospitalization duration chart post-surgery

Duration of hospital stay (in days)	Group A (BPHA) (no. of patients)'n'	Group B (DHS) (no. of patients) 'n'
12-15	16	8
16-20	3	7
21-25	1	5
Total	20	20

P value: 0.1374.
Mean for Group A(BPHA group): 14.7 days.
Mean for Group B(DHS group): 18.9 days

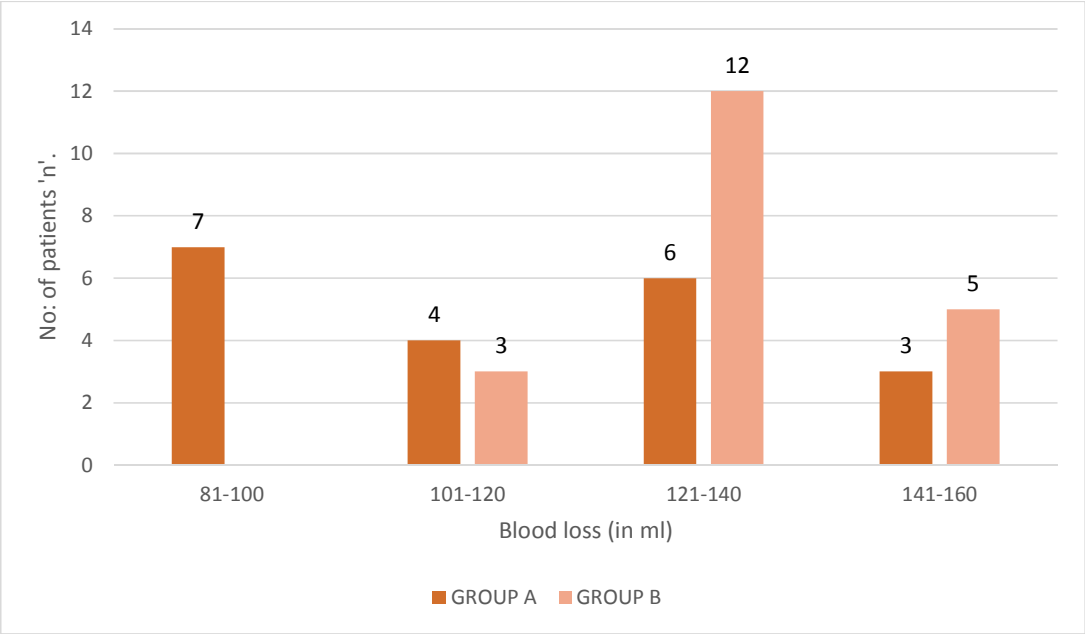

Fig. 9. Graphical representation of blood loss evaluation

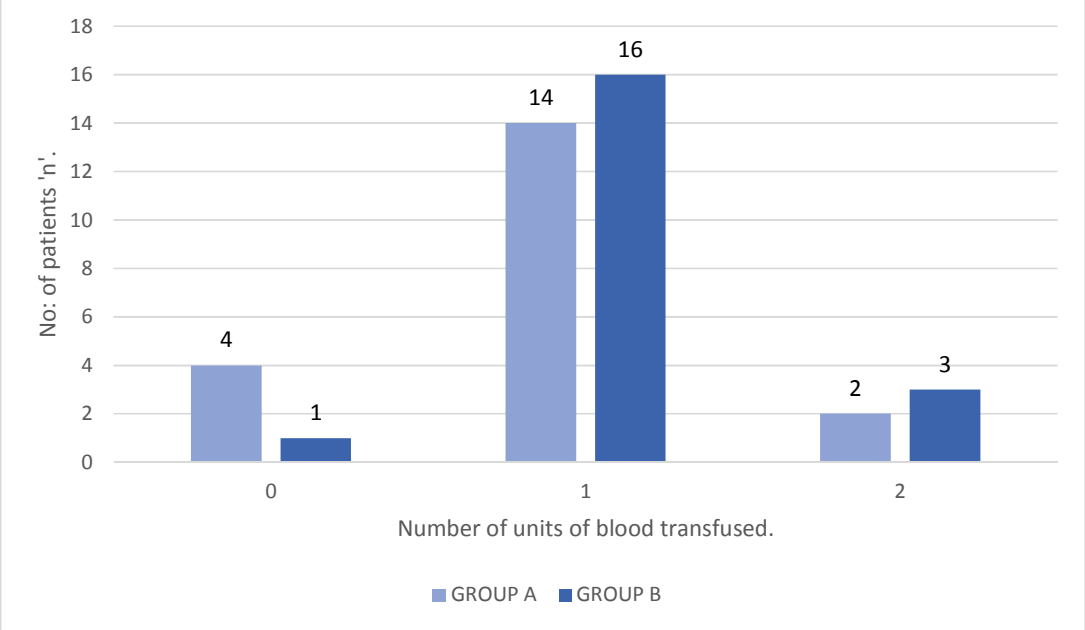

Fig. 10. Graphical representation of transfusion distribution

This prospective study was conducted at Sree Balaji Medical College and Hosital, Chrompet, Chennai from March 2017 to October 2018. The recruitment period was till February 2018 (12 months). The minimum follow-up period was 8 months (range: 8 to 20 months). 40 cases of unstable inter-trochanteric hip fractures were recruited, in this12 months, which satisfied our inclusion criteria. They were sub-divided into two groups of 20 cases each. The first group A set [BPHA], were surgically treated with bipolar hemi-arthroplasty and the second group B set [DHS], were surgically treated with dynamic hip screw fixation.

Table 11. Complication distribution chart

Complications	Group A (BPHA) 'n' (%age)	Group B (DHS) 'n' (%age)	Overall total 'n' (%age)
Infection	1 (5%)	1 (5%)	2 (5%)
Shortening	1 (5%)	1 (5%)	2 (5%)
Pulmonary complications	0	1 (5%)	1 (2.5%)
Pressure sores	0	0	0
Implant failure	0	1 (5%)	1 (2.5)
Urinary tract infection	0	0	0
Lengthening	0	0	0
TOTAL	2 (10%)	4 (20%)	6 (15%)

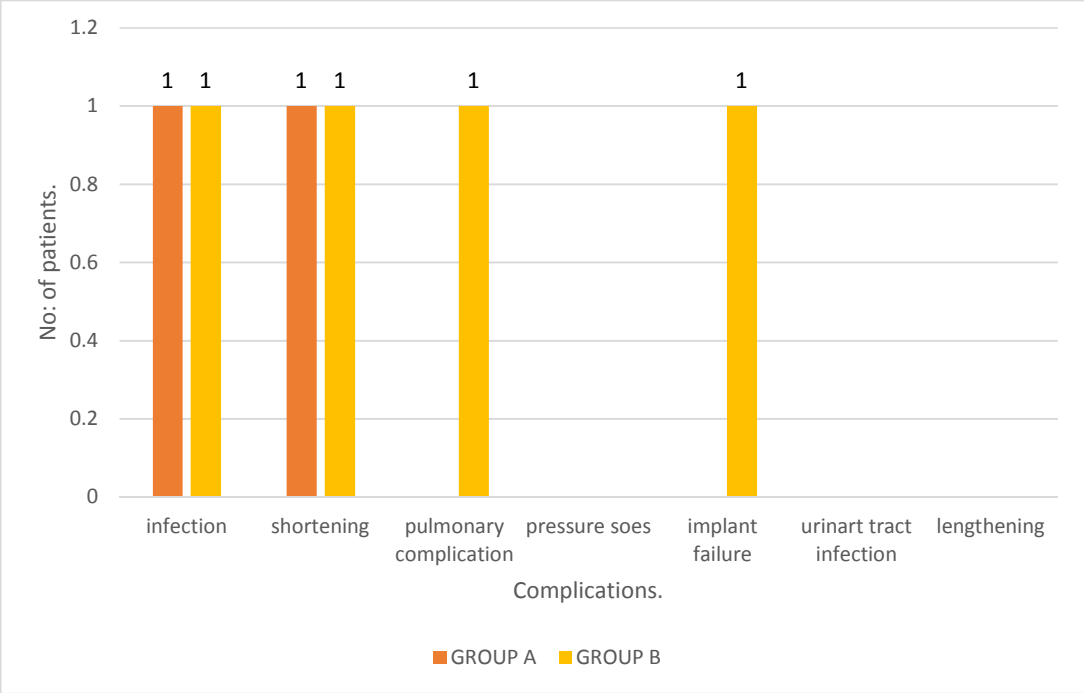

Fig. 11. Different complications

Table 12. Harris hip score grading

Grading	Group A (BPHA) 'n' (% age)	Group B (DHS) 'n' (% age)	Total 'n' (% age)
Excellent (>90points)	7 (35%)	4(20%)	11(27.5%)
Good (80-89 points)	8(40%)	7(35%)	15(37.5%)
Fair (70-79 points)	5(25%)	7(35%)	12(30%)
Poor (<70 points)	0	2(10%)	2(5%)
total	20(100%)	20(100%)	40(100%)

Table 13. Harris hip score mean values

Follow up (in months)	Harris HIP score		P value
	Group A	Group B	
9 Months	89.66	77.66	0.046

The following observations were made out in this study:

There was female predominance in both groups, 60% (n=12) in group A (BPHA) and 55% (n=11) in group B (DHS). Fracture incidence was more common in age group of 56-60 years with group A 40% (n=8) and group B 40% (n=8). The mean age for group A and group B was 61.3 years and 62.8 years respectively. Right side was more commonly involved in both group A (BPHA) 65% (n=13) and group B 75% (n=15) (DHS).

Among the fracture distribution in AO classification type A2.2 was more common in both group A 55% (n=11) and group B 50% (n=10).The commonest mode of injury in both the groups was accidental fall accounting for 50% (n=10) of all cases in group A and 55% (n=11) of all cases in group B. In both groups the most common Singh's index was grade III, 65% (n=13) in both Group A and Group B. Lateral surgical approach was dominant in both groups, 70% (n=14) cases and in group A and 100% (n=20) of cases in group B.

The mean operative time was only marginally greater in group B at 101 minutes than in group A at 99.5 minutes (P value 0.0004). The mean blood loss intraoperatively was higher in group B at 148 ml than in group A at 111 ml (P value 0.0310).

The mean blood transfusions (number of units) during the hospital stay was greater in group B at 1.9 units than in group A at 1.4 (P value 0.0276). The mean hospital stay post-surgery in group A was 14.7 days and it was higher at 18.9 days in group B (P value 0.032). The mean follow-up (in months), for group A and group B were 11 months and 10.7 months respectively.

Among the post-operative complication we had in group A, 5% case of superficial infection (n=1), 5% cases of shortening (n=1). We had no cases with pulmonary complications, pressure sore, implant failure, UTI or lengthening in group A. Thus the overall complications was lower at 10% (n=2). In group B, on the other hand we had 5% cases of infection (n=1), 5% cases of shortening (n=1), 5% cases of pulmonary pneumonia (n=1) and 5% case of implant failure (n=1). Thus the overall complication rate in group B was 20% (n=4).

At 9 months follow up for group A, the HHS was 90.66 and that for group B was 80.45 (P value 0.046). In group A 75% (n=15) had excellent to good outcomes whereas in group B it was at 55% (n=11). This clearly established the superiority of the implant in group A (bipolar hemi-arthroplasty) over group B (dynamic hip screw fixation).

4. DISCUSSION

Inter-trochanteric fractures in elderly patients are associated with notable morbidity and mortality. Internal fixation in these patients has reduced the mortality associated with these fractures [14,15], however failure rate in certain literature are as high as 56% [16-20] and early mobilization is avoided in these cases because of osteoporosis, poor screw fixation and comminution.

The weak and osteoporotic bone in these patients do not provide for a firm purchase of screw which leads to early bio-mechanical failure [21]. As a result the femoral head collapses and migrates into varus and retroversion. This leads to limping gait due to shortening and decreased abductor muscle lever arm [22-25].

Another cause for functional disability and pain in these patients is cutting out of the screw from the femoral head. Although the mortality rate is somewhat decreased with internal fixation, the complication rate still ranges from 4 to 50 percent [26-29].

Primary hemiarthroplasty in these patients provides for adequate fixation and early mobilization. It alleviates pain and improves function. It also prevents post-operative complications such as pneumonia, lung atelectasis and pressuresores [30,31].

In a study by Harwin et al., Bipolar Bateman-Leinbach prosthesis implanted in fifty eight elderly osteoporotic patients, who had comminuted inter-trochanteric fractures, were followed for an average duration of twenty eight months. The average age of the patient in this study was seventy eight years. There were no stem loosening, dislocations or deep infections. Ninety one percentage of patients walked before discharge [32,33].

In study by Broos et al. Bipolar Vandeputte prosthesis was implanted in ninety four elderly patients. Results were better with bipolar hemi-arthroplasty group with respect to shorter average operating time, lower mortality rate and better functional results [34].

In study by Rodop et al. Bipolar Leinbach hemi-prosthesis was implanted in fifty four elderly patients. There were no cases of stem loosening or dislocations. Harris Hip Scoring showed good to excellent result in eighty percent of these patients [35].

In our study, there was female preponderance in both the groups accounting for 60% in group A (BPHA) and 55% in group B (DHS). This is due to post-menopausal osteoporosis and lower peak bone mass.

The results in group A (BPHA) were better than group B (DHS) with respect to blood loss, operative time, peri-operative blood transfusion this compares favourably with the study alone by Sinno K et al. [18]; where one hundred and two patients participated in the study. Bipolar hemi-arthroplasty was done in 48 patients and 54 patients were treated with dynamic hip screw fixation.

The mean operative time was just less in group A (BPHA) (99.5 minutes) than that in group B (DHS) (101 minutes), which coincides with study by Sinno K et al. [18] where it is 112 minutes.

The amount of blood loss (mean) was lower in group A (BPHA) (111 ml) than in group B (DHS) (148 ml) with a P value of 0.03,which is similar to the study by Sinno K et al. [18]; where it was reported 129 ml in the hemiarthroplasty group with a P value of 0.005.

The mean blood transfusions (units) was higher in group B (DHS) (1.9 units) than in group A (BPHA) (1.4 units) with a P value of 0.02.This compares well with the study by Md Emami et al. [37]; where the mean blood transfusions was greater in internal fixation group (1.9 units) than in Bipolar hemiarthroplasty group (1.37 units), with a P value of 0.01.

Early mobilization with full weight bearing in group A (BPHA) compared to non-weight bearing or partial in group B (DHS) shows reduction in pulmonary complications (5%). This is in concurrence with the study done by Grimsurd et al. where they studied 39 patients treated with bipolar arthroplasty. It allowed for early weight bearing and had low rate of pulmonary complications and bed sores [36,37].

There was superficial infection in 1 patient in group A (BPHA), which comes to around 5%, whereas in group B (DHS), 1 patient had infection (5%), which is higher than the study by Sinno K et al.; where they had a 0% infection rate in hemi-arthroplasty group and 4% in internal fixation group [38].

There were no cases of dislocation reported in our study. Two patients (10%) had shortening post-operatively with 1.5 cm and 2 cm this is better than in the study by James et al. (11%).No patient had lengthening of the limb in our study.

The Harris hip score was better in group A (BPHA) than in group B (DHS). The Harris hip score at 9 months follow-up is significant with P value of 0.04 and were regarded as good in the hemi-arthroplasty group and fair in internal fixation group, which goes favourably with study by Sino K et al; where at 24 months follow up the score was significant better in the hemi-arthroplasty group with P value of 0.0001 [39].

Due to high risk of surgery in these elderly patients and the impossibility of imposing multiple surgeries, treatment goal should be to improve their function and quality of life. There is also a need to reduce the failure rates.

In general, device failure depends on several factors including the type of fractures and its stability, the co-existence or not of osteoporosis and last but not least is the incorrect placement of the screw into the femoral head [29,30]. In a study performed by Nordin et al. [31]; on the inter-trochanteric fractures treated with the DHS device, the incidence of device failure was reported to be 16.7%, although in the study by Md Emami et al., the rates were lower at 10%. In our study the DHS group had a 5% implant failure rate and the BPHA group had 0% [40].

Ehlinger et al. [32]; reported that about 6% of the patients treated with DHS device have had infections. In our study we had 5% infection rate in both the hemi-arthroplasty as well as the DHS group, which was effectively controlled by parentral antibiotics and dressings.

Sino et al; in 2010 conducted a retrospective study on 102 patients with inter-trochanteric fracture and compared the results of bipolar and DHS usage. In this study the function, complication rate and FWB in the bipolar group was significantly better [41].

Shan et al; in 2012 compared ORIF and bipolar outcomes in 124 patients with a 2 year follow-up and concluded that there were better results of

pain reduction, ability to walk and better HHS score in the arthroplasty group. This compares well with our deduction wherein, the mean HHS score for the bipolar hemi-arthroplasty was significantly better at 90.66, where as the mean HHS score in the DHS was 80.45 (Pvalue= 0.046).

In the study by Bhattacharya et al. [34]; in 2012 they concluded that for inter-trochanteric factures, bipolar is a better treatment in comparison to THA.

In our relative small cohort study and a relatively short follow-up, the parameters generator shows that bipolar hemi-arthroplasty may be a better choice for displaced unstable and osteoporotic inter-trochanteric fractures. Their benefits include early mobilization, lower rate of infection and better functional outcome scores.

5. CONCLUSION

From our clinical observation we would suggest that unstable intertrochanteric fractures in elderly result most frequently from accidental fall (52.5%), being the most common described mechanism of injury. In conclusion, bipolar is better than DHS in stable inter trochanteric fracture. Bad surgical technique may lead to prolonged operative time, high incidence of deep infection, dislocation, and a poor radiological and functional outcome.

CONSENT AND ETHICAL APPROVAL

As per university standard guideline, participant consent and ethical approval have been collected and preserved by the authors.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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