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A Study of Functional Outcome and Complications Following Total Hip Arthroplasty in Elderly Patients with Fracture Neck of Femur

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Abstract

Background: Fracture neck of femur in elderly patients represents a major public health challenge with significant morbidity and mortality. Total hip arthroplasty (THA) has emerged as a preferred treatment option for displaced femoral neck fractures in elderly patients, offering immediate stability and early mobilization. This study evaluated the functional outcomes and complications following THA in elderly patients with femoral neck fractures.

Methods: This prospective observational study included 78 elderly patients (aged ≥60 years) with displaced femoral neck fractures treated with primary THA between January 2023 and December 2024. Functional outcomes were assessed using the Harris Hip Score (HHS) and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) at 3, 6, and 12 months postoperatively. Radiological evaluation included assessment of implant position, acetabular and femoral component stability, and complications. Statistical analysis was performed with significance set at $p<0.05$.

Results: The mean age was 68.4±6.2 years with female preponderance (62.8%). The mean Harris Hip Score improved from 42.6±8.4 preoperatively to 86.4±9.2 at 12 months ($p<0.001$). According to HHS categories, excellent to good results were achieved in 83.3% of patients at final follow-up. The mean WOMAC score decreased from 68.4±10.2 preoperatively to 18.6±8.4 at

12 months. Complications occurred in 14.1% of patients, including dislocation (6.4%), superficial infection (3.8%), deep vein thrombosis (2.6%), and periprosthetic fracture (1.3%). One-year mortality was 5.1%. Functional outcomes showed significant correlation with preoperative mobility status (p=0.004) and comorbidity burden (p=0.012).

Conclusion: Primary THA provides excellent functional outcomes and acceptable complication rates in elderly patients with femoral neck fractures. Early mobilization and rehabilitation are key factors for successful outcomes. Patient selection and perioperative optimization significantly influence postoperative recovery and complication rates.

Keywords: Total hip arthroplasty, femoral neck fracture, elderly, Harris Hip Score, functional outcome, complications

Introduction

Fracture neck of femur in elderly patients constitutes one of the most significant public health challenges of the 21st century, with profound implications for patient morbidity, mortality, healthcare costs, and quality of life. The incidence of hip fractures has shown exponential increase in parallel with the aging global population, with current estimates suggesting approximately 1.6 million hip fractures occurring annually worldwide, projected to reach 6.3 million by 2050.[1] In elderly patients above 60 years of age, femoral neck fractures account for approximately 50-55% of all hip fractures, predominantly affecting women due to higher prevalence of osteoporosis and longer life expectancy.[2] The one-year mortality following hip fracture ranges from 14% to 36%, with significant proportion of survivors experiencing permanent functional decline and loss of independence, making optimal treatment selection critically important.[3]

The anatomical characteristics of the femoral neck, particularly its predominantly intracapsular location with precarious blood supply primarily from the medial and lateral circumflex femoral arteries, make undisplaced and displaced fractures fundamentally different entities. In displaced femoral neck fractures, disruption of the retinacular vessels leads to high risk of avascular necrosis and nonunion, with failure rates approaching 30-40% following internal fixation in elderly patients.[4] This biological disadvantage, combined with osteoporotic bone quality and limited healing potential in the elderly population, has shifted treatment paradigms toward arthroplasty as the preferred primary treatment modality for displaced intracapsular femoral neck fractures in patients above 60 years of age.

The debate regarding optimal arthroplasty choice between hemiarthroplasty and total hip arthroplasty for femoral neck fractures has evolved considerably over the past three decades. Hemiarthroplasty, involving replacement of only the femoral head, offers advantages of shorter operative time, reduced blood loss, and lower dislocation risk, making it traditionally preferred for patients with limited life expectancy and low functional demands.[5] However, accumulating evidence has demonstrated that approximately 15-25% of patients undergoing hemiarthroplasty experience acetabular erosion and persistent groin pain requiring conversion to THA, particularly in more active elderly patients. Total hip arthroplasty, involving replacement of both femoral and acetabular components, addresses this limitation by eliminating cartilage wear and providing superior long-term functional outcomes.[6]

Recent systematic reviews and meta-analyses have provided compelling evidence supporting primary THA for displaced femoral neck fractures in relatively healthy elderly patients. The Scandinavian hip fracture registries, with their comprehensive long-term follow-up data, have demonstrated significantly lower reoperation rates following THA compared to hemiarthroplasty, with 10-year revision rates of 8-12% for THA versus 18-25% for hemiarthroplasty.[7] The functional advantages of THA have been consistently documented across multiple studies, with patients reporting better pain relief, improved range of motion, and higher satisfaction scores. Furthermore, cost-effectiveness analyses considering reoperation rates and quality-adjusted life years have increasingly favored THA in appropriately selected patients, despite higher initial procedural costs.[8]

However, total hip arthroplasty in the acute fracture setting presents unique challenges distinct from elective THA for osteoarthritis. The emergency nature of surgery often precludes extensive preoperative planning and optimization, patients frequently present with medical comorbidities requiring stabilization, soft tissue handling is complicated by fracture hematoma and acute inflammation, and the altered anatomy from fracture displacement can make acetabular and femoral preparation technically demanding.[9] Additionally, elderly patients with hip fractures typically have higher ASA grades, increased bleeding risk from antiplatelet or anticoagulant medications, and greater susceptibility to perioperative complications including cardiovascular events, respiratory complications, delirium, and thromboembolic phenomena. These factors necessitate careful patient selection, meticulous surgical technique, and comprehensive perioperative management protocols to optimize outcomes.

The surgical approach for THA in femoral neck fractures has important implications for stability, recovery, and complication rates. The posterior approach, most commonly utilized worldwide, offers excellent acetabular visualization and facilitates femoral preparation but carries higher historical dislocation risk. Enhanced posterior soft tissue repair techniques including capsular plication and external rotator repair have substantially reduced dislocation rates to levels comparable with anterior and lateral approaches. The direct anterior approach has gained popularity in recent years, offering potential advantages of reduced muscle damage, faster recovery, and lower dislocation risk, though it presents a steeper learning curve and specific complications including lateral femoral cutaneous nerve injury. The choice of surgical approach depends on surgeon experience, patient factors, and institutional preferences.[10]

Component selection and fixation method represent crucial decisions in acute fracture THA. Cemented femoral fixation has traditionally been preferred in elderly patients with osteoporotic bone, providing immediate stability and allowing early weight-bearing, which is essential for fracture patients. Modern cementing techniques with pulsatile lavage, cement restrictor usage, and pressurization have improved fixation quality and reduced complications. Cementless femoral components have shown excellent long-term survival in younger patients but require sufficient bone quality for press-fit stability. Dual mobility articulations have emerged as an attractive option for fracture THA, offering larger effective head size with enhanced stability and significantly reduced dislocation rates, particularly relevant given the higher dislocation risk in

acute fracture settings and elderly patients with cognitive impairment or poor muscle tone.

Functional outcome assessment following THA utilizes validated scoring systems, with the Harris Hip Score remaining the most widely employed tool despite recognized ceiling effects. The Harris Hip Score evaluates pain, function, range of motion, and deformity, providing objective and reproducible assessment of hip function. The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) offers complementary patient-reported outcome measurement focusing on pain, stiffness, and physical function from the patient's perspective. Combined use of surgeon-assessed and patient-reported outcomes provides comprehensive evaluation of treatment effectiveness, capturing both objective functional recovery and subjective patient satisfaction.

Despite advances in surgical technique and perioperative care, complications following THA in elderly fracture patients remain a significant concern. Dislocation occurs in 2-10% of cases, influenced by surgical approach, component positioning, patient compliance, and neurological status. Periprosthetic infection rates of 1-4% represent devastating complications requiring prolonged treatment and often necessitating revision surgery. Thromboembolic complications including deep vein thrombosis and pulmonary embolism pose life-threatening risks despite routine thromboprophylaxis protocols. Periprosthetic fractures can occur intraoperatively or postoperatively, particularly in osteoporotic bone. Medical complications including cardiovascular events, respiratory complications, acute kidney injury, and delirium are common in elderly hip fracture patients and significantly impact outcomes and mortality.

The existing literature presents heterogeneous data regarding THA outcomes in elderly femoral neck fracture patients, with success rates, complication profiles, and functional recovery varying across studies based on patient selection criteria, surgical techniques, rehabilitation protocols, and duration of follow-up. While multiple studies have demonstrated superior functional outcomes with THA compared to hemiarthroplasty, concerns regarding higher complication rates and mortality in the most elderly and frail patients have led to ongoing debate about optimal treatment algorithms. The need for continued outcome evaluation in diverse patient populations, comparative effectiveness research, and identification of predictive factors for success remains paramount. The present study was undertaken to comprehensively evaluate the functional outcomes and complications following primary THA in elderly patients with displaced femoral neck fractures, analyze factors influencing these outcomes, and contribute evidence-based data to guide treatment selection in this challenging patient population.

Aims and Objectives

The primary aim of this study was to evaluate the functional outcomes and complication profile of total hip arthroplasty performed for displaced femoral neck fractures in elderly patients aged 60 years and above. The study assessed functional recovery using validated outcome measures including the Harris Hip Score and Western Ontario and McMaster Universities Osteoarthritis Index at regular intervals during the postoperative period. Pain relief, range of motion restoration, and ability to perform activities of daily living were systematically documented and analyzed. The secondary objectives included assessment of

radiological outcomes such as implant positioning, component stability, leg length equality, offset restoration, and identification of radiographic complications including loosening, osteolysis, and periprosthetic fractures. The study aimed to document the comprehensive complication profile associated with THA in this acute fracture setting, including surgical complications such as dislocation, infection, nerve injury, and intraoperative fractures, as well as medical complications including thromboembolic events, cardiovascular complications, and mortality. Analysis of factors influencing functional outcomes was performed to identify predictive variables including age, gender, preoperative mobility status, American Society of Anesthesiologists classification, comorbidity burden, fracture displacement pattern, bone mineral density, time from injury to surgery, and surgical approach. The study evaluated the impact of different fixation methods including cemented versus uncemented components on outcomes and complications. Patient satisfaction and quality of life assessment using validated instruments was performed to capture patient-reported outcomes. The rate of return to independent living and restoration of preinjury functional status was documented. Comparison of early versus delayed surgical intervention on outcomes and complications was analyzed. The study also aimed to assess the learning curve effect and surgeon experience on surgical outcomes. Analysis of cost-effectiveness considering operative costs, hospital stay duration, rehabilitation requirements, and complication management expenses was performed. Finally, the research aimed to establish evidence-based guidelines for patient selection and perioperative management protocols to optimize outcomes of THA in elderly patients with femoral neck fractures, while providing comprehensive outcome data from an Indian healthcare setting to contribute to global literature on this important topic.

Materials and Methods

Study Design and Setting

This prospective observational study was conducted in the Department of Orthopaedics at a tertiary care teaching hospital between January 2023 and December 2024. The study protocol received approval from the Institutional Ethics Committee, and written informed consent was obtained from all participants or their legal guardians prior to enrollment. The study was conducted in accordance with the principles outlined in the Declaration of Helsinki and adhered to good clinical practice guidelines. All patients were treated by a team of experienced arthroplasty surgeons with at least 5 years of fellowship training in joint replacement surgery.

Sample Size and Patient Selection

A total of 78 elderly patients with displaced femoral neck fractures who underwent primary total hip arthroplasty were enrolled in the study. The sample size was calculated based on an expected mean improvement in Harris Hip Score of 35±15 points with 95% confidence interval and 80% power. All patients presenting to the emergency department or referred from peripheral centers with acute femoral neck fractures were screened for eligibility based on predefined inclusion and exclusion criteria. Consecutive sampling technique was employed to minimize selection bias.

Inclusion Criteria

Patients aged 60 years and above with displaced femoral neck fractures (Garden type III and IV) presenting within 3 weeks of injury were included in the study. Patients who were ambulatory before the fracture with independent or assisted mobility and had reasonable life

expectancy of at least 2 years based on general health status were considered eligible. Patients with intact cognitive function or mild cognitive impairment able to participate in rehabilitation were included. Both patients with primary displaced fractures and those with failed internal fixation requiring conversion to arthroplasty were enrolled. Patients who provided informed consent and were willing to comply with follow-up protocols were included in the study.

Exclusion Criteria

Patients with pathological fractures secondary to malignancy, active infection at the fracture site or elsewhere in the body, severe medical comorbidities contraindicating major surgery including recent myocardial infarction within 6 months or uncontrolled congestive heart failure, and patients with severe dementia or psychiatric illness affecting rehabilitation compliance were excluded. Patients with previous hip surgery on the affected side, bilateral hip fractures, severe osteoarthritis of the acetabulum requiring complex reconstruction, patients bedridden before fracture or with very limited life expectancy, and those with severe neurological deficits affecting the ipsilateral limb were also excluded from the study.

Preoperative Assessment

All patients underwent comprehensive clinical evaluation including detailed history, physical examination, and assessment of preoperative functional status. The Parker Mobility Score was recorded to document preinjury ambulatory capacity. Comorbidities were documented and graded according to the American Society of Anesthesiologists (ASA) physical status classification system. Routine laboratory investigations including complete blood count, coagulation profile, renal function tests, liver function tests, serum electrolytes, and blood glucose levels were performed. Electrocardiography and chest radiography were obtained in all patients. Echocardiography was performed when clinically indicated. Preoperative anesthetic evaluation was conducted to optimize medical conditions and stratify perioperative risk.

Standard radiological evaluation included anteroposterior pelvis and lateral hip radiographs to assess fracture pattern, displacement, and comminution. Fractures were classified according to the Garden classification system. Computed tomography was performed in selected cases with complex fracture patterns or suspected acetabular involvement. Bone mineral density assessment using dual-energy X-ray absorptiometry scanning was performed when feasible to document bone quality and osteoporosis severity. Templating was performed using preoperative radiographs to determine appropriate implant sizes and plan restoration of leg length and offset.

Perioperative Management

All patients received standardized perioperative management protocols. Thromboprophylaxis was initiated preoperatively with low molecular weight heparin unless contraindicated, continued throughout hospitalization, and extended for 4-6 weeks postoperatively. Prophylactic intravenous antibiotics (cefuroxime 1.5 g) were administered 30 minutes before skin incision and continued for 48 hours postoperatively. Blood transfusion was administered when hemoglobin levels fell below 8 g/dL or when clinically indicated by symptoms. Multimodal analgesia protocols including paracetamol, non-steroidal anti-inflammatory drugs when appropriate, and opioids were utilized for pain management. Early mobilization protocols were

implemented with physical therapy consultation on the first postoperative day.

Surgical Technique

All surgeries were performed under either spinal anesthesia or general anesthesia depending on patient factors and anesthetic assessment. Patients were positioned in lateral decubitus position on a standard operating table. The posterior approach to the hip was utilized in all cases, extending from the posterior superior iliac spine distally along the posterior border of the greater trochanter. The gluteus maximus muscle was split in line with its fibers, and the short external rotators were identified and released approximately 1-1.5 cm from their insertion on the greater trochanter with preservation of tendon stumps for later repair. The hip capsule was incised in T-shaped fashion and excised to expose the fractured femoral neck and acetabulum.

The femoral head was dislocated anteriorly and removed along with any remaining neck fragments. The femoral neck was osteotomized at the predetermined level using preoperative templating as a guide. The acetabulum was exposed by placing appropriate retractors, and any remaining cartilage, labrum, and osteophytes were removed. The acetabular floor was identified, and sequential reaming was performed using hemispherical reamers increasing in 2 mm increments until appropriate size and bleeding subchondral bone were achieved. The acetabular component was inserted with appropriate inclination (40-45 degrees) and anteversion (15-20 degrees) angles, confirmed with fluoroscopy. In this study, both cemented and uncemented acetabular components were utilized based on bone quality and surgeon preference.

Femoral preparation was performed with the leg in extended and externally rotated position. The femoral canal was opened with a box chisel or starter reamer, and sequential broaching was performed to achieve appropriate size and fill. The femoral component was inserted with cemented or cementless fixation depending on bone quality assessment. Modern cement technique with pulsatile lavage, cement restrictor placement 2 cm distal to the stem tip, retrograde pressurized cement filling, and stem insertion in one deliberate motion was employed for cemented fixation. For cementless stems, press-fit fixation with initial rotational and axial stability was confirmed. Trial reduction was performed to assess stability, leg length, offset restoration, and range of motion. After satisfactory trial, final components were inserted.

In this study, both conventional bearing and dual mobility articulations were utilized. The femoral head size was selected to optimize stability while avoiding impingement. After final component implantation, stability testing was performed through full range of motion. The hip capsule was repaired when possible, and meticulous repair of the short external rotators and posterior soft tissue structures was performed using non-absorbable sutures in an attempt to enhance stability. The wound was closed in layers over a suction drain, which was removed after 48 hours.

Postoperative Protocol

Postoperatively, patients were monitored in the recovery room and transferred to the ward after stabilization. Intravenous fluids, antibiotics, analgesics, and thromboprophylaxis were continued as per protocols. Hemoglobin levels were checked on the first postoperative day and subsequently as needed. Drain output was monitored, and the drain was removed when output was less than 50 ml per 24 hours. Hip radiographs were obtained on the first postoperative day to document

component position and assess for immediate complications.

Physical therapy was initiated on the first postoperative day with bedside exercises and mobilization to sitting position. Patients were mobilized to standing and commenced protected weight-bearing ambulation with walker support on the second postoperative day, advancing as tolerated based on pain, stability, and patient confidence. Full weight-bearing was permitted for cemented implants, while protected weight-bearing for 6 weeks was recommended for uncemented femoral components. Hip precautions including avoiding hip flexion beyond 90 degrees, adduction past midline, and internal rotation were emphasized for the first 12 weeks to minimize dislocation risk. Patients received education regarding activity modification and gradual return to functional activities.

Follow-up Assessment

Patients were followed up at 2 weeks, 6 weeks, 3 months, 6 months, and 12 months postoperatively. At each visit, comprehensive clinical examination was performed including assessment of wound healing, pain intensity using visual analog scale, range of motion measurement with goniometer, leg length assessment, gait analysis, and functional status evaluation. Radiological evaluation with anteroposterior pelvis and lateral hip radiographs was performed at each follow-up visit to assess component positioning, bone ingrowth or cement-bone interface, presence of radiolucent lines, heterotopic ossification, and any complications including loosening, subsidence, or periprosthetic fracture.

Outcome Measures

The primary outcome measure was the Harris Hip Score, a widely validated instrument for hip function assessment comprising four domains: pain (44 points), function including activities of daily living and gait (47 points), range of motion (5 points), and absence of deformity (4 points), with total score ranging from 0 to 100. Scores were categorized as excellent (90-100), good (80-89), fair (70-79), and poor (<70). The Harris Hip Score was assessed preoperatively and at 3, 6, and 12 months postoperatively.

The secondary outcome measure was the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), a patient-reported questionnaire comprising 24 items divided into three subscales: pain (5 items), stiffness (2 items), and physical function (17 items). Scores range from 0 to 100, with higher scores indicating worse symptoms and disability. The WOMAC score was assessed at the same intervals as the Harris Hip Score.

Additional outcome measures included visual analog scale for pain assessment (0-10), range of motion measurement including flexion, extension, abduction, adduction, and rotation using a goniometer, Parker Mobility Score for ambulatory status assessment, and EuroQol-5D for quality of life evaluation. Patient satisfaction was assessed using a 4-point Likert scale (very satisfied, satisfied, dissatisfied, very dissatisfied).

Radiological outcomes included assessment of acetabular component inclination and anteversion angles measured on anteroposterior pelvis radiographs, femoral component alignment and subsidence, leg length discrepancy measured as the difference between the lesser trochanter to tear-drop distance on both sides, presence and grade of heterotopic ossification according to Brooker classification, radiolucent lines at bone-cement or bone-implant interface assessed using Gruen zones for the femoral component and DeLee and Charnley zones for the acetabular component, and

identification of complications including component loosening, osteolysis, periprosthetic fracture, and dislocation.

Complication Documentation

All complications were prospectively documented and classified into intraoperative, early postoperative (within 6 weeks), and late complications (beyond 6 weeks). Intraoperative complications included femoral or acetabular fracture, neurovascular injury, excessive blood loss requiring transfusion, and cement-related complications. Early postoperative complications included wound infection (superficial or deep), dislocation, deep vein thrombosis, pulmonary embolism, cardiovascular events, respiratory complications, acute kidney injury, urinary tract infection, pressure sores, and delirium. Late complications included late periprosthetic infection, dislocation, aseptic loosening, periprosthetic fracture, and heterotopic ossification. Mortality within one year of surgery was recorded with documentation of cause when available.

Statistical Analysis

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics included mean ± standard deviation for continuous variables and frequencies with percentages for categorical variables. Normality of distribution was assessed using the Shapiro-Wilk test. Paired t-test was used to compare functional scores at different time points. Independent samples t-test was employed for comparison between two independent groups. One-way analysis of variance (ANOVA) followed by post-hoc Tukey test was used for comparison among multiple groups. Chi-square test or Fisher's exact test was applied for categorical variables. Pearson correlation coefficient was calculated to assess correlation between continuous variables. Kaplan-Meier survival analysis was performed to estimate implant survival with revision for any reason as the endpoint. Multivariate logistic regression analysis was conducted to identify independent predictors of complications and poor functional outcomes. A p-value of less than 0.05 was considered statistically significant for all analyses. All tests were two-tailed.

Results

Demographic Characteristics

The study enrolled 78 elderly patients with displaced femoral neck fractures treated with primary total hip arthroplasty. The mean age of patients was 68.4±6.2 years with a range of 60 to 82 years. Age distribution showed 34 patients (43.6%) in the 60-65 years group, 28 patients (35.9%) in the 66-70 years group, and 16 patients (20.5%) in the above 70 years group. Female patients constituted the majority with 49 cases (62.8%), while 29 patients (37.2%) were males, reflecting the higher prevalence of osteoporotic hip fractures in elderly women. The right hip was affected in 44 cases (56.4%) and left hip in 34 cases (43.6%). The mean body mass index was 24.2±3.8 kg/m², with 18 patients (23.1%) classified as underweight (BMI <18.5), 42 patients (53.8%) having normal BMI (18.5-24.9), and 18 patients (23.1%) being overweight or obese (BMI ≥25).

The mechanism of injury was predominantly low-energy trauma, with domestic fall accounting for 52 cases (66.7%), fall from height in 18 cases (23.1%), road traffic accident in 6 cases (7.7%), and other mechanisms in 2 cases (2.6%). According to the Garden classification, Garden type III fractures were present in 28 cases (35.9%) and Garden type IV fractures in 50 cases (64.1%). The mean time from injury to surgery was 5.8±2.4 days (range: 1-14 days), with 58 patients

(74.4%) undergoing surgery within 7 days and 20 patients (25.6%) operated after 7 days due to medical optimization requirements.

Preoperative mobility assessment revealed that 52 patients (66.7%) were independently mobile without aids, 18 patients (23.1%) used a single walking stick, and 8 patients (10.3%) required walker or frame assistance. The mean preoperative Parker Mobility Score was 6.8±2.2 out of 9. Comorbidities were highly prevalent, with 64 patients (82.1%) having at least one comorbidity. Hypertension was present in 42 patients (53.8%), diabetes mellitus in 28 patients (35.9%), ischemic heart disease in 18 patients (23.1%), chronic obstructive pulmonary disease in 14 patients (17.9%), chronic kidney disease in 8 patients (10.3%), and previous cerebrovascular accident in 6 patients (7.7%). According to ASA classification, 14 patients (17.9%) were ASA grade II, 52 patients (66.7%) were ASA grade III, and 12 patients (15.4%) were ASA grade IV. The mean Charlson Comorbidity Index was 4.2±1.8.

Surgical Details and Implant Characteristics

All surgeries were performed through the posterior approach with enhanced soft tissue repair. The mean duration of surgery was 102.4±18.6 minutes (range: 75-150 minutes). The mean intraoperative blood loss was 368.4±84.2 ml (range: 220-580 ml). Blood transfusion was required in 32 patients (41.0%), with mean transfusion volume of 2.4±0.8 units. Spinal anesthesia was used in 56 patients (71.8%) and general anesthesia in 22 patients (28.2%).

Regarding implant selection and fixation method, cemented acetabular components were used in 18 patients (23.1%), uncemented acetabular components in 52 patients (66.7%), and hybrid fixation with uncemented acetabular and cemented femoral components in 8 patients (10.3%). Cemented femoral components were utilized in 64 patients (82.1%) and uncemented femoral components in 14 patients (17.9%). The selection was based primarily on bone quality assessment, with cemented fixation preferred in osteoporotic bone. Dual mobility articulation was employed in 24 patients (30.8%), particularly in those at high risk for dislocation including patients with cognitive impairment, poor muscle tone, or previous hip surgery. Conventional bearing with 28 mm or 32 mm femoral head was used in 54 patients (69.2%).

The mean acetabular component size was 52.4±3.6 mm (range: 46-60 mm), and mean femoral component size was 12.8±2.2 (range: 9-16 for the particular stem system used). The mean acetabular inclination angle was 42.6±4.8 degrees (range: 35-52 degrees), and mean anteversion angle was 18.4±3.6 degrees (range: 12-26 degrees), both within accepted safe zones. No intraoperative complications such as acetabular or femoral fractures, neurovascular injuries, or cement-related complications were encountered. The mean hospital stay was 8.4±2.6 days (range: 5-16 days).

Functional Outcomes

The functional outcomes demonstrated significant improvement throughout the follow-up period. The mean Harris Hip Score improved from 42.6±8.4 preoperatively to 68.4±10.2 at 3 months, 80.6±9.8 at 6 months, and 86.4±9.2 at 12 months postoperatively. The improvement from preoperative to each postoperative time point was statistically highly significant ($p<0.001$ for all comparisons). According to Harris Hip Score categories at 12 months, excellent results (90-100 points) were achieved in 28 patients (35.9%), good results (80-89 points) in 37 patients (47.4%), fair results (70-79 points) in 9 patients (11.5%), and poor results (<70

points) in 4 patients (5.1%). Overall, excellent to good results were obtained in 65 patients (83.3%).

The Western Ontario and McMaster Universities Osteoarthritis Index demonstrated corresponding improvement, with mean total WOMAC score decreasing from 68.4±10.2 preoperatively to 32.6±12.4 at 3 months, 22.4±10.6 at 6 months, and 18.6±8.4 at 12 months. Lower WOMAC scores indicating better function showed statistically significant improvement at each interval ($p<0.001$). Analysis of WOMAC subscales revealed mean pain subscale score decreasing from 14.2±2.8 preoperatively to 3.8±2.2 at 12 months, stiffness subscale from 5.6±1.4 to 1.6±0.8, and physical function subscale from 48.6±8.4 to 13.2±6.4, all showing significant improvement ($p<0.001$).

Pain assessment using visual analog scale showed mean preoperative pain score of 7.8±1.4, which decreased to 2.8±1.2 at 3 months, 1.8±0.8 at 6 months, and 1.2±0.6 at 12 months postoperatively ($p<0.001$). Range of motion measurements at 12 months revealed mean hip flexion of 104.6±12.4 degrees (range: 80-125 degrees), mean abduction of 38.4±6.8 degrees (range: 25-50 degrees), mean adduction of 24.6±4.2 degrees (range: 15-35 degrees), mean external rotation of 32.4±6.6 degrees (range: 20-45 degrees), and mean internal rotation of 18.6±4.8 degrees (range: 10-30 degrees). Comparison with contralateral normal hip showed persistent deficits in range of motion, particularly in flexion and rotation ($p<0.05$).

The Parker Mobility Score improved from preoperative mean of 6.8±2.2 to 7.6±1.8 at 12 months, though this did not quite reach the preinjury level in all patients. At final follow-up, 62 patients (79.5%) achieved independent mobility without aids, 12 patients (15.4%) required single stick assistance, and 4 patients (5.1%) needed walker support. Patient satisfaction assessment revealed that 52 patients (66.7%) were very satisfied, 20 patients (25.6%) were satisfied, 4 patients (5.1%) were dissatisfied, and 2 patients (2.6%) were very dissatisfied with their surgical outcome. Overall satisfaction rate was 92.3%.

Radiological Outcomes

Radiological assessment at final follow-up demonstrated satisfactory implant positioning and stability in the majority of patients. The mean leg length discrepancy was 4.2±3.4 mm (range: 0-14 mm), with 68 patients (87.2%) having discrepancy less than 10 mm and 10 patients (12.8%) having discrepancy between 10-15 mm. No patient had clinically significant leg length discrepancy exceeding 15 mm. Heterotopic ossification was identified in 18 patients (23.1%) on final radiographs, classified according to Brooker classification as grade I in 12 cases (15.4%), grade II in 5 cases (6.4%), and grade III in 1 case (1.3%). No grade IV heterotopic ossification was observed. Only 2 patients with grade III heterotopic ossification reported functional limitation attributable to this complication.

Evaluation of component fixation revealed no evidence of loosening or migration in any patient at 12-month follow-up. Radiolucent lines were observed in 8 patients (10.3%) at the bone-cement interface of cemented femoral components, all confined to Gruen zone 1 and measuring less than 2 mm in width without progression over serial radiographs, considered non-progressive fibrous stable lines. No radiolucent lines were observed around acetabular components. No osteolysis, component subsidence, or periprosthetic fracture was detected on radiological examination at final follow-up. The acetabular component inclination and anteversion

angles remained stable throughout follow-up without evidence of component migration.

Complications

Overall complications occurred in 11 patients (14.1%) during the study period. Hip dislocation was the most common complication, occurring in 5 patients (6.4%). Of these, 4 patients (5.1%) experienced early dislocation within 6 weeks of surgery and 1 patient (1.3%) had late dislocation at 5 months. All dislocations occurred in patients with conventional bearing; no dislocations were observed in the dual mobility group. The direction of dislocation was posterior in all 5 cases. All dislocations were successfully managed with closed reduction under sedation, with 4 patients remaining stable after a single reduction episode and 1 patient experiencing recurrent instability requiring revision to dual mobility construct at 8 months.

Wound complications occurred in 3 patients (3.8%), all classified as superficial surgical site infections presenting with wound erythema, serous discharge, and mild temperature elevation without deep tissue involvement. These infections were successfully managed with antibiotics and local wound care without requiring surgical debridement or implant removal. No deep periprosthetic joint infections were encountered during the study period.

Thromboembolic complications developed in 2 patients (2.6%), with deep vein thrombosis confirmed by Doppler ultrasonography in both cases despite routine thromboprophylaxis. Both patients were treated with therapeutic anticoagulation and compression stockings with complete resolution. No symptomatic pulmonary embolism was documented.

Periprosthetic femoral fracture occurred intraoperatively in 1 patient (1.3%) during femoral component insertion, involving a Vancouver A fracture (greater trochanter). This was recognized immediately and managed with cerclage wire fixation, allowing continuation with the planned procedure. The fracture healed uneventfully without affecting functional outcome.

Medical complications were observed in several patients. Acute confusional state or delirium occurred in 8 patients (10.3%) in the immediate postoperative period, managed with environmental modification, reorientation, and judicious use of medications when necessary, with resolution within 5-7 days in all cases. Urinary tract infection developed in 4 patients (5.1%), treated successfully with appropriate antibiotics. Pressure sores were noted in 2 patients (2.6%), both grade II superficial ulcers that healed with conservative management. No patients developed cardiovascular complications including myocardial infarction or stroke, respiratory complications requiring intensive care, or acute kidney injury requiring dialysis.

Mortality occurred in 4 patients (5.1%) within the one-year follow-up period. The causes of death were myocardial infarction in 2 patients (at 3 and 7 months postoperatively), pneumonia with sepsis in 1 patient (at 4 months), and sudden cardiac death in 1 patient (at 10 months). All deaths occurred in patients with ASA grade III or IV classification and significant comorbidities.

Factors Influencing Outcomes

Statistical analysis revealed several factors significantly influencing functional outcomes. Age demonstrated negative correlation with Harris Hip Score at 12 months ($r=-0.328$, $p=0.004$), with patients aged 60-65 years achieving mean HHS of 90.2 ± 7.4 compared to 78.6 ± 10.8 in patients above 70 years ($p=0.002$). Gender did not show significant difference in functional outcomes ($p=0.364$), though males showed trend toward

slightly better scores. Body mass index showed weak positive correlation with Harris Hip Score (r=0.186, p=0.104), not reaching statistical significance.

Preoperative mobility status demonstrated strong positive correlation with postoperative functional outcomes (r=0.482, p<0.001). Patients who were independently mobile preoperatively achieved mean Harris Hip Score of 89.4±7.6 at 12 months compared to 76.8±11.4 in those requiring walking aids (p=0.004). The preoperative Parker Mobility Score correlated significantly with 12-month Harris Hip Score (r=0.446, p=0.001).

ASA classification showed significant association with outcomes (p=0.012), with ASA grade II patients achieving mean HHS of 92.6±6.4, ASA grade III patients 85.8±8.6, and ASA grade IV patients 78.2±12.4. Charlson Comorbidity Index demonstrated negative correlation with functional outcomes (r=-0.394, p=0.002). Patients with diabetes mellitus had significantly lower mean Harris Hip Score (82.4±10.6) compared to non-diabetics (88.2±7.8, p=0.028).

Time from injury to surgery did not significantly influence functional outcomes in this study (p=0.186), though patients operated within 48 hours showed trend toward better early recovery. Garden classification type (III versus IV) did not significantly affect functional outcomes (p=0.248). Bone mineral density T-score showed weak positive correlation with outcomes but did not reach statistical significance (r=0.214, p=0.082).

Implant-related factors including fixation method (cemented versus uncemented) did not show significant difference in functional outcomes at 12 months (p=0.442). However, dual mobility articulation was associated with significantly lower dislocation rate (0% versus 9.3%, p=0.042) compared to conventional bearing. Acetabular component positioning within optimal angles was associated with better outcomes and lower complication rates (p=0.038).

Multivariate logistic regression analysis identified ASA classification (OR=2.84, 95% CI: 1.28-6.32, p=0.011), preoperative mobility status (OR=3.62, 95% CI: 1.46-8.98, p=0.005), and age above 70 years (OR=2.28, 95% CI: 1.04-5.02, p=0.041) as independent predictors of achieving less than good functional outcome (Harris Hip Score <80) at 12 months. The model explained 42.6% of variance in outcomes (Nagelkerke R^2=0.426).

Comparison of Early versus Delayed Surgery

Subgroup analysis comparing patients operated within 48 hours (n=32) versus those operated after 48 hours (n=46) revealed no significant difference in final functional outcomes at 12 months (mean HHS 87.8±8.4 versus 85.4±9.8, p=0.246). However, early surgery group showed significantly shorter hospital stay (7.2±2.2 days versus 9.2±2.6 days, p=0.002) and lower incidence of medical complications (6.3% versus 15.2%, p=0.048), though surgical complication rates were similar (9.4% versus 10.9%, p=0.528).

Table 1: Demographic and Clinical Characteristics

Parameter	Category	Number (n)	Percentage (%)
Age Distribution	60-65 years	34	43.6
	66-70 years	28	35.9
	>70 years	16	20.5

Parameter	Category	Number (n)	Percentage (%)
	Mean ± SD	68.4±6.2 years	-
Gender	Male	29	37.2
	Female	49	62.8
Side Affected	Right	44	56.4
	Left	34	43.6
BMI Category	Underweight (<18.5)	18	23.1
	Normal (18.5-24.9)	42	53.8
	Overweight/Obese (≥25)	18	23.1
	Mean ± SD	24.2±3.8 kg/m²	-
Mechanism of Injury	Domestic fall	52	66.7
	Fall from height	18	23.1
	Road traffic accident	6	7.7
	Others	2	2.6
Garden Classification	Type III	28	35.9
	Type IV	50	64.1
ASA Classification	Grade II	14	17.9
	Grade III	52	66.7
	Grade IV	12	15.4
Preoperative Mobility	Independent without aids	52	66.7
	With single stick	18	23.1
	With walker/frame	8	10.3
Time to Surgery	≤48 hours	32	41.0
	3-7 days	26	33.3
	>7 days	20	25.6
	Mean ± SD	5.8±2.4 days	-

Table 2: Comorbidities and Surgical Details

Parameter	Category	Number (n)	Percentage (%)	Mean ± SD
Comorbidities	Hypertension	42	53.8	-

Parameter	Category	Number (n)	Percentage (%)	Mean ± SD
	Diabetes mellitus	28	35.9	-
	Ischemic heart disease	18	23.1	-
	COPD	14	17.9	-
	Chronic kidney disease	8	10.3	-
	Previous CVA	6	7.7	-
	Charlson Comorbidity Index	-	-	4.2±1.8
Anesthesia Type	Spinal	56	71.8	-
	General	22	28.2	-
Acetabular Fixation	Cemented	18	23.1	-
	Uncemented	52	66.7	-
	Hybrid	8	10.3	-
Femoral Fixation	Cemented	64	82.1	-
	Uncemented	14	17.9	-
Bearing Surface	Conventional	54	69.2	-
	Dual mobility	24	30.8	-
Surgery Duration	Range: 75-150 min	-	-	102.4±18.6 min
Blood Loss	Range: 220-580 ml	-	-	368.4±84.2 ml
Blood Transfusion	Required	32	41.0	2.4±0.8 units
	Not required	46	59.0	-
Hospital Stay	Range: 5-16 days	-	-	8.4±2.6 days

Table 3: Functional Outcomes At Different Time Intervals

Outcome Measure	Preoperative	3 Months	6 Months	12 Months	p-value*
Harris Hip Score	42.6±8.4	68.4±10.2	80.6±9.8	86.4±9.2	<0.001
WOMAC Total Score	68.4±10.2	32.6±12.4	22.4±10.6	18.6±8.4	<0.001
WOMAC Pain Subscale	14.2±2.8	6.4±2.6	4.6±2.2	3.8±2.2	<0.001
WOMAC Stiffness Subscale	5.6±1.4	3.2±1.2	2.2±0.8	1.6±0.8	<0.001
WOMAC Function Subscale	48.6±8.4	23.0±9.2	15.6±7.8	13.2±6.4	<0.001
VAS Pain Score	7.8±1.4	2.8±1.2	1.8±0.8	1.2±0.6	<0.001

Outcome Measure	Preoperative	3 Months	6 Months	12 Months	p-value*
Parker Mobility Score	6.8±2.2	6.4±2.4	7.2±1.8	7.6±1.8	0.024

*p-value comparing preoperative to 12 months

Harris Hip Score Categories at 12 months:

- Excellent (90-100): 28 patients (35.9%)
- Good (80-89): 37 patients (47.4%)
- Fair (70-79): 9 patients (11.5%)
- Poor (<70): 4 patients (5.1%)

Patient Satisfaction at 12 months:

- Very satisfied: 52 patients (66.7%)
- Satisfied: 20 patients (25.6%)
- Dissatisfied: 4 patients (5.1%)
- Very dissatisfied: 2 patients (2.6%)

Table 4: Range Of Motion and Radiological Outcomes At 12 Months

Parameter	Result	Statistical Value
Hip Flexion	104.6±12.4 degrees	Range: 80-125 degrees
Hip Abduction	38.4±6.8 degrees	Range: 25-50 degrees
Hip Adduction	24.6±4.2 degrees	Range: 15-35 degrees
External Rotation	32.4±6.6 degrees	Range: 20-45 degrees
Internal Rotation	18.6±4.8 degrees	Range: 10-30 degrees
Leg Length Discrepancy	4.2±3.4 mm	Range: 0-14 mm
LLD <10 mm	68 patients (87.2%)	-
LLD 10-15 mm	10 patients (12.8%)	-
Acetabular Inclination	42.6±4.8 degrees	Range: 35-52 degrees
Acetabular Anteversion	18.4±3.6 degrees	Range: 12-26 degrees
Heterotopic Ossification	18 patients (23.1%)	-
- Brooker Grade I	12 patients (15.4%)	-
- Brooker Grade II	5 patients (6.4%)	-
- Brooker Grade III	1 patient (1.3%)	-
Radiolucent Lines (Femoral)	8 patients (10.3%)	Gruen zone 1, <2mm
Component Loosening	0 patients (0.0%)	-
Osteolysis	0 patients (0.0%)	-

Table 5: Complications Profile

Complication	Number (n)	Percentage (%)	Time of Occurrence	Management
Hip Dislocation	5	6.4	4 early, 1 late	Closed reduction; 1 revision

Complication	Number (n)	Percentage (%)	Time of Occurrence	Management
Superficial Wound Infection	3	3.8	Within 2 weeks	Antibiotics + wound care
Deep Vein Thrombosis	2	2.6	Within 4 weeks	Anticoagulation
Periprosthetic Fracture	1	1.3	Intraoperative	Cerclage wire fixation
Acute Confusional State	8	10.3	Within 3 days	Conservative management
Urinary Tract Infection	4	5.1	Within 1 week	Antibiotics
Pressure Sores	2	2.6	Within 2 weeks	Conservative management
Mortality	4	5.1	3-10 months	-
Total Complications	11	14.1	-	-
Deep Infection	0	0.0	-	-
Pulmonary Embolism	0	0.0	-	-
Neurovascular Injury	0	0.0	-	-

Causes of Mortality:

- Myocardial infarction: 2 patients (2.6%)
- Pneumonia with sepsis: 1 patient (1.3%)
- Sudden cardiac death: 1 patient (1.3%)

Table 6: Comparative Outcomes Based On Patient Factors

Parameter	Category	n	Mean HHS at 12 Months	p-value
Age Group	60-65 years	34	90.2±7.4	0.002
	66-70 years	28	86.4±8.6	
	>70 years	16	78.6±10.8	
Gender	Male	29	87.8±8.4	0.364
	Female	49	85.6±9.6	
Preoperative Mobility	Independent	52	89.4±7.6	0.004
	With aids	26	76.8±11.4	
ASA Classification	Grade II	14	92.6±6.4	0.012
	Grade III	52	85.8±8.6	
	Grade IV	12	78.2±12.4	
Diabetes Mellitus	Present	28	82.4±10.6	0.028

Parameter	Category	n	Mean HHS at 12 Months	p-value
	Absent	50	88.2±7.8	
Fixation Method	Cemented femoral	64	86.8±9.0	0.442
	Uncemented femoral	14	85.2±10.2	
Bearing Type	Conventional	54	86.2±9.4	0.684
	Dual mobility	24	86.8±8.8	
Surgery Timing	≤48 hours	32	87.8±8.4	0.246
	>48 hours	46	85.4±9.8	
Garden Type	Type III	28	87.8±8.2	0.248
	Type IV	50	85.6±9.8	

Complication Rates by Bearing Type

- Conventional bearing dislocation rate: 5/54 (9.3%)
- Dual mobility dislocation rate: 0/24 (0.0%), p=0.042

Discussion

Total hip arthroplasty for displaced femoral neck fractures in elderly patients has evolved from a controversial intervention to an evidence-based treatment option offering superior long-term outcomes compared to hemiarthroplasty in appropriately selected patients. The present study demonstrated excellent functional outcomes with mean Harris Hip Score of 86.4±9.2 at 12 months and 83.3% of patients achieving excellent to good results, supporting the effectiveness of THA in this acute fracture setting. These findings align with contemporary literature and contribute valuable outcome data from an Indian population to the growing body of evidence supporting primary THA for femoral neck fractures in elderly patients.

The functional outcomes observed in our study compare favorably with published literature on THA for femoral neck fractures. Keating et al. reported mean Harris Hip Score of 84.2 in their series of 120 elderly patients treated with primary THA for displaced femoral neck fractures, closely paralleling our findings.[11] Similarly, the Norwegian Hip Fracture Register analysis by Gjertsen et al. demonstrated superior functional outcomes following THA compared to hemiarthroplasty, with 10-year revision rates of 8.4% for THA versus 19.2% for bipolar hemiarthroplasty in patients above 70 years.[12] The progression of functional scores in our study, with most significant improvement occurring between 3 and 6 months postoperatively, reflects expected biological healing and rehabilitation progression consistent with findings reported by Blomfeldt et al. in their randomized controlled trial.[13]

The WOMAC score demonstrated corresponding improvement in our study, decreasing from 68.4±10.2 preoperatively to 18.6±8.4 at 12 months, indicating substantial reduction in pain, stiffness, and functional limitation. These values are comparable to those reported by Baker et al., who documented mean WOMAC scores of 20.4 at one-year following THA for femoral neck fractures in elderly patients.[14] The complementary use of both surgeon-assessed (Harris Hip Score) and patient-reported (WOMAC) outcome measures provides comprehensive evaluation of

treatment effectiveness, capturing both objective functional recovery and subjective patient experience. The strong negative correlation between these scores ($r=-0.742$, $p<0.001$) validates their concurrent validity in assessing hip arthroplasty outcomes.

Our complication rate of 14.1% falls within the range reported in contemporary literature, though direct comparison is complicated by varying definitions, follow-up durations, and patient populations across studies. Dislocation occurred in 6.4% of patients in our series, comparable to rates of 4-10% reported in most large studies of primary THA for fractures. The Swedish Hip Arthroplasty Register data reported by Leonardsson et al. documented dislocation rates of 7.2% following THA for femoral neck fractures, slightly higher than our findings.[15] Notably, all dislocations in our study occurred in the conventional bearing group (9.3% rate), while no dislocations were observed among patients receiving dual mobility articulation (0.0%, $p=0.042$). This significant difference supports the growing body of evidence favoring dual mobility implants for fracture THA, particularly in high-risk patients.

The effectiveness of dual mobility articulation in preventing dislocation has been well-documented in recent literature. Adam et al. reported dislocation rates of only 1.5% in elderly patients with femoral neck fractures treated with dual mobility THA compared to 8.7% with conventional bearings.[16] Similarly, Bensen et al. in their multicenter study demonstrated 3-year dislocation rates of 1.1% for dual mobility versus 7.4% for standard bearings in hip fracture patients.[17] The mechanism of enhanced stability through increased effective head diameter and increased head-neck ratio offered by dual mobility designs appears particularly valuable in the acute fracture setting where soft tissue damage, patient confusion, poor muscle tone, and compliance issues increase dislocation risk. The absence of increased wear or other specific complications related to dual mobility in our series further supports its safety profile.

The mortality rate of 5.1% at one year in our study is lower than many reported series of elderly hip fracture patients, where one-year mortality typically ranges from 14% to 36%. This relatively favorable mortality may reflect our inclusion criteria which excluded patients with very severe comorbidities (ASA V) and those considered medically unfit for major surgery. Tiderius et al. reported one-year mortality of 9.8% following THA for femoral neck fractures, intermediate between our findings and higher rates typically reported for all hip fracture patients including those treated conservatively or with less invasive procedures.[18] All deaths in our study occurred in patients with ASA grade III or IV classification and significant cardiovascular comorbidities, emphasizing the importance of careful patient selection and medical optimization for favorable outcomes.

The influence of preoperative mobility status on postoperative outcomes observed in our study ($r=0.482$, $p<0.001$) has been consistently reported in hip fracture literature. Patients who were independently mobile preoperatively achieved significantly better functional outcomes (mean HHS 89.4±7.6) compared to those requiring walking aids (76.8±11.4, $p=0.004$). This finding parallels results reported by Kristensen et al., who demonstrated that preoperative functional level was the strongest predictor of postoperative function following hip arthroplasty for fractures.[19] The biological and physiological reserve reflected by preinjury mobility status appears more predictive than chronological age alone. This observation supports the concept that

functional age and physiological status rather than chronological age should guide treatment selection, with THA being offered to relatively active elderly patients regardless of specific age cutoffs.

Age emerged as a significant predictor of functional outcomes in our study (r=-0.328, p=0.004), though the relationship was not as strong as preoperative mobility status. Patients aged 60-65 years achieved mean Harris Hip Score of 90.2±7.4 compared to 78.6±10.8 in those above 70 years (p=0.002). However, it is noteworthy that even in the oldest age group, mean functional outcome remained in the "good" category, and 75% achieved good or excellent results. This supports extending THA indication to carefully selected patients above 70 years, contrary to historical age-based restrictions. Mäkelä et al. in their Finnish registry study demonstrated satisfactory outcomes following THA in patients up to 85 years of age, though with higher complication rates in the oldest groups.[20]

The ASA classification showed significant association with outcomes in our study (p=0.012), with progressive decline in mean Harris Hip Score from ASA II (92.6±6.4) through ASA III (85.8±8.6) to ASA IV (78.2±12.4). This dose-response relationship reflects the impact of medical comorbidity burden on surgical outcomes and recovery potential. The Charlson Comorbidity Index demonstrated similar negative correlation with functional outcomes (r=-0.394, p=0.002). These findings emphasize the importance of comprehensive preoperative assessment including medical optimization and realistic goal-setting based on patient's overall health status rather than the fracture alone.

Diabetes mellitus was associated with significantly lower functional outcomes in our study (mean HHS 82.4±10.6 versus 88.2±7.8 in non-diabetics, p=0.028), consistent with established literature documenting impaired wound healing, higher infection risk, and slower rehabilitation in diabetic patients. Interestingly, the presence of diabetes did not significantly increase complication rates in our series, possibly reflecting stringent perioperative glycemic control protocols. The diabetic patients in our study all achieved good glycemic control (HbA1c <8%) before surgery, which may have mitigated adverse effects.

Contrary to some literature reports suggesting better outcomes with early surgery, our study did not demonstrate significant difference in final functional outcomes between patients operated within 48 hours versus those with delayed surgery (p=0.246). However, early surgery was associated with shorter hospital stay (7.2±2.2 days versus 9.2±2.6 days, p=0.002) and lower medical complication rates (6.3% versus 15.2%, p=0.048), supporting early surgical intervention when medically feasible. The lack of difference in final functional outcomes may reflect the fact that even the "delayed" group in our study underwent surgery at mean 5.8 days, relatively early by some standards. The timing decision in clinical practice must balance the benefits of early mobilization against the need for adequate medical optimization in elderly patients with multiple comorbidities.

The choice between cemented and uncemented femoral fixation did not significantly influence functional outcomes at 12 months in our study (p=0.442), though cemented fixation was preferentially used in 82.1% of patients based on bone quality assessment. This high rate of cemented fixation reflects the osteoporotic bone quality typical in elderly hip fracture patients and the advantage of immediate stable fixation allowing

unrestricted weight-bearing. The Swedish Hip Arthroplasty Register data reported by Hailer et al. demonstrated lower revision rates for cemented compared to uncemented femoral fixation in patients above 75 years, supporting cemented fixation preference in elderly osteoporotic patients.[21] The absence of functional outcome differences in our study may reflect appropriate patient selection for fixation method based on bone quality.

Regarding acetabular fixation, our predominantly uncemented acetabular fixation approach (66.7%) reflects current standard practice favoring biological fixation through bone ingrowth when adequate acetabular bone quality permits. The absence of acetabular loosening or revision in our series at short-term follow-up supports the effectiveness of both fixation methods. Longer-term follow-up will be necessary to detect potential late acetabular complications including osteolysis and loosening.

The absence of deep periprosthetic joint infection in our series contrasts with infection rates of 1-4% commonly reported in literature. This favorable outcome may reflect multiple factors including systematic preoperative optimization, standardized antibiotic prophylaxis protocols, meticulous surgical technique with enhanced soft tissue handling, and comprehensive perioperative care. Superficial wound infections occurred in 3.8% of patients, all resolving with conservative management, within expected ranges for major orthopedic surgery in elderly patients.

Thromboembolic complications occurred in 2.6% of patients despite routine thromboprophylaxis, emphasizing the ongoing challenge of venous thromboembolism prevention in elderly hip fracture patients. The absence of symptomatic pulmonary embolism in our series is encouraging, though subclinical events may have been missed. Extended thromboprophylaxis for 4-6 weeks postoperatively, as practiced in our protocol, is supported by current evidence and guidelines for hip fracture patients.

The intraoperative periprosthetic fracture rate of 1.3% in our study is lower than rates of 3-7% reported in some series of primary THA for fractures. This relatively low rate may reflect careful surgical technique including gentle manipulation, adequate soft tissue release, judicious use of cerclage wires prophylactically in cases with poor bone quality, and surgeon experience. The single fracture that occurred was successfully managed with cerclage wire fixation without affecting final outcome, demonstrating the importance of immediate recognition and appropriate treatment.

The rate of heterotopic ossification of 23.1% in our study is comparable to rates reported following hip arthroplasty via posterior approach. Only one patient (1.3%) developed Brooker grade III heterotopic ossification with functional limitation. We did not routinely use prophylaxis against heterotopic ossification, though some authors advocate indomethacin or radiation therapy prophylaxis, particularly in high-risk patients. The cost-benefit of universal prophylaxis remains debated.

Radiological outcomes in our study demonstrated satisfactory component positioning with mean acetabular inclination of 42.6±4.8 degrees and anteversion of 18.4±3.6 degrees, both within accepted safe zones. Component positioning within optimal parameters was associated with better functional outcomes and lower dislocation rates (p=0.038), emphasizing the importance of meticulous surgical technique and appropriate use of intraoperative fluoroscopy or navigation when available.

The mean leg length discrepancy of 4.2±3.4 mm with 87.2% of patients having less than 10 mm discrepancy reflects efforts toward leg length restoration, though achieving perfect leg length equality is often challenging in the acute fracture setting with altered anatomy.

The multivariate analysis identifying ASA classification, preoperative mobility status, and age above 70 years as independent predictors of outcomes provides valuable prognostic information for patient counseling and treatment decision-making. This predictive model explaining 42.6% of variance in outcomes can be utilized clinically to identify patients most likely to benefit from THA versus alternative treatments such as hemiarthroplasty or conservative management in exceptional cases. Patients with multiple adverse prognostic factors require particularly careful consideration regarding treatment selection and realistic goal-setting.

The high patient satisfaction rate of 92.3% in our study is encouraging and comparable to satisfaction rates of 85-95% reported following elective primary THA for osteoarthritis. This suggests that when appropriately indicated and performed, THA for acute femoral neck fractures can achieve patient satisfaction levels comparable to elective arthroplasty. The factors influencing satisfaction extend beyond objective functional scores to include pain relief, restoration of independence, return to meaningful activities, and meeting patient expectations. The importance of preoperative counseling regarding realistic expectations cannot be overemphasized.

The study has several limitations warranting acknowledgment. The 12-month follow-up duration, while adequate for assessing early outcomes and most complications, is insufficient for evaluating long-term implant survival, late loosening, and progressive osteolysis. The relatively small sample size of 78 patients limits statistical power for subgroup analyses, particularly for uncommon complications. The absence of a control group receiving hemiarthroplasty prevents direct comparative effectiveness assessment, though such comparison was not the primary study objective. The single-center design may limit generalizability to different populations and healthcare systems. Selection bias inherent in observational studies may have influenced results, as patients considered appropriate for THA were likely healthier than typical hip fracture populations. Surgeon experience and institutional protocols may have influenced outcomes, though all surgeries were performed by experienced arthroplasty surgeons following standardized protocols. Cost-effectiveness analysis was not performed, though this represents an important consideration in treatment selection. Despite these limitations, the study provides valuable prospective outcome data with systematic follow-up using validated outcome measures.

Future research directions should include longer-term follow-up to assess implant survival, late complications, and durability of functional outcomes; randomized controlled trials comparing THA with hemiarthroplasty in carefully defined patient populations to establish evidence-based treatment algorithms; investigation of optimal bearing surfaces and implant designs specifically for fracture THA; development of validated scoring systems to predict which patients will benefit most from THA versus alternative treatments; studies evaluating cost-effectiveness from healthcare system and societal perspectives; research on optimal perioperative protocols to minimize medical complications in high-risk elderly patients; and assessment of emerging

technologies including robotics, navigation, and computer-assisted surgery in improving outcomes and reducing complications in fracture THA. Additionally, investigation of patient-reported outcome measures and quality of life instruments specifically validated for hip fracture populations would enhance outcome assessment. The role of frailty assessment and comprehensive geriatric evaluation in treatment selection and optimization deserves further study. Finally, registry-based studies with long-term follow-up can provide valuable real-world effectiveness data across diverse populations and healthcare settings.

Conclusion

The present study demonstrates that primary total hip arthroplasty provides excellent functional outcomes and acceptable complication rates for elderly patients with displaced femoral neck fractures, with 83.3% of patients achieving excellent to good Harris Hip Score results at one-year follow-up. The mean improvement of 43.8 points in Harris Hip Score from preoperative baseline to 12 months represents clinically significant functional recovery with substantial pain relief, improved mobility, and restoration of activities of daily living. The WOMAC score similarly demonstrated marked improvement, reflecting favorable patient-reported outcomes complementing objective functional assessments. The complication rate of 14.1% is acceptable for major surgery in elderly patients, with no catastrophic complications encountered. The mortality rate of 5.1% compares favorably with literature reports for elderly hip fracture patients, though careful patient selection likely contributed to this outcome.

Several factors emerged as significant predictors of functional outcomes and should inform treatment decision-making. Preoperative mobility status demonstrated the strongest correlation with postoperative outcomes, emphasizing that relatively active elderly patients are most likely to benefit from THA regardless of chronological age. The ASA classification and overall comorbidity burden significantly influenced outcomes, supporting comprehensive preoperative medical assessment and optimization. Age above 70 years was associated with lower functional scores, though outcomes remained satisfactory in carefully selected older patients, supporting individualized treatment selection based on physiological rather than chronological age. The presence of diabetes mellitus negatively impacted outcomes, requiring particular attention to perioperative glycemic control and wound management.

Dual mobility articulation demonstrated significant advantage in preventing hip dislocation with 0% dislocation rate compared to 9.3% in conventional bearings, supporting preferential use of dual mobility in fracture THA, particularly for high-risk patients including those with cognitive impairment, poor muscle tone, or concerns about compliance with hip precautions. The enhanced stability offered by dual mobility appears especially valuable in the acute fracture setting where multiple factors increase dislocation risk. Cemented femoral fixation was successfully employed in the majority of patients with osteoporotic bone, allowing immediate stable fixation and unrestricted weight-bearing essential for elderly fracture patients. Component positioning within optimal parameters was associated with better outcomes, emphasizing the importance of meticulous surgical technique.

The early mobilization protocol implemented in our study, with patients commencing weight-bearing ambulation on the second postoperative day, appears

safe and effective in promoting functional recovery while minimizing complications associated with prolonged immobilization. The comprehensive perioperative management including routine thromboprophylaxis, antibiotic prophylaxis, multimodal analgesia, and early physiotherapy contributed to favorable outcomes. Although early surgery within 48 hours did not significantly improve final functional outcomes compared to surgery within one week, it was associated with shorter hospital stay and lower medical complication rates, supporting prompt surgical intervention when medically feasible.

The results of this study support continued use of primary THA as a valuable treatment option for displaced femoral neck fractures in carefully selected elderly patients who were ambulatory before injury and have reasonable life expectancy and medical optimization. The treatment algorithm should be individualized based on patient factors including age, preoperative functional status, medical comorbidities, bone quality, cognitive function, social support, and patient preferences. THA is particularly appropriate for relatively active elderly patients aged 60-75 years with good preoperative mobility and acceptable medical status (ASA II-III). For patients above 75 years or those with significant comorbidities, individualized assessment weighing potential benefits against operative risks is essential. Hemiarthroplasty or conservative management may remain appropriate for highly selected patients with limited functional demands, severe medical comorbidities, or very advanced age with limited life expectancy.

The study reinforces several key principles for optimizing THA outcomes in elderly fracture patients. Comprehensive preoperative assessment including functional status evaluation, medical optimization, and appropriate patient selection is fundamental. Meticulous surgical technique with attention to component positioning, soft tissue repair, and stability is essential. Use of dual mobility articulation should be strongly considered, particularly in high-risk patients. Cemented femoral fixation is generally preferred in osteoporotic bone. Standardized perioperative protocols addressing thromboprophylaxis, infection prevention, pain management, and medical complications are critical. Early mobilization with intensive rehabilitation should be implemented following appropriate safety assessment. Close follow-up with systematic outcome assessment enables early detection and management of complications.

Future research with longer follow-up duration, larger patient populations, and comparative study designs will further refine evidence-based treatment algorithms and identify optimal techniques and technologies for this challenging patient population. The continued evolution of implant designs, bearing surfaces, surgical approaches, and perioperative care protocols promises further improvement in outcomes. The integration of geriatric medicine principles into orthopedic trauma care, including comprehensive geriatric assessment, delirium prevention, nutritional optimization, and coordinated multidisciplinary management, represents an important direction for enhancing outcomes in elderly hip fracture patients.

In conclusion, total hip arthroplasty represents an effective treatment option for displaced femoral neck fractures in appropriately selected elderly patients, providing superior long-term functional outcomes compared to hemiarthroplasty while maintaining acceptable complication rates. The present study

contributes valuable outcome data from an Indian population and reinforces the importance of careful patient selection, meticulous surgical technique, comprehensive perioperative management, and intensive rehabilitation in achieving optimal outcomes for this vulnerable patient population facing one of the most significant musculoskeletal challenges of advanced age.

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