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COMPARATIVE FUNCTIONAL OUTCOME ASSESSMENT: TOTAL HIP ARTHROPLASTY VERSUS HEMIARTHROPLASTY IN CASES OF DISPLACED INTRACAPSULAR NECK OF FEMUR FRACTURE IN >65 YEARS

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Abstract

Fractures of the femoral neck predominantly occur in the elderly due to low-energy falls and are often linked with osteoporosis. In contrast, femoral neck fractures in the young usually result from high-energy trauma and require different treatment approaches. These fractures are typically intracapsular, risking the blood supply to the femoral head. The study is to assess the functional and clinical outcomes of Total Hip Arthroplasty (THR) versus Hemiarthroplasty (HA) in displaced intracapsular femoral neck fractures in patients over 65 years old and to evaluate intraoperative and postoperative complications. This prospective study was conducted at T D Govt Medical College Hospital, Alappuzha, over one year after obtaining clearance from the Institutional Ethics Committee. Fifty patients over 65 years with displaced intracapsular femoral neck fractures, scheduled for either THR or HA, were enrolled after informed consent.

Patients were assessed preoperatively, at 10 days, 1 month, 3 months, and 6 months postoperatively using the Harris Hip Score for functional outcome and radiological evaluation with a pelvis and bilateral hip AP view on X-ray. Most patients undergoing THR (40%) and HA (64%) were aged 65-70 years. Females constituted 56% of THR and 52% of HA cases. Right-sided fractures were more common, accounting for 56% in THR and 52% in HA. Falls were the cause in 84% of both groups, and 60% of fractures were classified as Garden stage 4. No complications were observed in 56% of THR and 60% of HA cases, though periprosthetic fractures were noted in HA. The majority of surgeries (76% of THR and 84% of HA) were completed in less than 120 minutes. THR showed 40% excellent, 44% good, and 16% fair outcomes, while HA showed 12% excellent, 36% good, 48% fair, and 4% poor outcomes.

Keywords: THA: Total Hip Arthroplasty; THR: Total Hip Replacement; Harris Hip Score; Hemiarthroplasty

INTRODUCTION

Femoral neck fractures predominantly occur in the elderly, usually as a result of low-energy falls, and are often linked with osteoporosis. However, femoral neck fractures in younger individuals represent a distinctly different type of injury and require a different treatment approach. In younger patients, these fractures are typically caused by high-energy trauma and are often accompanied by other injuries. Most femoral neck fractures are intracapsular, which can endanger the delicate blood supply to the femoral head. Understanding this blood supply is crucial for surgical approaches to the proximal femur and for implant placement. The superior retinacular artery is well known as the primary source of blood flow to the femoral head, but recent studies have also highlighted the significant role of the inferior retinacular artery, which follows a consistent anatomical path.(1)

The following procedures are commonly used for treating intracapsular femoral neck fractures:

• **Multiple Screw Fixation**: This is the most widely accepted method of fixation. The screws must cross the fracture site to enable compression, with three parallel screws typically used. Proper placement in an inverted triangular configuration is essential for ensuring stability and minimizing the risk of joint penetration.(1,2)

• **Hemiarthroplasty**: This surgical procedure involves replacing the damaged femoral head with an implant that stabilizes the femur and restores hip function. Unlike total hip replacement, which replaces both the femoral head and the

acetabulum, hemiarthroplasty replaces only the femoral head.(1,2)
• **Total Hip Arthroplasty**: In this procedure, both the femoral head and the acetabulum are replaced with artificial components(1,2)

MATERIALS AND METHODS

STUDY DESIGN
Hospital based prospective study

STUDY PERIOD
1 Year from date of obtaining clearance from Institutional Ethics
Committee or till the expected sample size is obtained.

STUDY SETTING
Govt. T D Medical college Alappuzha in Department of Orthopaedics.

STUDY POPULATION
Inclusion criteria
1. Age group > 65 years
2. Radiologically diagnosed intracapsular fracture neck of femur
3. Grading according to Garden's classification (for grade 3 and 4)

Exclusion criteria
1. Patient with associated Osteoarthritis, Avascular Necrosis, Rheumatoid
Arthritis, Pathological fractures due to any other cause
2. Patient with significant comorbidities

SAMPLE SIZE
Sample size calculated using the formula
n = Sample size per group
= 1.96 at 95% confidence interval
= 0.84 at 80 % power
= Standard deviation of 1st group BHA = 10.4 = Mean of 1st group BHA = 68.82
= Standard deviation of 2nd group THA = 5.4 = Mean of 2nd group BHA = 76.81
Final sample size is 40
Reference study: Fahad, et al, Comparison of bipolar hemiarthroplasty and total hip arthroplasty with dual mobility cup in the treatment of old active patients with displaced 30 neck of femur fracture: A retrospective cohort study. Annals of Medicine and Surgery 45 (2019) 62–65.[33]

Sampling Procedure:
Convenience sampling will be used. A total of 40 patients admitted to the Department of Orthopaedics at T.D. Medical College, Alappuzha, during the study period will be included after meeting the inclusion and exclusion criteria.

Data Collection Tool:
Functional outcomes will be assessed using Harris Hip Score.

Data Collection Technique:
Patients above 65 years old with intracapsular neck of femur fractures attending the Department of Orthopaedics will be selected for the study. After baseline screening, patients will undergo surgery (either total hip replacement or hemiarthroplasty). Study parameters such as pain, tenderness, wound condition, and range of motion will be evaluated. Follow-up assessments will be conducted using the Harris Hip Score to evaluate functional outcomes.

Data Collection Procedures:
• Informed consent will be obtained.
• Patient history will be gathered through verbal communication with the patients and their attendants.
• Clinical examinations, both local and systemic, will be performed.
• Diagnosis will be made both clinically and radiologically.
• Baseline investigations and basic radiological examinations (X-ray: pelvis with bilateral hips) will be conducted.
• Surgical findings and postoperative evaluations will be documented through clinical examinations.

Study Variables:
Preoperative assessments will focus on evaluating the age group above 65 years affected by displaced intracapsular neck of femur fractures, identifying risk factors and associated pathologies, and noting intraoperative and postoperative complications. The efficacy and advantages of the treatments will be assessed. Follow-up examinations will be conducted on the 10th day, after 1 month, 3 months, and 6 months. Patients will be assessed functionally using Harris Hip Score and radiologically through X-ray imaging of the pelvis with bilateral hip AP views. 31
HARRIS HIP SCORE –for functional outcome and radiologically in the form of pelvis
with bilateral hip AP view on x-ray.

Methodology:
Patients above 65 years old with displaced intracapsular femoral neck fractures undergoing total hip arthroplasty or hemiarthroplasty will be evaluated prospectively at the 10th day, 1st month, 3rd month, and 6th month. Functional outcomes will beassessed using the Harris Hip Score, and radiological evaluations will be performed
through X-ray imaging of the pelvis with bilateral hip AP views.

Data Analysis:
Data will be periodically reviewed by a guide, and necessary adjustments will be made under their guidance. Data will be entered into an Excel sheet and analyzed using SPSS version 20. Qualitative variables will be expressed as frequency and percentage, while quantitative variables will be presented as mean and standard deviation or median with Q1 and Q3. Appropriate statistical tests will be used to determine associations. The Student's t-test will be used for associations between quantitative variables and outcomes, and Chi-square test will be used to assess associations between qualitative variables and outcomes. A p-value of < 0.05 will be considered significant. Regression analysis will be performed to identify predictors of outcomes.

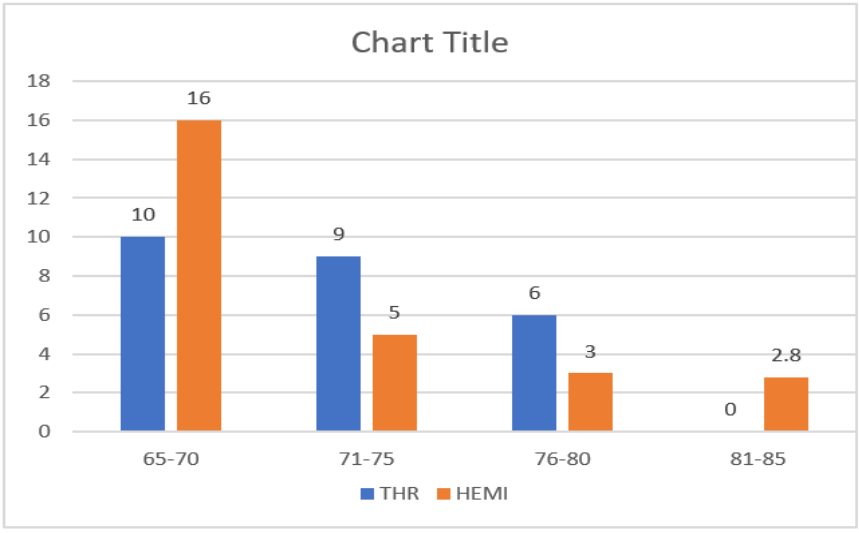
RESULTS AND DISCUSSION

TABLE 1: AGE INCIDENCE

	TOTAL HIP REPLACEMENT		**HEMIARTHROPLASTY**	
	Frequency	Percentage	Frequency	Percentage
65-70	10	40%	16	64%
71-75	9	36%	5	20%
76-80	6	24%	3	12%
81-85	0	0%	1	4%
TOTAL	25	100%	25	100%

Above table shows that most patients (40% of Total Hip Replacement and 64% of Hemiarthroplasty) were 65-70 years old in both surgeries.

FIGURE 1: CLUSTERED BAR DIAGRAM SHOWING AGE DISTRIBUTION OF PARTICIPANTS



S.NO	TYPE OF SURGERY	MEAN RANK	SUM OF RANKS	P VALUE	INFERENCE
1.	Total Hip Replacement	28.46	711.50	0.15	Not significant
2.	Hemiarthroplasty	22.54	563.50		

P value <0.05 (significant)

We rejected the null hypothesis of the Shapiro-Wilk test for some groups and dimensions, indicating a non-normal data distribution, likely due to small sample sizes. We chose the Mann Whitney-U test for those comparisons due to its suitability for non-normally distributed data.
There was no significant age difference found between two surgeries.

TABLE 3: SEX INCIDENCE

	TOTAL HIP REPLACEMENT		HEMIARTHROPLASTY	
	Frequency	Percentage	Frequency	Percentage
Female	14	56%	13	52%
Male	11	44%	12	48%
Total	25	100%	25	100%

Above table shows that 56% of Total Hip Replacement and 52% of Hemiarthroplasty were of females.

FIGURE 2: CLUSTERED BAR DIAGRAM SHOWING SEX INCIDENCE OF PARTICIPANTS

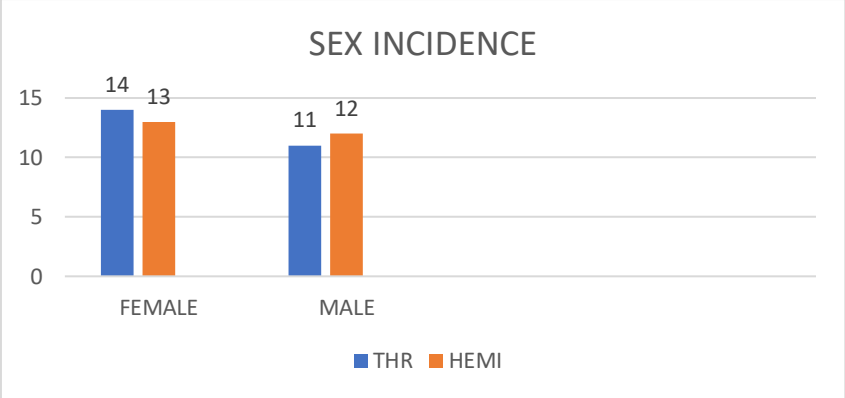
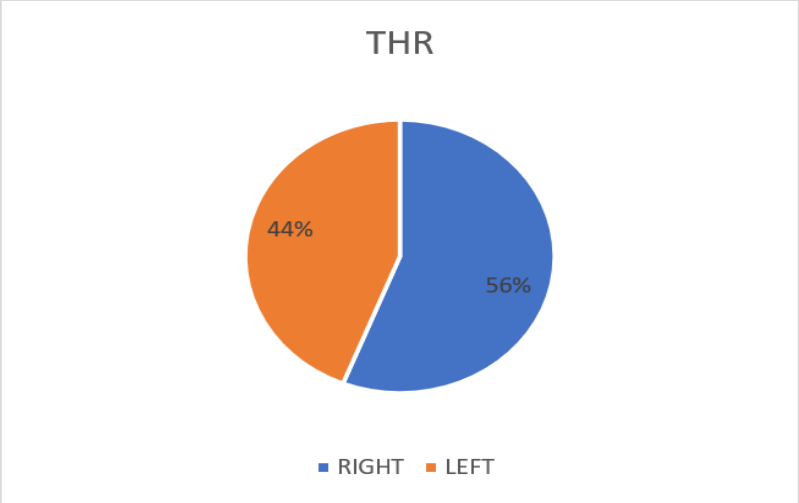


TABLE 4: SIDE INVOLVEMENT

SIDE	TOTAL HIP REPLACEMENT		HEMIARTHROPLASTY	
	Frequency	Percentage	Frequency	Percentage
LEFT	11	44%	12	48%
RIGHT	14	56%	13	52%
TOTAL	25	100%	25	100%

Above table shows that 56% of Total Hip Replacement and 52% of Hemiarthroplasty were right side involvement.

FIGURE 3: PIE DIAGRAM SHOWING SIDE INVOLVEMENT



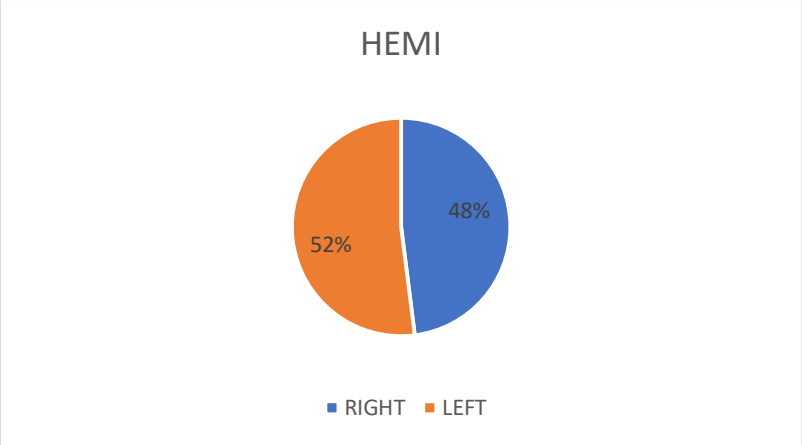


TABLE 8: MODE OF INJURY

MODE OF INJURY	TOTAL HIP REPLACEMENT		HEMIARTHROPLASTY	
	Frequency	Percentage	Frequency	Percentage
Fall	21	84%	21	84%
RTA	4	16%	4	16%
Total	25	100%	25	100%

Above table shows that majority surgeries (84% of Total Hip Replacement and hemiarthroplasty) done due to fall.

TABLE 5: GARDEN CLASSIFICATION

GARDEN STAGING	TOTAL HIP REPLACEMENT		HEMIARTHROPLASTY	
	Frequency	Percentage	Frequency	Percentage
3	10	40%	10	40%
4	15	60%	15	60%
Total	25	100%	25	100%

Above table shows that 60% of Total Hip Replacement and Hemiarthroplasty was of Garden staging 4.

TABLE 6: COMPLICATIONS OF SURGERY

COMPLICATIONS	REPLACEMENT TOTAL HIP		HEMIARTHROPLASTY	
	Frequency	Percentage	Frequency	Percentage
Dislocation	1	4%	1	4%
Deep vein thrombosis	5	20%	2	8%
Nerve injury	2	8%	2	8%
Periprosthetic fracture	0	0%	2	8%
Surgical site infection	2	8%	2	8%
Varus	1	4%	1	4%
No complications	14	56%	15	60%
Total	25	100%	25	100%

Above table shows that 56% 0f Total Hip Replacement and 60% of Hemiarthroplasty had no complications. Periprosthetic fracture was seen in Hemiarthroplasty

FIGURE 4: STACKED BAR DIAGRAM SHOWING COMPLICATIONS OF SURGERY

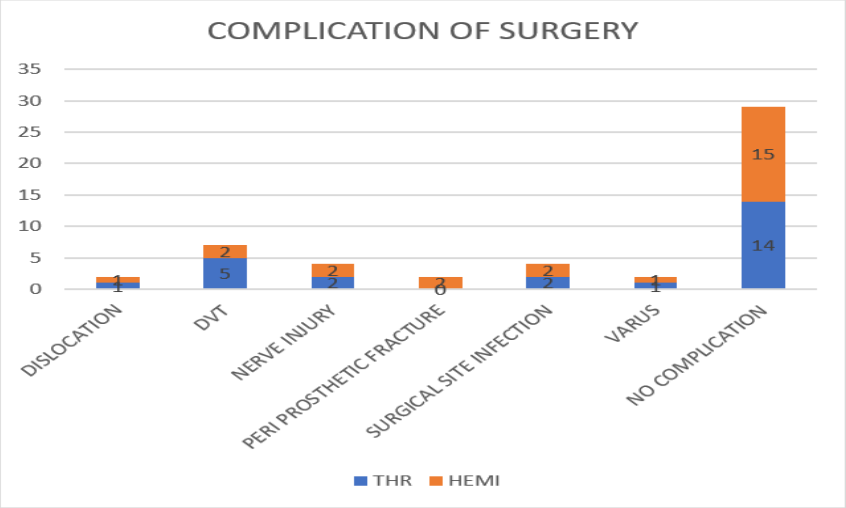


TABLE 7: DURATION OF SURGERY

	TOTAL HIP REPLACEMENT		HEMIARTHROPLASTY	
	Frequency	Percentage	Frequency	Percentage
<120 min	19	76%	21	84%
>120 min	6	24%	4	16%
Total	25	100%	25	100%

Above table shows that 76% of Total Hip Replacement and 84% of Hemiarthroplasty took <120 min for surgery.

FIGURE 5: CLUSTERED BAR DIAGRAM SHOWING SURGICAL TIME

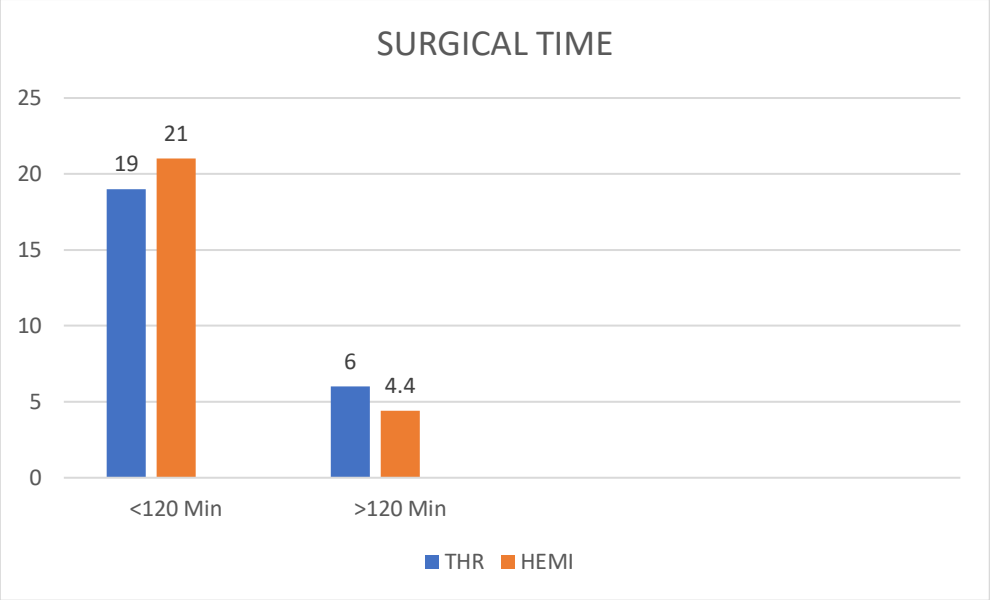


TABLE 8: MEAN SURGICAL TIME DIFFERENCE BETWEEN THE SURGERIES

Sl.NO;	TYPE OF SURGERY	MEAN RANK	SUM OF RANKS	P VALUE	INFERENCE
1.	Total Hip Replacement	33.34	833.50	<0.001	Significant
2.	Hemiarthroplasty	17.66	441.50		

By applying Mann Whitney –U Test the difference between the two groups found to be statistically significant. The mean rank of Total Hip Replacement surgical time is 33.34 and that of Hemiarthroplasty is 17.66.

TABLE 9: OUTCOME OF SURGERY

RESULT	TOTAL HIP REPLACEMENT		HEMIARTHROPLASTY	
	Frequency	Percentage	Frequency	Percentage
Excellent	10	40%	6	12%
Good	11	44%	9	36%
Fair	4	16%	12	48%
Poor	0	0%	1	4%
Total	25	100%	25	100%

Above table shows that 40% of THR showed excellent outcome of surgery, 44% Good, 16% Fair and 0% Poor outcome for THR surgery. And in Hemiarthroplasty only 12% showed excellent outcome of surgery, 36% Good, 48% Fair and 4% Poor outcome of surgery.

FIGURE 6: STACKED BAR DIAGRAM SHOWING RESULTS OF SURGERY

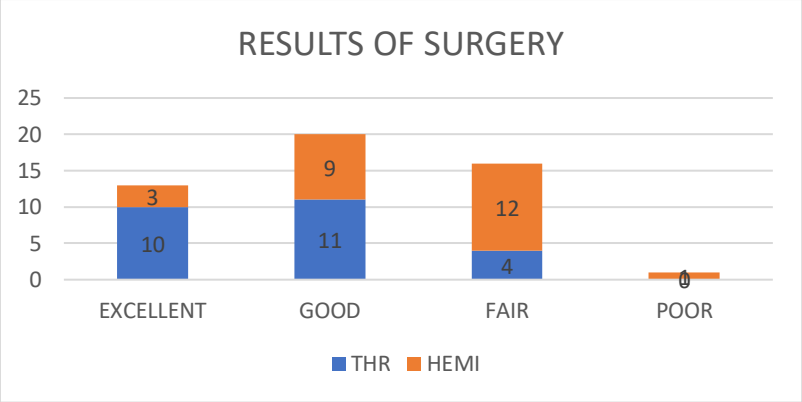


TABLE 10: HARRIS HIP SCORE AT POST OP DAY 10

Sl. No :	TYPE OF SURGERY	MEAN	SD	P VALUE	INFERENCE
1.	Total Hip Replacement	87.56	6.279	<0.001	Significant
2.	Hemiarthroplasty	79.64	7.444		

By applying independent t-test the difference between two groups found to be statistically significant. The mean of Total Hip Replacement was 87.56 (SD-6.279) and mean of Hemiarthroplasty was 79.64 (SD-7.444).

TABLE 11: HARRIS HIP SCORE AT 1 MONTH

Sl. No :	TYPE OF SURGERY	MEAN	SD	P VALUE	INFERENCE
1.	Total Hip Replacement	88.00	6.570	0.001	Significant
2.	Hemiarthroplasty	80.84	7.081		

By applying independent t-test the difference between two groups found to be statistically significant. The mean of Total Hip Replacement was 88 (SD-6.57) and mean of Hemiarthroplasty was 80.84 (SD-7.081).

TABLE 12: HARRIS HIP SCORE AT 3 MONTHS

Sl. No:	TYPE OF SURGERY	MEAN RANK	SUM OF RANKS	P VALUE	INFERENCE
1.	Total Hip Replacement	32.56	814.00	0.001	Significant
2.	Hemiarthroplasty	18.44	461.00		

By applying Mann Whitney –U Test the difference between two groups found to be statistically significant. The mean rank of Total Hip Replacement was 32.56 and mean rank of Hemiarthroplasty was 18.44 .

TABLE 13: HARRIS HIP SCORE AT 6 MONTHS

Sl. No:	TYPE OF SURGERY	MEAN RANK	SUM OF RANKS	P VALUE	INFERENCE
1.	Total Hip Replacement	32.04	801.00	0.001	Significant
2.	Hemiarthroplasty	18.96	474.00		

By applying Mann Whitney –U Test the difference between two groups found to be statistically significant. The mean rank of Total Hip Replacement was 32.04 and mean rank of Hemiarthroplasty was 18.96 .

The primary goal of an orthopedic surgeon in managing intracapsular neck of femur fractures is to achieve a pain-free hip with sufficient strength and mobility to allow normal activities and function. This is also what patients expect from their surgeons, although perfection is not always attainable. This challenge is due to the complex nature of human locomotion, which requires coordinated action of the musculoskeletal components under conscious and subconscious neurological control and feedback mechanisms. Additionally, there is ongoing debate regarding the use of cement versus cementless fixation of the stem in the femoral canal. Proponents of each method highlight their respective merits and demerits, with some clear points of discussion. Cementless fixation offers the advantage of achieving a permanent bond with bone that does not deteriorate over time. Moreover, cementless fixation is often accompanied by new bone formation.

Preoperative planning is of utmost importance, including the selection of the implant, offset measurements, and addressing leg length discrepancy. Leg length corrections up to 4 cm are considered, although corrections greater than 5 cm have been associated with sciatic nerve injury.

1. Age

- **Shukla et al. (2017) [22]:** The mean age for bipolar hemiarthroplasty was 68.5 ± 6.5 years, and for total hip arthroplasty, it was 65.36 ± 6.5 years, with a p-value of 0.1235.
- **R, S. et al. [34]:** This prospective study included 47 patients over the age of 60 with femoral neck fractures, 25 of whom were managed with a cemented bipolar prosthesis and 22 with cemented THR.
- **Sharma et al. [23]:** The mean age of patients was 73 years in the hemiarthroplasty group and 78 years in the THR group.
- **Present Study:** The mean age was 70.52 years for hemiarthroplasty and 71.88 years for total hip arthroplasty, with a p-value of 0.15, comparable to previous studies.

2. Sex

- **Shukla et al. (2017) [22]:** There were 9 males and 16 females in the bipolar hemiarthroplasty group and 8 males and 14 females in the total hip arthroplasty group.
- **Sharma et al. [23]:** The study included 45 males and 55 females.
- **Present Study:** There were 12 males and 13 females in the hemiarthroplasty group, and 11 males and 14 females in the total hip arthroplasty group, comparable to previous studies.

3. Operative Time

- **R. Blomfeldt et al. [35]:** The duration of surgery was longer in the total hip replacement group (102 minutes, ranging from 70 to 151 minutes) compared to the hemiarthroplasty group (78 minutes, ranging from 43 to 131 minutes) ($p<0.001$).
- **Shukla et al. (2017) [22]:** The mean duration of surgery in the THR group was 110.00 minutes, significantly higher than the 82.12 minutes in the bipolar prosthesis group ($p<0.0001$).
- **Sharma et al. [23]:** The mean operative time was 35 minutes for hemiarthroplasty and 45 minutes for THR.
- **Sonaje JC et al. [36]:** The mean total duration of surgery was 51.80 ± 8.70 minutes in the BHA group, significantly less than the 119.10 ± 16.75 minutes in the THA group ($p<0.0001$).
- **Present Study:** Operative time exceeded 120 minutes for 24% of total hip replacements and 16% for hemiarthroplasties.

4. Blood Loss

- **Shukla et al. (2017) [22]:** The mean blood loss in the THR group was 468.18 ml, significantly higher than the 320.40 ml in the bipolar prosthesis group ($p=0.015$).
- **Sonaje et al. [36]:** The total blood loss during BHA was 238.15 ± 20.43 ml compared to 336.85 ± 23.56 ml in THR ($p<0.0001$).
- **Sharma et al. [23]:** The average intraoperative blood loss was 200 cc for hemiarthroplasty and 300 cc for THR.
- **R. Blomfeldt et al. [35]:** Intraoperative blood loss was 460 ml (ranging from 100 to 1100 ml) in THR versus 320 ml (ranging from 50 to 850 ml) in BHA ($p<0.001$).
- **Present Study:** The mean blood loss was 352.52 ml for total hip arthroplasty and 220.16 ml for hemiarthroplasty, comparable to previous studies.

5. Harris Hip Score [(2)]

- **Shukla et al. (2017) [22]:** At six months,Harris Hip Score was 74.68 in the bipolar prosthesis group compared to 80.68 in the THR group, with a significant difference ($p<0.0001$). There was no significant difference in mean pain score between the groups at six months ($p=0.083$). Gait score, activity score, and range of motion were significantly higher in the THR group.
- **Sharma et al. [23]:** The mean Harris Hip Score was better in the THR group compared to the hemiarthroplasty group at one-year follow-up.

- **Burgers et al. [37]:** The weighted mean Harris Hip Score was 81 points after THA compared to 77 after HA. The subdomain of pain in the HHS showed a weighted mean score of 42 points after THA versus 39 points after HA, with 75% of THA patients reporting mild to no pain compared to 56% in the HA group.

.In our study involving 50 patients, among the 25 patients who were underwent total hip arthroplasty, 40% had an excellent outcome, 44% had a good outcome, and 16% had a fair outcome, with no cases of poor results. In contrast, among the 25 patients who underwent hemiarthroplasty, 12% had an excellent outcome, 36% had a good outcome, 48% had a fair outcome, and there was 1 case (4%) with a poor result. These results are consistent with previous studies, demonstrating that total hip arthroplasty generally yields better outcomes than hemiarthroplasty.

CONCLUSIONS

1. **Total Hip Replacement (THR)** is a better option for elderly patients with displaced intracapsular neck of femur fractures due to its superior functional outcomes and the avoidance of a second surgery, which is often required in hemiarthroplasty.
2. **Careful Preoperative Planning** along with good and sterile surgical techniques, proper implant selection, effective postoperative physiotherapy, and adherence to precautions by the patient can significantly minimize complications.
3. The **Overall Clinical and Functional Outcomes** in our study have demonstrated excellent results for total hip arthroplasty.

Ethics approval and consent to participate

List of abbreviations

AP -Antero-Posterior COC-Ceramic on ceramic
CCD-Caput Collum-DiaphysealDVT- Deep Vein Thrombosis MOM-Metal on metal
HMWPE – High molecular weight polyethylene UHMWPE- Ultra high molecular weight

polyethylene ROM Range of movements
THR-Total Hip Replacement SSI- Surgical site infection PMMA-Polymethylmethacrylate HA- Hydroxyapatite
LLD-Limb Length Discrepancy
RA – Rheumatoid Arthritis
OA - Osteoarthritis

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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