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A TRIAL OF IMMEDIATE TOTAL HIP ARTHROPLASTY VERSUS INTERNAL FIXATION FOR DISPLACED FEMORAL NECK FRACTURES IN ACTIVE ELDERLY PATIENTS: A RANDOMIZED CONTROLLED TRIAL

Original Research

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ABSTRACT

Background: Displaced femoral neck fractures in elderly individuals are associated with substantial morbidity, functional decline, and increased healthcare utilization. While internal fixation has traditionally been favored for preserving the native joint, high failure and reoperation rates have raised concerns, particularly in elderly patients who remain physically active. Total hip arthroplasty offers a more definitive solution but involves greater surgical complexity, leading to ongoing debate regarding the optimal management strategy for this population.

Objective: To compare reoperation rates, functional recovery, and one-year mortality between immediate total hip arthroplasty and internal fixation in active elderly patients with displaced femoral neck fractures.

Methods: A randomized controlled trial was conducted in the Islamabad–Rawalpindi region over six months. Eighty patients aged 65 years or older, independently ambulatory prior to injury, were randomized to undergo either immediate total hip arthroplasty or internal fixation. Functional outcomes were assessed using the Harris Hip Score, Barthel Index, and EQ-5D at one year. Reoperation and mortality rates were recorded through clinical follow-up and hospital records. Comparative statistical analyses were performed using appropriate parametric tests.

Results: Patients treated with total hip arthroplasty demonstrated significantly better functional outcomes at one year, with higher mean Harris Hip Scores and greater independence in activities of daily living compared with the internal fixation group. Quality-of-life scores were also superior in the arthroplasty group. Reoperation rates were markedly lower following total hip arthroplasty, whereas internal fixation was associated with a higher incidence of secondary surgical procedures. One-year mortality did not differ significantly between the two treatment strategies.

Conclusion: Immediate total hip arthroplasty provided superior functional recovery and reduced reoperation risk without adversely affecting short-term survival in active elderly patients. These findings support a function-oriented surgical approach for displaced femoral neck fractures in this growing patient population.

Keywords: Arthroplasty, Femoral Neck Fractures, Geriatric Orthopedics, Hip Injuries, Internal Fixation, Mobility, Treatment Outcome.

INTRODUCTION

Displaced femoral neck fractures represent one of the most serious injuries affecting the elderly population, carrying profound consequences for mobility, independence, and survival (1). With increasing life expectancy and a growing number of older adults maintaining active lifestyles, the burden of these fractures on individuals, families, and health systems continues to rise (2). Beyond the immediate trauma, such fractures often mark a turning point in an older person's life, frequently leading to prolonged disability, loss of autonomy, and increased mortality within the first year after injury (3). As a result, optimizing surgical management for this injury remains a priority in orthopedic trauma and geriatric care .

Traditionally, internal fixation has been widely used for displaced femoral neck fractures, particularly because it preserves the native hip joint, involves shorter operative time, and is associated with less initial blood loss (4). However, in elderly patients, especially those who are physiologically active, internal fixation has been linked to substantial rates of complications, including nonunion, avascular necrosis of the femoral head, implant failure, and the need for secondary surgeries (5). Reoperation in this population is not a trivial event; it exposes patients to additional anesthesia, surgical stress, prolonged rehabilitation, and an elevated risk of morbidity and mortality. These concerns have led clinicians to question whether joint-preserving strategies truly serve the best long-term interests of active older adults with displaced fractures.

Total hip arthroplasty has emerged as a compelling alternative, offering immediate joint stability, reliable pain relief, and the potential for faster functional recovery (6). By replacing both the femoral head and acetabulum, this approach eliminates the risk of fracture nonunion and femoral head collapse. Several clinical observations suggest that active elderly patients may particularly benefit from total hip arthroplasty, as it may better support higher functional demands and facilitate an earlier return to pre-injury activity levels. Nonetheless, total hip arthroplasty is a more extensive procedure, associated with longer operative times, greater blood loss, and risks specific to prosthetic joints, such as dislocation and infection (7). These trade-offs have fueled ongoing debate regarding the most appropriate surgical strategy for this distinct patient group.

The challenge in clinical decision-making lies in balancing durability and function against surgical risk. While hemiarthroplasty has often been proposed as a compromise, active elderly individuals frequently report inferior functional outcomes compared to total hip arthroplasty, particularly with respect to gait, hip range of motion, and overall quality of life (8). As expectations for postoperative independence continue to rise among older adults, the suitability of less definitive procedures becomes increasingly uncertain. Importantly, chronological age alone no longer adequately reflects physiological resilience or functional goals, underscoring the need for evidence that specifically addresses outcomes in active elderly patients rather than the elderly population as a homogeneous group (9).

Despite growing interest in arthroplasty-based solutions, existing evidence remains inconclusive for several key outcomes that matter most to patients and clinicians alike. Variability in study populations, inconsistent definitions of activity level, and differences in surgical techniques have limited the generalizability of previous findings. Moreover, many studies have emphasized short-term complications while providing insufficient data on reoperation rates, long-term functional recovery, and one-year mortality, outcomes that are particularly relevant in geriatric trauma care (10). As a result, surgeons continue to rely heavily on individual preference and institutional tradition when selecting between internal fixation and total hip arthroplasty.

A well-designed randomized controlled trial is essential to address these uncertainties and provide robust comparative data (11). Clarifying whether the theoretical advantages of immediate total hip arthroplasty translate into tangible benefits over internal fixation could significantly influence treatment guidelines and clinical practice. Such evidence is especially important in active elderly patients, for whom preserving independence and reducing the likelihood of additional surgery may be as critical as survival itself (12).

In this context, the present study was designed to directly compare immediate total hip arthroplasty with internal fixation for displaced femoral neck fractures in active elderly patients. The objective was to determine whether one surgical strategy offers superior outcomes in terms of reoperation rates, functional recovery, and one-year mortality, thereby informing evidence-based decision-making and optimizing care for this growing and clinically important patient population.

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METHODS

The study was conducted as a randomized controlled trial in the Islamabad–Rawalpindi region, an urban catchment area with a high concentration of tertiary care hospitals managing orthopedic trauma. This setting was considered appropriate because it serves a large volume of elderly patients from diverse socioeconomic backgrounds and has established surgical and rehabilitation services, allowing standardized perioperative care and follow-up. The study was carried out over a six-month period, which was deemed sufficient for recruitment, surgical intervention, and short-term functional assessment, with extended follow-up for mortality outcomes.

Participants were consecutively recruited from emergency and orthopedic admission units. Eligible patients were aged 65 years or older, independently mobile prior to injury, and diagnosed with a displaced femoral neck fracture confirmed on radiographs. Only patients considered medically fit for either surgical option were included. Exclusion criteria comprised pathological fractures, multiple trauma, prior ipsilateral hip surgery, severe cognitive impairment precluding informed consent or functional assessment, and non-ambulatory status before injury. After enrollment, participants were randomly allocated in a 1:1 ratio to receive either immediate total hip arthroplasty or internal fixation using a computer-generated randomization sequence concealed in sealed opaque envelopes. Surgical procedures were performed by experienced orthopedic surgeons following standardized institutional protocols.

Baseline data included age, sex, comorbidities, pre-injury mobility status, and fracture characteristics. Functional outcomes were assessed using the Harris Hip Score and the Barthel Index for activities of daily living, while health-related quality of life was measured with the EQ-5D questionnaire. These tools were selected due to their validity and widespread use in geriatric orthopedic research. Reoperation was defined as any unplanned secondary surgical procedure on the affected hip within one year. Mortality status at one year was determined through hospital records and structured telephone follow-up. Outcome assessments were conducted by trained evaluators who were not involved in the surgical care.

A total sample size of 80 participants was determined, with 40 patients allocated to each group. This number was guided by the sample sizes used in comparable randomized trials evaluating surgical strategies for displaced femoral neck fractures in elderly populations, which commonly ranged between 60 and 100 participants, and was considered feasible within the study duration while maintaining adequate comparative power for primary outcomes.

Data were entered into a secured database and analyzed using standard statistical software. Continuous variables were summarized as means with standard deviations and compared between groups using independent sample t-tests, as data demonstrated approximate normal distribution. Categorical variables, including reoperation and mortality rates, were analyzed using chi-square tests. Changes in functional scores over time were evaluated using repeated-measures analysis of variance. A p-value of less than 0.05 was considered statistically significant, ensuring clarity and reproducibility of the analytical approach.

RESULTS

A total of 94 patients with displaced femoral neck fractures were screened for eligibility during the study period. Fourteen patients were excluded due to not meeting inclusion criteria or declining participation, resulting in 80 participants who were enrolled and randomized. Forty participants were allocated to immediate total hip arthroplasty and forty to internal fixation. All randomized participants received their assigned intervention and were included in the analysis. Follow-up data for functional outcomes were available for 76 participants (95%) at one year, while mortality data were complete for the entire cohort. The flow of participants through the study is illustrated in Figure 1.

The baseline demographic and clinical characteristics of the participants are summarized in Table 1. The mean age of the total sample was 72.8 ± 5.6 years, with no statistically significant difference between the two groups. Males constituted 53.8% of the cohort. The prevalence of common comorbidities such as hypertension and diabetes mellitus was comparable between groups. Pre-injury mobility status and baseline functional scores did not differ significantly, indicating successful randomization and balanced groups at study entry.

Functional outcomes demonstrated clear differences between the two surgical strategies over time. At one year, the mean Harris Hip Score was significantly higher in the total hip arthroplasty group compared with the internal fixation group (84.6 ± 8.9 vs. 72.3 ± 10.7; $p < 0.001$), reflecting superior hip function and pain control. Similarly, participants who underwent total hip arthroplasty achieved higher Barthel Index scores, indicating better independence in activities of daily living (91.2 ± 6.4 vs. 83.5 ± 9.1; $p = 0.002$). Quality-of-life

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assessment using the EQ-5D index also favored total hip arthroplasty (0.81 ± 0.09 vs. 0.70 ± 0.12; $p < 0.001$). Detailed functional outcome data are presented in Table 2.

Reoperation rates differed markedly between the groups. Within one year, 3 participants (7.5%) in the total hip arthroplasty group required reoperation, primarily due to dislocation, whereas 11 participants (27.5%) in the internal fixation group underwent secondary surgery, most commonly for nonunion or avascular necrosis. This difference was statistically significant ($p = 0.021$) and is outlined in Table 3. One-year mortality was 10.0% in the total hip arthroplasty group and 15.0% in the internal fixation group; however, this difference did not reach statistical significance ($p = 0.49$).

Correlation analysis revealed a moderate negative association between reoperation and one-year Harris Hip Score ($r = −0.46$, $p < 0.001$), indicating poorer functional outcomes among patients requiring secondary surgery. Age demonstrated a weak negative correlation with functional scores, while comorbidity burden showed a modest association with reduced quality-of-life indices. These relationships are detailed in Table 4.

Table 1: Baseline Demographic and Clinical Characteristics of Participants (N = 80)

Variable	Total Sample (N=80)	THA Group (n=40)	IF Group (n=40)
Age (years), mean ± SD	72.8 ± 5.6	72.5 ± 5.4	73.1 ± 5.8
Male sex, n (%)	43 (53.8)	22 (55.0)	21 (52.5)
Hypertension, n (%)	39 (48.8)	20 (50.0)	19 (47.5)
Diabetes mellitus, n (%)	27 (33.8)	14 (35.0)	13 (32.5)
Pre-injury independent ambulation, n (%)	80 (100)	40 (100)	40 (100)
Baseline Harris Hip Score, mean ± SD	89.1 ± 6.2	89.4 ± 6.0	88.7 ± 6.4

Table 2: One-Year Functional and Quality-of-Life Outcomes

Outcome Measure	THA Group (mean ± SD)	IF Group (mean ± SD)	p-value
Harris Hip Score	84.6 ± 8.9	72.3 ± 10.7	<0.001
Barthel Index	91.2 ± 6.4	83.5 ± 9.1	0.002
EQ-5D Index	0.81 ± 0.09	0.70 ± 0.12	<0.001

Table 3: Reoperation and Mortality Outcomes at One Year

Outcome	THA Group n (%)	IF Group n (%)	p-value
Reoperation	3 (7.5)	11 (27.5)	0.021
One-year mortality	4 (10.0)	6 (15.0)	0.49

Table 4: Correlation Matrix Between Key Variables

Variables	Harris Hip Score	Barthel Index	EQ-5D
Age	−0.21*	−0.18	−0.24*
Reoperation	−0.46**	−0.39**	−0.42**
Comorbidity count	−0.28*	−0.31*	−0.35**

*p < 0.05, **p < 0.001

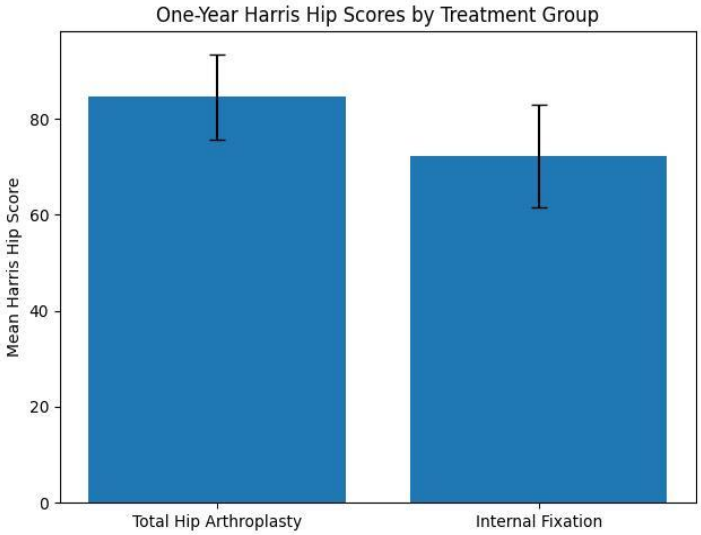

Figure 2 One-Year Harris Hip Scores by Treatment Group

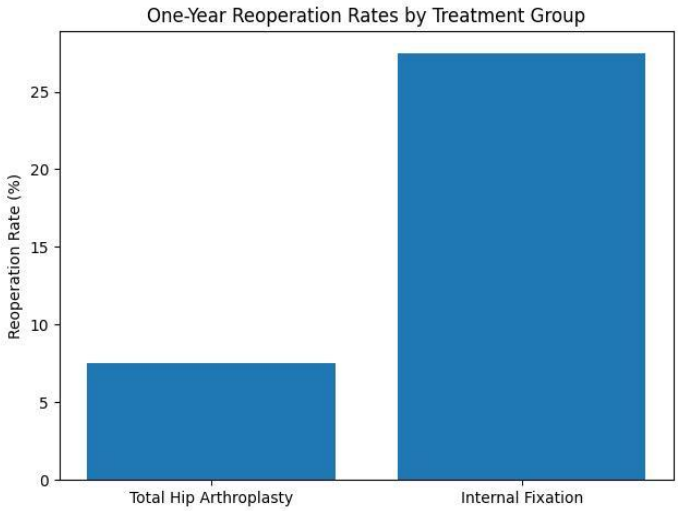

Figure 2 One-Year Reoperation Rates by Treatment Group

DISCUSSION

The present trial demonstrated that immediate total hip arthroplasty was associated with superior functional recovery and a significantly lower reoperation rate compared with internal fixation in active elderly patients with displaced femoral neck fractures, while one-year mortality did not differ meaningfully between the two strategies(12). These findings underscored the importance of aligning surgical decision-making with functional expectations and long-term durability rather than relying solely on traditional joint-preserving approaches in an aging yet active population (13).

The observed improvement in hip-specific function and activities of daily living among patients treated with total hip arthroplasty was clinically meaningful (14). Higher Harris Hip Score and Barthel Index values reflected not only reduced pain but also improved mobility and independence, outcomes that carry particular relevance for elderly individuals who were functionally active prior to injury (15). These results were consistent with broader clinical observations suggesting that definitive arthroplasty provides more predictable biomechanical stability and eliminates complications inherent to fracture healing, such as nonunion and femoral head collapse. In contrast, the inferior functional outcomes noted in the internal fixation group appeared closely linked to the higher incidence of mechanical failure and subsequent reoperation, which disrupted rehabilitation trajectories and prolonged functional decline (16).

Reoperation emerged as a critical differentiating outcome between the two surgical strategies (17). The substantially higher reoperation rate following internal fixation highlighted the vulnerability of this approach in displaced fractures among older adults, even when patients were physiologically fit and active (18). Secondary procedures not only exposed patients to additional surgical risk but also correlated with poorer functional scores at one year, reinforcing the cumulative burden of repeated interventions (19). Conversely,

although total hip arthroplasty was associated with a small number of reoperations, these events were primarily related to prosthesis-specific complications and occurred at a markedly lower frequency, suggesting a more durable initial solution.

Mortality at one year did not differ significantly between groups, a finding that aligned with the multifactorial nature of survival following hip fracture in elderly patients (20). While surgical technique influenced functional outcomes and reoperation risk, mortality appeared more strongly related to age, comorbidity burden, and overall physiological reserve (21). The absence of a mortality difference supported the interpretation that the functional advantages of total hip arthroplasty were achieved without an apparent survival trade-off, an important consideration when selecting a more extensive surgical intervention.

Several strengths enhanced the interpretability of these findings. The randomized controlled design minimized selection bias and ensured comparable baseline characteristics between groups (22, 23). The focus on an active elderly cohort addressed a clinically relevant subgroup often underrepresented in broader geriatric fracture studies. The use of validated functional and quality-of-life instruments allowed for a comprehensive assessment of outcomes that extended beyond radiographic or surgeon-centered measures. Additionally, high follow-up completeness strengthened confidence in the reported results.

Nonetheless, certain limitations warranted careful consideration. The relatively small sample size limited the precision of subgroup analyses and reduced the ability to detect modest differences in mortality(23). The single-region study setting may have constrained generalizability to healthcare systems with different surgical expertise, rehabilitation resources, or patient demographics. Functional outcomes were assessed at one year, which captured medium-term recovery but did not address longer-term prosthesis survival or late complications. Furthermore, although outcome assessors were not involved in surgical care, blinding to treatment allocation was not feasible and may have introduced subtle assessment bias.

The findings contributed to ongoing debate regarding optimal management of displaced femoral neck fractures in elderly patients who remain functionally demanding (24). They supported a growing perspective that chronological age alone should not dictate the choice of a less definitive procedure when functional goals and life expectancy favor a more durable solution. At the same time, the results cautioned against indiscriminate application of total hip arthroplasty, emphasizing the need for careful patient selection and surgical expertise to minimize prosthesis-related complications.

Future research would benefit from larger multicenter trials with longer follow-up to better define the durability of functional gains and prosthetic outcomes beyond the first postoperative year (25). Incorporation of cost-effectiveness analyses and patient-reported outcome measures could further inform shared decision-making. Exploration of tailored rehabilitation strategies and optimization of perioperative care may also enhance outcomes regardless of surgical approach (26).

In summary, the study findings suggested that immediate total hip arthroplasty provided meaningful functional advantages and reduced the likelihood of reoperation compared with internal fixation in active elderly patients with displaced femoral neck fractures, without adversely affecting short-term survival. These results supported a more individualized, function-oriented approach to surgical decision-making in this increasingly important patient population.

CONCLUSION

Immediate total hip arthroplasty resulted in superior functional recovery and significantly fewer reoperations compared with internal fixation in active elderly patients with displaced femoral neck fractures, without increasing one-year mortality. These findings highlighted the value of prioritizing durable surgical solutions that support independence and long-term mobility in this population. Adopting a function-centered approach to procedure selection may improve patient outcomes and reduce the burden of secondary surgery in geriatric orthopedic trauma care.

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AUTHOR CONTRIBUTIONS

Author	Contribution
Sana Ejaz*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Mah Rukh Khan	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Muhammad Faraz Tariq	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Muhammad Ramzan	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published

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