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Original Research Article

Study of Computed Tomography and X-Rays of Adults with Fracture Neck of Femur

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Conflict of interest: Nil

Abstract

Background: Neck of femur fractures predominantly affect the adult population, particularly the elderly, due to factors like decreased bone density and osteoporosis. Additionally, younger adults may experience these fractures through high-energy impacts, such as vehicle accidents or sports-related injuries.

Aims & Objectives: To compare the effectiveness of X-ray and CT scan in detecting different types of neck of femur fractures.

Methodology: A Cross sectional study was conducted among 30 patients diagnosed with isolated intracapsular neck of femur fractures came to OPD at department of Orthopaedics, at tertiary care centre during March 2022 to July 2024.

Results: In the study majority of cases belonged to 71-80 years of age group. Total 19 cases were males and 11 cases were females. The majority of patients, 21 out of 30 (68.42%), were diagnosed with a right NOF fracture. Out of the total cases, 89.47% (27 cases) were impacted fractures, while 10.53% (3 cases) were non-impacted fractures. The highest number of patients (7 out of 30) were found with bone defect in shaft fragment which was more than 10mm in depth. The data signifies variable amount of bone defect depth which can be present in either fragment or both fragments.

Conclusion: The prevalance of higher incidence of Gardens Type 3 and Pauwels Type 2 fractures, highlights the need for tailored surgical approaches, especially in managing complex cases involving posterior wall comminution and fracture impaction. The results also underscore the preference for bipolar hemiarthroplasty in elderly patients, a choice supported by its lower complication rates and faster recovery time compared to other surgical options.

Keywords: Computed tomography, Fracture, Neck of Femur, X-ray.

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Introduction

The femur, commonly known as the thigh bone, is the longest and strongest bone in the human body, pivotal for bearing the body's weight and facilitating movement. Fractures of the femur can occur at various locations along the bone, with one of the most clinically significant types being the neck of femur fracture.[1]

This type of fracture occurs at the proximal end of the femur, just below the femoral head. Neck of femur fractures predominantly affect the adult population, particularly the elderly, due to factors like decreased bone density and osteoporosis. Additionally, younger adults may experience these fractures through high-energy impacts, such as vehicle accidents or sports-related injuries. The anatomy of the femoral neck, inherent in its slender and angled structure, predisposes it to fractures, especially under stress or sudden impacts. [2] Neck of femur fractures are a major public health concern due to their high prevalence and the significant morbidity and mortality associated with them and are most common reasons for acute orthopaedic hospital admissions in older adults.

The clinical significance of these fractures extends beyond the immediate physical injury. For many patients, particularly the elderly, a neck of femur

fracture is a life-altering event that drastically affects their mobility. [3,4] Studies report that the one-year mortality rate post-fracture can be as high as 30%, underscoring the severity of this condition. For those who survive, many do not regain their pre-fracture level of mobility or independence, which significantly impacts their quality of life. [5,6,7] Given these challenges, accurate and early diagnosis of neck of femur fractures is crucial to improving clinical outcomes. Radiographic imaging plays a fundamental role in this diagnostic process as they provide a quick and effective means of identifying the location and pattern of the fracture, which are critical for determining the appropriate management strategy. However, X-rays can sometimes fail to reveal more subtle fractures or the exact extent of the injury, which is where CT scans prove invaluable. CT scans offer a more detailed view of the bone architecture, allowing for a better assessment of complex fractures and planning for surgical intervention. [7]

Aims & Objectives: To compare the effectiveness of X-ray and CT scan in detecting different types of neck of femur fractures.

Material and Methods

A Cross sectional study was conducted among 30 patients diagnosed with isolated intracapsular neck of femur fractures came to OPD at department of orthopaedics, at tertiary care centre during March 2022 to July 2024.

Skeletally mature patients aged 18 years or older, Patients with isolated intracapsular neck of femur fractures and Patients who are willing and able to undergo both X-ray and CT scan evaluations were included in the study.

Data were collected from case record form including details of high-resolution X-ray machines and CT scanners with capabilities for various slice thicknesses were noted. Specific settings on these machines were standardized, and the personnel were trained to maintain consistency across all scans. For the measurement of radiographic parameters such as the angle of fracture inclination, displacement, and the spatial relationship of the fracture to the femoral head, digital callipers within the imaging software were utilized.

Data entry and analysis: Data were collected in Microsoft excel sheet and analysed by using SPSS Software. Qualitative data were described as frequency and percentages and quantitative data were described as Mean and SD.

Results

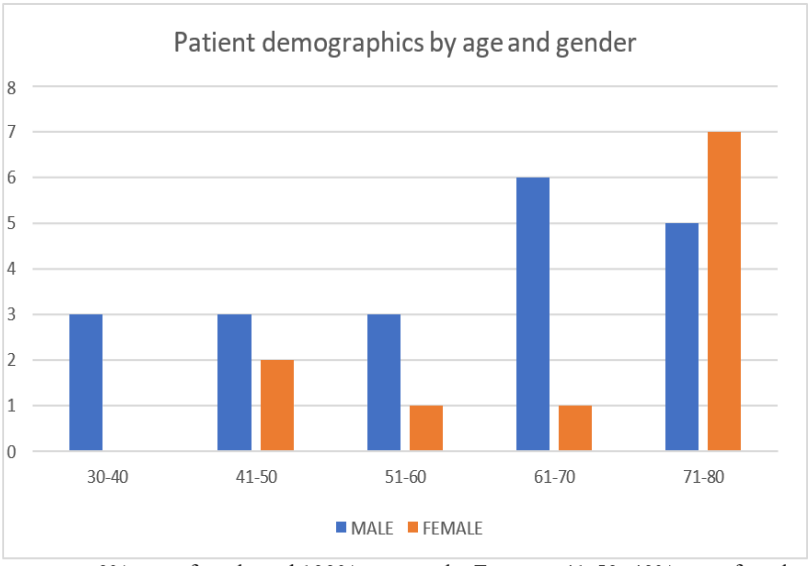


Figure 1: Age and Gender distribution

In the 30-40 age group, 0% were female and 100% were male. For ages 41-50, 40% were female and 60% were male. In the 51-60 age group, 25% were female and 75% were male. For ages 61-70, 83.3% male were reported, while 16.7% were female. In the 71-80 age group, 58.4% were female, and 41.6% were male. [Figure 1]

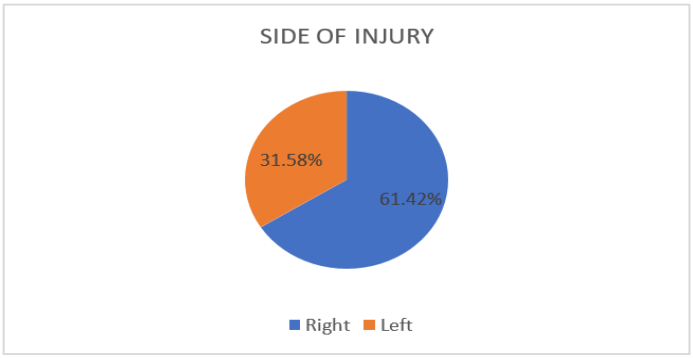


Figure 2: Distribution of side

The majority of patients, 21 out of 30 (68.42%), were diagnosed with a right NOF fracture. The remaining 9 patients (31.58%) had a left NOF fracture. [Figure 2]

Table 1: Femoral Head Size Distribution

Sr. no	Femoral Head Size	Frequency		
		Male	Female	Total
1)	36-40 mm	1	5	6
2)	41-45 mm	7	0	7
3)	46-50 mm	10	3	13
4)	51-55 mm	1	3	4

The femoral head size distribution shows a variety of sizes. The range of head size was from 36mm to 53mm. Most frequent range was from 46 to 50 mm. Average head size in male was 46mm while in female it was 45mm. [Table 1]

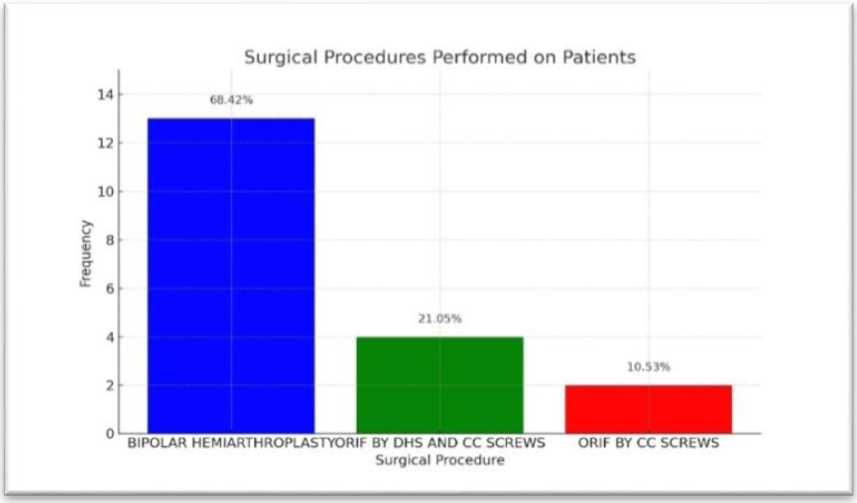


Figure 3: Surgical Procedures Performed on Patients

The most common procedure is bipolar hemiarthroplasty, performed on 21 patients, accounting for 68.42% of the cases. Open reduction and internal fixation (ORIF) using dynamic hip screws (DHS) and cannulated cancellous (CC) screws was performed on 6 patients (21.05%), while ORIF using only CC screws was done on 3 patients (10.53%). [Figure 3]

Table 2 : Posterior Tilt Angle Measurement

Sr. no.	Tilt Angle	Frequency
1)	0-20 degrees	3
2)	21-40 degrees	9
3)	41-60 degrees	11
4)	61-80 degrees	7

The mean posterior tilt angle is 45.8 degrees. The minimum tilt recorded is 18 degrees, while the maximum is 71 degrees. [Table 2]

Table 3: Bone Defect Analysis

Sr. No	Depth of Bone Defect	Frequency
1)	**In head fragment**	
	a) <10 mm	5
	b) >10 mm	5
2)	**In shaft fragment**	
	a) <10 mm	4
	b) >10 mm	7
3)	**In both fragments**	
	a) <10 mm in shaft and >10 mm in head	3
	b) >10 mm in shaft and <10 mm in head	4
	c) >10 mm in both fragments	0
	d) <10 mm in both fragments	2

The highest number of patients (7 out of 30) were found with bone defect in shaft fragment which was more than 10mm in depth. The data signifies variable amount of bone defect depth which can be present in either fragment or both fragments. [Table 3]

Discussion

In present study, majority of patients were within the 71-80 age group, with a higher proportion of females. This is attributed to factors like osteoporosis and decreased bone density. The gender distribution shows increased vulnerability of women to fractures, particularly post-menopause, due to hormonal changes that lead to bone loss. This age and gender distribution aligns with findings from other studies, such as those by Sundkvist and Brüggeman. [8] Similar studies, like the one by Cooper and Campion, [9] corroborate this trend, emphasizing the importance of targeted interventions in this demographic. However, some studies, such as by Davidson and Blum, [10] noted a more balanced gender distribution and a lower age prevalence suggesting that regional variations, lifestyle factors, and access to healthcare may influence the gender-specific prevalence of femoral neck fractures.

In this study, right-sided femoral neck fractures were more common than left-sided fractures. This could be attributed to the dominant leg hypothesis, where the leg predominantly used bears more stress, predisposing it to fractures. This distribution mirrors findings from Hinton et al, who reported a similar prevalence of right-sided fractures. [11] The classification of fractures using the Gardens, Pauwels, and AO systems in our study showed a predominance of Gardens Type 3 and 4, Pauwels Type 2, and AO Type 31B1 fractures. These findings are consistent with the study by Knutsson and Wennergren. [12]

The surgical procedures performed showed that bipolar hemiarthroplasty was the most common, accounting for 68.42% of cases. This preference for hemiarthroplasty is in line with the recommendations of multiple studies, including those by Cui and Wang [13] and Parker and Khan [14], which advocate for its use in elderly patients due to lower revision rates and better post-operative functional outcomes compared to internal fixation. However, Parker and Pryor [15] concluded that both internal fixation and arthroplasty produce similar final outcomes of treatment. Internal fixation may have a slight tendency towards improved mobility in comparison to an uncemented arthroplasty, but fixation incurs a markedly increased re-operation rate. The choice of surgical procedure in our study appears justified by the patient age and comorbidity profile and better immediate post op outcomes, which favoured the less invasive and quicker recovery associated with hemiarthroplasty.

The analysis of fracture line to head tip distance and femoral neck length revealed considerable variability across patients, with distances ranging from 28 mm to 46 mm and neck lengths from 31 mm to 61 mm. Neck length trend shows higher values in male than female with average of 45mm and 42mm respectively. These parameters do not strongly correlate with surgical outcomes but are important for surgical planning, particularly in ensuring appropriate screw placement and fixation. Cheng et al. emphasized that accurate measurement of these parameters is critical for optimizing screw placement and ensuring stable fixation. The lack of significant differences in these metrics within our study cohort suggests that while they are important for surgical planning, they may not independently predict outcomes. [16]

Presence of parameters like high posterior tilt angle, significant posterior wall comminution, highly osteoporotic bone, and higher classification

grades along with patient's age in grey zone could favour more towards choosing replacement over fixation to prevent additional surgeries and complications like nonunion and AVN. However, if fixation is planned it should be either augmented with fibular strut graft or fracture should be over reduced and impacted.

Conclusion

The prevalence of higher incidence of Gardens Type 3 and Pauwels Type 2 fractures, highlights the need for tailored surgical approaches, especially in managing complex cases involving posterior wall comminution and fracture impaction. The results also underscore the preference for bipolar hemiarthroplasty in elderly patients, a choice supported by its lower complication rates and faster recovery time compared to other surgical options. The study also reveals significant variability in femoral head sizes and fracture metrics, such as the distance from the fracture line to the head tip and femoral neck length. These variations necessitate careful preoperative planning and individualized prosthetic selection to optimize surgical outcome. There is critical role of bone quality in surgical decision-making, particularly in elderly patients with varying degrees of osteoporosis. Presence of certain factors pertains to augment the fixation with fixed angle implants and fully threaded screws along the deficit cortex or use of grafting procedures. Despite the valuable insights gained, the study has several limitations that must be acknowledged. The relatively small sample size and single-centre design limit the generalizability of the findings.

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