



TO STUDY THE FUNCTIONAL OUTCOME OF ELDERLY PATIENTS HAVING INTERTROCHANTERIC FEMUR FRACTURE TREATED WITH HEMIARTHROPLASTY

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ABSTRACT

Background Among proximal femoral fractures, displaced femoral neck fractures (FNFs) are the most common (37% frequency), while two-thirds of total FNFs are displaced fractures. Fractures of Hip are one of the commonest injuries sustained by the aged. These occur predominantly in patients over 60 years of age. Morbidity and mortality increases with age. Over the years, osteosynthesis has been indicated as the preferable treatment for stable intertrochanteric fractures and has shown promising results, but high rate of mortality render this option impractical in unstable intertrochanteric fracture cases. As a result, role of primary hemiarthroplasty in intertrochanteric femur fractures emerged as a valid choice for treatment of unstable intertrochanteric fractures and has shown promising results with fewer complications. Hence the present study was done to analyze the role of primary hemiarthroplasty and the functional outcomes in cases of intertrochanteric femur fractures using Harris Hip Score. **Methods** A prospective observational study was done on 25 patients with intertrochanteric fractures treated with hemiarthroplasty. Patients with age more than 65 years, consent to participate and follow up in post-operative rehabilitation were included. There were 20 females and 5 males with an average age of 77.5 years. After proper assessment, patients were treated using direct lateral approach for hip with monopolar or modular bipolar hemiarthroplasty. All patients were assessed by Harris Hip score. These scores were used as an outcome measure of functional recovery in activities of daily living (ADLs). **Results** The mean VAS Score at discharge was 5.15 ± 2.26 which improved significantly at post-op 1 month (3.52 ± 0.86) and post-op 3 months (2.56 ± 0.57). The difference in VAS score during follow-up period was statistically significant as per ANOVA test ($p < 0.05$). The functional daily activities in patients were measured by Harris Hip Score. The mean Harris Hip Score at discharge was 65.88 ± 8.65 which improved significantly at post-op 1 month (72.68 ± 4.57) and post-op 3 months (76.88 ± 5.54). The difference in Harris Hip Score during follow-up period was statistically significant as per ANOVA test ($p < 0.05$).

KEYWORDS :

INTRODUCTION

The history of development of treatment rationale for hip fractures parallels historical development of Orthopaedic Surgery. In spite of earnest work of many in this field, the problem still remains far from being solved. This fracture is rightly being labeled as the "unsolved fracture" by Dickson J.A.¹. The goal of treatment of an intertrochanteric fracture must be restoration of the patient to his or her pre-injury status at the earliest possible time. This led to recommendations for internal fixation of these fractures to increase patient comfort, facilitate nursing care, decrease hospitalization and reduce complications of prolonged recumbency.² The greatest problems for the Orthopaedic surgeon treating this fracture are instability and the complications of fixation that result from instability. Unstable intertrochanteric fracture in the elderly patient is associated with high rate of mortality as much as 20 per cent during the first postoperative year.³⁻⁷ The treatment of such unstable intertrochanteric fracture is still controversial, despite of the publication of reports of randomized trials and comparative studies.⁸⁻¹⁰

Over the years, osteosynthesis has been indicated as the preferable treatment for stable intertrochanteric fractures and has shown promising results, but high rate of mortality render this option impractical in unstable intertrochanteric fracture cases. As a result, role of primary hemiarthroplasty in intertrochanteric femur fractures emerged as a valid choice for treatment of unstable intertrochanteric fractures and has shown promising results with fewer complications. Hence the present study was done to analyze the role of primary hemiarthroplasty and the functional outcomes in cases of intertrochanteric femur fractures using Harris Hip Score.

MATERIAL AND METHODS

A hospital based prospective, observational study was conducted with 25 patients to assess the functional outcomes of Intertrochanteric Femur Fractures treated with hemiarthroplasty.

The study was done on attending OPD/IPD after due permission from the Institutional Ethics Committee and Review Board and after taking Written Informed Consent from the patients.

After approval from the Institutional Ethics Committee a valid informed consent was taken. Once the patients were enrolled for the study, a thorough history and physical examination was done as per proforma. An informed consent was taken in written from patients or patient's attendant. Patients presenting with Intertrochanteric femur fracture were evaluated as per inclusion/exclusion criterion. The patients were then assessed clinically to evaluate their general condition and local injury. Patients were interviewed about their pre fracture ambulatory status and any disabilities using HHS. Radiographs were obtained and complete lab investigations. Modified Harris Hip Score were recorded for the following intervals discharge, 1-month, 3-month. These scores were be used as an outcome measure of functional recovery in activities of daily living (ADLs).

Operative procedure:

All patients were operated by Direct Lateral approach by coxofemoral bypass. Longitudinal incision from 5cm above the greater trochanter which passes over the center of the tip of the greater trochanter and extends to approximately 8 cm down the line of the shaft of the femur. Incision of the fat and

the deep fascia in line with the skin incision to pull the tensor fascialata anteriorly and the gluteus maximus posteriorly. Fracture line of the greater trochanter is palpated and a plane is developed for the entry to be made through the fracture site. The superior aspect of the capsule is incised by a T shaped incision. Femoral head along with the neck is extracted using a head extractor.

Acetabulum is cleared of all soft tissues. Insertion of the broaches in 10-15 degrees of anteversion in relation to the axis of the flexed tibia was done to remove cancellous bone in the proximal shaft of femur.

Trial reduction with trial stems performed. Limb length is determined and range of motion and stability of the arthroplasty is checked using trial components. Depth of insertion of the component is determined at the level when limb lengths become equal and a bony landmark is marked as a guide during prosthesis insertion. One millimeter (18 gauge) stainless steel wire is passed through the drill hole created just below the lesser trochanter to fix the greater trochanter in figure of 8 fashion after inserting the prosthesis and reduction of the joint. Cement injecting gun was used for cement delivery.

Desired amount of anteversion and mediolateral position of the stem is determined before insertion. Limb length and stability of the prosthesis confirmed. Soft tissue and skin closure achieved after keeping a suction drain. Limb is kept in abduction with pillow in between to prevent adduction and internal rotation. Supine static quadriceps exercises and ankle pumps are started on day of surgery and sitting quadriceps exercises started on 2nd day postoperatively. Full weight bearing started between Day 3- Day 8 postoperatively. Patients having delayed full weight bearing were started on toe touch weight bearing. Alternate and complete suture removal on 10th and 12th day postoperatively. At each follow up visit patients were evaluated radiologically and clinically. Functional outcome was evaluated by Harris hip score and were graded as

Harris Hip Score Grading

<70	Poor
71-80	Fair
81-90	Good
91-100	Excellent

Radiographs were taken at each follow up and analyzed to note any evidence of dislocation or prosthesis loosening. Post-operative management and rehabilitation was started as per protocol. Patients of hemiarthroplasty were ambulated with full weight bearing on the first postoperative day with the aid of physiotherapist. All patients were followed up at the time of discharge with check X ray at 6 weeks 3 months.



Intraop and postop images

OBSERVATIONS AND RESULTS

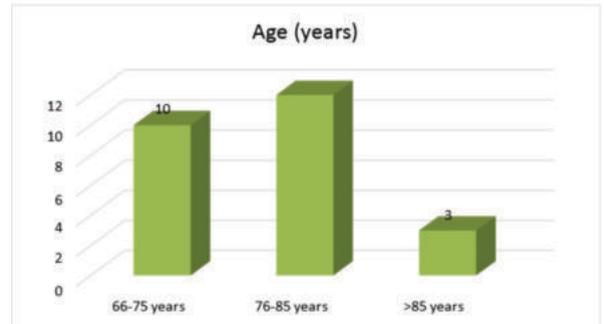
A hospital based prospective, observational study was conducted with 25 patients to assess the functional outcomes of Intertrochanteric Femur Fractures treated with hemiarthroplasty.

Distribution of patients according to Age

Majority of the patients (48%) were from the age group of 76-85 years followed by 40% from the age group of 66-75 years and 12% from the age group of >85 years. The mean age of patients was 77.56 ± 6.60 years.

Table 1: Distribution of patients according to Age

Age (years)	N	%
66-75 years	10	40%
76-85 years	12	48%
>85 years	3	12%
Total	25	100%
Mean ± SD	77.56 ± 6.60	

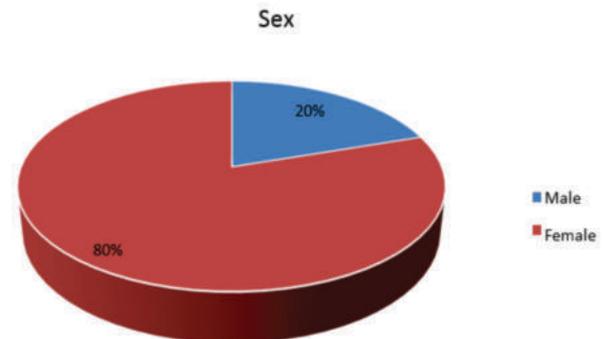


Graph 1: Distribution of patients according to Age

Majority of the patients were female (80%) while male patients constituted 20% of the study group.

Table 2: Distribution of patients according to Sex

Sex	N	%
Male	5	20%
Female	20	80%
Total	25	100%



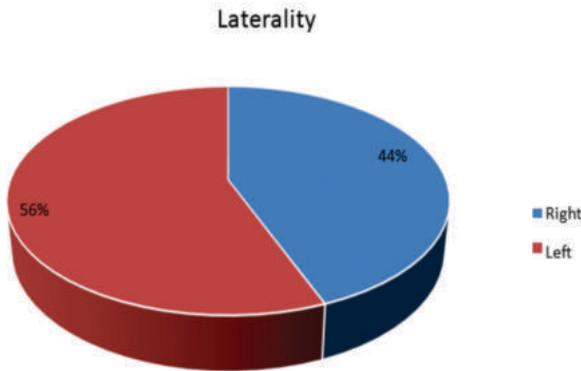
Graph2: Distribution of patients according to Sex

SexDistribution of patients according to Laterality of Fracture

11 (44%) fractures were on right side while 14 (56%) fractures were on left side.

Table 3: Distribution of patients according to Laterality of Fracture

Laterality	N	%
Right	11	44%
Left	14	56%
Total	25	100%

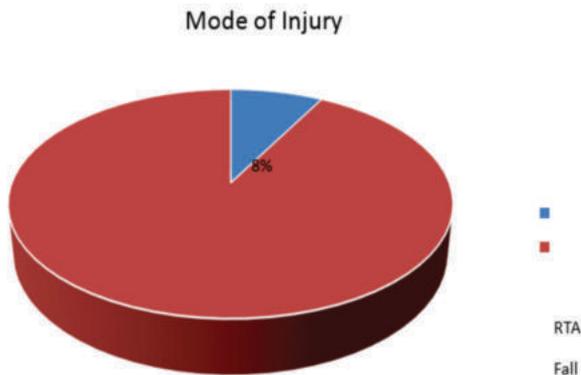


Graph3: Distribution of patients according to Laterality of Fracture

Fall was observed to be the main cause of fracture (92%) followed by Road Traffic Accident (8%).

Table 4: Distribution of patients according to Mode of Injury

Mode of Injury	N	%
RTA	2	8%
Fall	23	92%
Total	25	100%



Graph4: Distribution of patients according to Mode of Injury

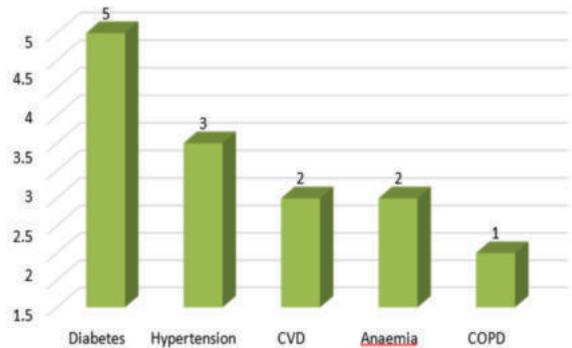
5 (20%) and 3 (12%) patients had Diabetes Mellitus and Hypertension respectively whereas 2 (8%) patients each had cardiovascular disease (CVD) and anaemia respectively. 1 (4%) patient had Chronic Obstructive Pulmonary Disease (COPD).

Table 5: Distribution of patients according to Co-morbidities

Co-morbidities	N	%
Diabetes Mellitus	5	20%
Hypertension	3	12%
CVD	2	8%
Anaemia	2	8%
COPD	1	4%

CVD - cardiovascular disease; COPD - Chronic Obstructive Pulmonary Disease

Co-morbidities

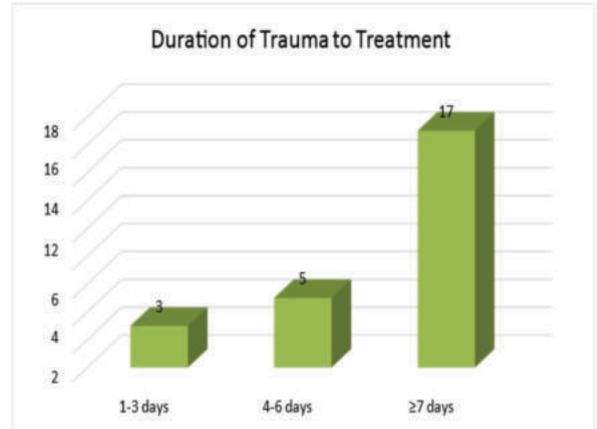


Graph5: Distribution of patients according to Co-morbidities

The duration of trauma to treatment in 3 (12%) and 5 (20%) patients was 1-3 days and 4-6 days respectively and it was ≥ 7 days in 17 (68%) patients. The mean duration of trauma to surgery was 8.04 ± 3.74 days.

Table 6: Distribution of patients according to Duration of Trauma to Treatment

Duration (days)	N	%
1-3 days	3	12%
4-6 days	5	20%
≥ 7 days	17	68%
Total	25	100%
Mean \pm SD	8.04 ± 3.74	

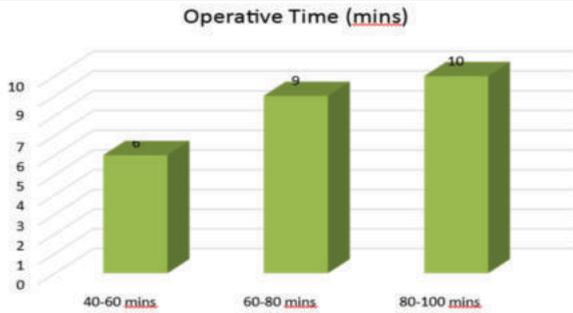


Graph6: Distribution of patients according to Duration of Trauma to Treatment

6 (24%) patients had operative time of 40-60 minutes whereas 9 (36%) and 10 (40%) patients had operative time of 60-80 minutes and 80-100 minutes respectively. The mean operative time was 72.56 ± 16.35 minutes.

Table 7: Distribution of patients according to Duration of Operative Time

Operative Time (mins)	N	%
40-60 mins	6	24%
60-80 mins	9	36%
80-100mins	10	40%
Total	25	100%
Mean \pm SD	72.56 ± 16.35	

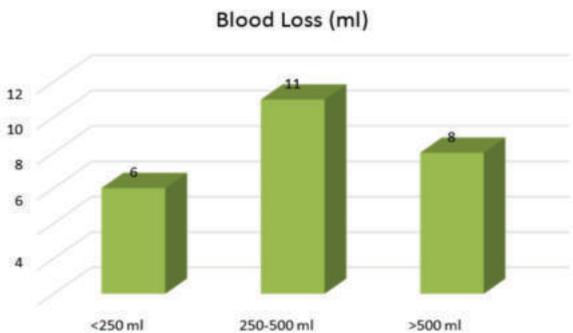


Graph7: Distribution of patients according to Duration of Operative Time

6 (24%) patients had blood loss <250 ml whereas 11 (44%) and 8 (32%) patients had blood loss of 250-500 ml and >500 ml respectively. The mean blood loss was 423.92 ± 181.38 ml.

Table 8: Distribution of patients according to Blood Loss

Blood Loss (ml)	N	%
<250 ml	6	24%
250-500 ml	11	44%
>500 ml	8	32%
Total	25	100%
Mean \pm SD	423.92 ± 181.38	



Graph8: Distribution of patients according to Blood Loss

Majority of the patients (68%) had a hospital stay after operation of 11-14 days followed by 5- 10 days (20%) and <5 days (12%). The mean duration of hospital stay after operation was 10.24 ± 3.46 days.

Table 9: Distribution of patients according to Duration of Hospital Stay after Operation

Time Interval	N	%
<5 days	3	12%
5-10 days	5	20%
11-14 days	17	68%
Total	25	100%
Mean \pm SD	10.24 ± 3.46	



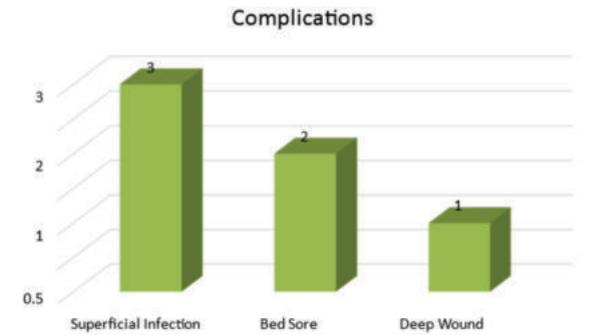
Graph9: Distribution of patients according to Duration of

Hospital Stay after Operation

Distribution of patients according to Complications
 3 (12%) patients had superficial infection while 2 (8%) and 1 (4%) patient had bed sore and deep wound infection respectively.

Table 10: Distribution of patients according to Complications

Complications	N	%
Superficial Infection	3	12%
Bed Sore	2	8%
Deep Wound Infection	1	4%

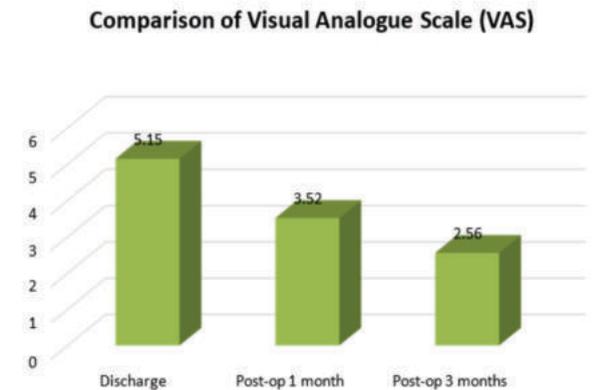


Graph10: Distribution of patients according to Complications

Comparison of Visual Analogue Scale (VAS) score during Follow-up Period
 The mean VAS Score at discharge was 5.15 ± 2.26 which improved significantly at post-op 1 month (3.52 ± 0.86) and post-op 3 months (2.56 ± 0.57). The difference in VAS score during follow-up period was statistically significant as per ANOVA test ($p < 0.05$).

Table 11: Comparison of VAS score during Follow-up Period

VAS Score	Mean	SD	p Value
Discharge	5.15	2.26	<0.05
Post-op 1 month	3.52	0.86	
Post-op 3 months	2.56	0.57	

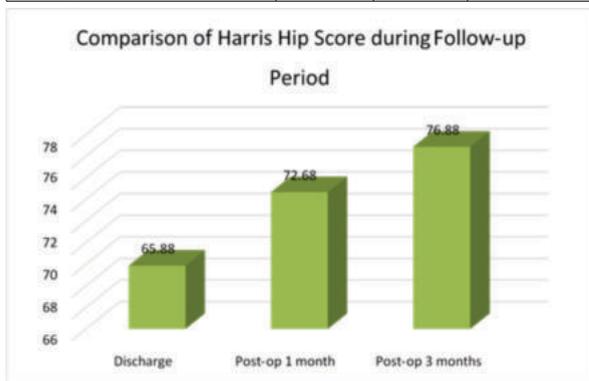


Graph11: Comparison of VAS score during Follow-up Period

Comparison of Harris Hip Score during Follow-up Period
 The functional daily activities in patients were measured by Harris Hip Score. The mean Harris Hip Score at discharge was 65.88 ± 8.65 which improved significantly at post-op 1 month (72.68 ± 4.57) and post-op 3 months (76.88 ± 5.54). The difference in Harris Hip Score during follow-up period was statistically significant as per ANOVA test ($p < 0.05$).

Table 12: Comparison of Harris Hip Score during Follow-up Period

Harris Hip Score	Mean	SD	p Value
Discharge	65.88	8.65	<0.05
Post-op 1 month	72.68	4.57	
Post-op 3 months	76.88	5.54	



Graph 12: Comparison of Harris Hip Score during Follow up period

DISCUSSION

A hospital based prospective, observational study was conducted with 25 patients to assess the functional outcomes of Intertrochanteric Femur Fractures treated with hemiarthroplasty.

In the present study, majority of the patients (48%) were from the age group of 76-85 years followed by 40% from the age group of 66-75 years and 12% from the age group of >85 years. The mean age of patients was 77.56 ± 6.60 years. Majority of the patients were female (80%) while male patients constituted 20% of the study group. This is similar to the studies of Dawadi TP et al¹¹, Sullivan NPT et al¹² and Gadre N et al¹³.

Dawadi TP et al¹¹ prospective observational study evaluating the outcome in terms of Harris Hip Score and Mobility and Aid Score found mean age of the patients was 74 ± 5.31 . 18 patients 60% were females while 40% (12) were male.

Sullivan NPT et al¹² retrospective study evaluating the early complications following cemented hemiarthroplasty found average age of the patients was 83 years (52-100), 76% were female.

Gadre N et al¹³ prospective study on comminuted intertrochanteric fractures of femur found most of the patients (64%) were of age group 70-80 yrs and 62% being females among them, 65 yrs was lowest aged patient and 89 yrs was oldest and the average age was 73.98 yrs thus suggesting that comminuted IT fractures were more common in elderly patients, owing to osteoporosis and poor bone quality.

In our study, 11 (44%) fractures were on right side while 14 (56%) fractures were on left side. Fall was observed to be the main cause of fracture (92%) followed by Road Traffic Accident (8%). This is comparable to the studies of Dawadi TP et al¹¹ and Gadre N et al¹³.

Dawadi TP et al¹¹ study showed most of the cases (86.7%) were due to low velocity injury with the Involvement of right side to be slightly more (56.7%) than left.

Gadre N et al¹³ prospective study observed domestic fall was the most common mode of injury, 88% of the patients had domestic fall that caused the fracture. It was observed in the present study that 5 (20%) and 3 (12%) patients had Diabetes Mellitus and Hypertension respectively whereas 2 (8%) patients each had cardiovascular disease (CVD) and anaemia respectively. 1 (4%) patient had Chronic Obstructive

Pulmonary Disease (COPD). This is concordant to the study of Gadre N et al¹³. Gadre N et al¹³ prospective study many of these patients had associated medical ailments. Hypertension had the most frequent association (20%) though many had transient raised blood pressure due to anxiety. Diabetes mellitus was present in two patients, but blood sugar levels were within normal limits after anti-diabetic treatment. It was observed in our study that the duration of trauma to treatment in 3 (12%) and 5 (20%) patients was 1-3 days and 4-6 days respectively and it was ≥ 7 days in 17 (68%) patients. The mean duration of trauma to surgery was 8.04 ± 3.74 days. 6 (24%) patients had operative time of 40-60 minutes whereas 9 (36%) and 10 (40%) patients had operative time of 60-80 minutes and 80-100 minutes respectively. The mean operative time was 72.56 ± 16.35 minutes. This is consistent with the studies of Dawadi TP et al¹¹, Moerman S et al¹⁴ and Gadre N et al¹³. Dawadi TP et al¹¹ study observed mean operative delay for surgery was 11.23 days with a range from 7 to 16 days. The mean duration of hospital stay was 16.73 days and mean duration of surgery was 52.83 minutes. Moerman S et al¹⁴ multicenter parallel-randomized controlled study found no difference in mean operation time (57.3 vs 55.4 min).

Gadre N et al¹³ prospective study found average surgery time was 101.86 mins (rang, 80-120 min). The patients walked on an average 4 days after surgery (range, 1-21 days). In the present study, 6 (24%) patients had blood loss <250 ml whereas 11 (44%) and 8 (32%) patients had blood loss of 250-500 ml and >500 ml respectively. The mean blood loss was 423.92 ± 181.38 ml. Majority of the patients (68%) had a hospital stay after operation of 11-14 days followed by 5-10 days (20%) and <5 days (12%). The mean duration of hospital stay after operation was 10.24 ± 3.46 days. 3 (12%) patients had superficial infection while 2 (8%) and 1 (4%) patient had bed sore and deep wound infection respectively. This is in concordance to the studies of Sullivan NPT et al¹⁵, Gocer H et al¹⁶, Moerman S et al¹⁴, Gadre N et al¹³ and Huang J et al¹⁷. Sullivan NPT et al¹⁵ retrospective study observed twenty (4%) of the patients with wound infections, of which 11 (2.4%) were superficial and treated with antibiotics and nine (2%) were deep requiring surgical debridement. Three deep infections subsequently required revision. There was a single diagnosis of foot-drop. No patients represented with aseptic loosening. Gocer H et al¹⁶ study observed aseptic loosening and infection in one patient in Group II and two patients in Group III had one stage revision surgery due to aseptic loosening. One patient in Group II and one patient in Group III had a two-stage revision due to infection. Two dislocations were seen in Group III. Moerman S et al¹⁴ multicenter parallel-randomized controlled study comparing cemented and uncemented hemiarthroplasty observed uncemented group showed more major local complications (intra- and postoperative fractures and dislocations) odds ratio (95% confidence interval) 3.36 (1.40 to 8.11). Gadre N et al¹³ prospective study observed one case had DVT which was managed by close monitoring and conservative management in ICU setup. Two cases had superficial infection which were managed by targeted antibiotic therapy after culture and sensitivity testing. One case had preoperative pressure sore which was managed by aggressive nursing care and since the patient had early post-operative mobilization, it helped in early healing of the wound. Three patients had limb shortening of 1 cm each which was managed by shoe raises. There was one case of post-operative posterolateral dislocation, which occurred on third post-operative day due to excessive hip flexion by the patient, which was managed by closed reduction under anaesthesia. One patient had pulmonary embolism as result of cementing which was managed by intensive care in ICU setup. Huang J et al¹⁷ study comparing the early outcome of PFNA and BPH for ITFs in elderly patients found operation time and blood loss during surgery in group A are less than in Group

B. Time of weight bearing after operation in Group A is longer

than in Group B. Incidence of complications 2 weeks after operation in Group A is 9.29% less than 25.81% in Group B ($\chi^2=9.539, p=0.002$). In our study, the mean VAS Score at discharge was 5.15 ± 2.26 which improved significantly at post-op 1 month (3.52 ± 0.86) and post-op 3 months (2.56 ± 0.57). The difference in VAS score during follow-up period was statistically significant as per ANOVA test ($p < 0.05$). Gadre N et al¹³ noted similar observations in their study.

Gadre N et al¹³ prospective study observed all patients recovered well and progressed to full weight bearing. The functional daily activities in patients were measured by Harris Hip Score. It was observed in the present study that the mean Harris Hip Score at discharge was 65.88 ± 8.65 which improved significantly at post-op 1 month (72.68 ± 4.57) and post-op 3 months (76.88 ± 5.54). The difference in Harris Hip Score during follow-up period was statistically significant as per ANOVA test ($p < 0.05$). Similar observations were noted in the studies of Dawadi TP et al¹¹, Gocer H et al¹⁶, Moerman S et al¹⁴, Gadre N et al¹³, Jolly A et al¹⁸ and Huang J et al¹⁷. Dawadi TP et al¹¹ study observed mean Harris Hip Score was 63.93 at 2 weeks, 73.83 at 6 weeks, 80.53 at 12 weeks and 86.48 at 6 months. The mean MASM score at 6 months was 4.02. Gocer H et al¹⁶ study investigating the correlation between the hemiarthroplasty treatment method and functional results reported Harris hip score was 80.4, 85.2, 76.4, respectively in Group I, II, III. There was no significant difference between three groups in term of functional results. Moerman S et al¹⁴ multicenter parallel-randomized controlled study found no differences in functional outcomes (TUG 12.8 (9.4) vs. 13.9 (9.0), GARS 43.2 (19.7) vs. 39.2 (16.5)) and mid-thigh pain (18.6 vs 21.6%). Physical component SF-12 HRQoL was lower in the uncemented group (30.3 vs. 35.3 $p < 0.05$ after six weeks, 33.8 vs 38.5 $p < 0.05$ after 12 weeks). Gadre N et al¹³ prospective study observed good clinical and functional outcomes assessed as per Harris hip score with 96% patients showing fair to excellent results. Good results were reported in 42% of the patients and fair results in 52% of the patients. A total of 48 out of 50 patients (96%) had excellent to fair functional results and 2 had poor result with respect to the Harris hip score (67-93) at the end of 6 months.

Jia.bao J et al¹⁹ retrospective cohort study found HHS at final follow-up was 71.8 ± 13.1 , and the following were associated with hip functional recovery: age (-0.45 , 95% confidence interval (CI) -0.73 to -0.18 , $P < 0.01$), serum albumin (0.65, 95% CI 0.04 to 1.27, $P < 0.05$), and ADL at discharge (0.18, 95% CI 0.01 to 0.33, $P < 0.0$). The Barthel index at final follow-up in this cohort was 80.2 ± 18.1 , and multivariable linear regression analysis showed that age (-0.49 , 95% CI -0.85 to -0.12 ; $P < 0.05$), ADL score at discharge (0.29, 95% CI 0.07 to 0.51; $P < 0.05$) and internal fixation (16.3, 95% CI 3.3 to 29.3; $P < 0.05$) were associated with ADL at final follow-up. EQ.5D at final follow-up was 0.74 ± 0.2 , with which HHS (0.012, 95% CI 0.011 to 0.013; $P < 0.01$) was positively associated.

Jolly A et al¹⁸ prospective, comparative study comparing the complications and functional results revealed Harris Hip score analysis that the difference between the patients treated with cemented hemiarthroplasty and proximal femoral nailing was statistically significant in favour of the hemiarthroplasty group within the first 3 months.

Huang J et al¹⁷ study comparing the early outcome of PFNA and BPH for ITFs in elderly patients found Harris Hip Score 12 months after operation in Group A was 68.00 ± 29.11 points similar with 65.73 ± 33.29 points in Group B ($t = 0.490, p = 0.625$).

CONCLUSION

Cemented bipolar hemiarthroplasty offers a modality of treatment that provides adequate fixation and early

mobilization in these patients thus preventing postoperative complications. This will have a direct effect on the general condition and the post-operative rehabilitation. Good clinical and functional outcomes assessed as per Harris hip score were obtained showing fair to excellent results. The mean Harris Hip Score at discharge improved significantly at post-op 1 month and post-op 3 months. Thus, bipolar hemiarthroplasty should be considered as one of the modalities for the primary treatment of intertrochanteric fractures of femur.

REFERENCES

- Dickson J.A: The Unsolvable Fracture, J Bone Joint Surg 1953;35A: 805-822
- Cooper AP A Treatise on dislocations and fractures of the joints. London, England: Longman, Hurst, Rees, Orme and Brown; 1822
- Jensen JS. Trochanteric Fractures. An Epidemiological, Clinical and Biomechanical Study. Acta Orthop Scand. 1981;(Sup 188):11-19.
- Sexson SB, Lehner JT Fractures Affecting Hip Fracture Mortality. J Orthop Trauma. 1987;1:298-305
- White BL, Fisher WD, Laurin CA et al. Rate of Mortality for Elderly Patients after Fracture of the Hip in the 1980's. J Bone Joint Surg. 1987;69-A:1335-1340.
- Eiskjaer S, Otsgard SE, Jakobsen BW et al. Years of potential life lost after hip fracture among postmenopausal women. Acta Orthop Scand. 1992;63(3):293-296.
- Dahl E. Mortality and life expectancy after hip fractures. Acta Orthop Scand. 1980;51(1):163-170.
- Claes H, Broos P, Stappaerts K et al. Pertrochanteric Fractures in Elderly Patients: Treatment with Ender's Nails, Blade-Plate, or Endoprosthesis? Injury. 1985;16:261-264
- Cobelli NJ, Sadler AH. Ender Rod versus Compression Screw Fixation of Hip Fractures. Clin Orthop. 1985;201:123-129.
- Esser MP, Kassab JY, Jones DHA et al. Trochanteric Fractures of the Femur. A Randomised Prospective Trial Comparing the Jewew Nail-Plate with the Dynamic Hip Screw. J Bone Joint Surg. 1986;68-B(4):557-560.
- Dawadi TP, Bhatta TR, Gyawali B et al. Functional outcome of Austin Moore Hemi replacement Arthroplasty in Fracture Neck of Femur in elderly. JMMIHS. 2017; 3(1):6-15.
- Göçer H, Coşkun S, Karaismailoğlu N et al. Comparison of treatment of unstable intertrochanteric fracture with different arthroplasty methods. Niger Med J. 2016;57(2):81-85.
- Barshan FC, Akesen B, Atci T et al. Comparison of hemiarthroplasty and total hip arthroplasty in elderly patients with displaced femoral neck fractures. J Int Med Res. 2018;46(7):2717-2730
- Moerman S, Mathijssen NMC, Niesten DD et al. More complications in uncemented compared to cemented hemiarthroplasty for displaced femoral neck fractures: a randomized controlled trial of 201 patients, with one year follow-up. BMC Musculoskeletal Disorders BMC series. 2017;18:169
- Sullivan NPT, Hughes AW, Halliday RL et al. Early Complications Following Cemented Modular Hip Hemiarthroplasty. Open Orthop J. 2015; 9: 15-19
- Göçer H, Coşkun S, Karaismailoğlu N et al. Comparison of treatment of unstable intertrochanteric fracture with different arthroplasty methods. Niger Med J. 2016;57(2):81-85
- Huang J, Shi Y, Pan W et al. Bipolar Hemiarthroplasty should not be selected as the primary option for intertrochanteric fractures in elderly patients. Sci Rep. 2020;10(1):4840
- Jolly A, Bansal R, More RR et al. Comparison of complications and functional results of unstable intertrochanteric fractures of femur treated with proximal femur nails and cemented hemiarthroplasty. Journal of Clinical Orthopaedics and Trauma. 2019; 10(2):296-301
- Jia.bao J, Zhang PX, Jiang BG. Risk Factors for Functional Outcomes of the Elderly with Intertrochanteric Fracture: A Retrospective Cohort Study. Orthopaedic surgery. 2019;11(4): 643-652