e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2024; 16(5); 420-425

Original Research Article

Outcome Assessment of Concomitant Fixation of the Ipsilateral Femoral Neck and Shaft Fracture using Single versus Dual Surgical Implants

Raj Kumar[1], Sudhanshu Shekhar[2], Niraj Narain Singh[3], Rajat Charan[4]

[1]Assistant Professor, Department of Orthopaedics, ESIC Medical College and Hospital, Bihta, Patna, Bihar, India

[2]Senior Resident, Department of Orthopaedics, ESIC Medical College and Hospital, Bihta, Patna, Bihar, India

[3]Associate Professor, Department of Orthopaedics, ESIC Medical College and Hospital, Bihta, Patna, Bihar, India

[4]Professor and HOD, Department of Orthopaedics, ESIC Medical College and Hospital, Bihta, Patna, Bihar, India

Received: 15-03-2024 / Revised: 22-04-2024 / Accepted: 25-05-2024
Corresponding Author: Dr. Niraj Narain Singh
Conflict of interest: Nil

Abstract

Aim: The aim of the study was to assess the outcome of concomitant fixation of the ipsilateral femoral neck and shaft fracture using single versus dual implant osteosynthesis.

Methods: The retrospective study was conducted in the Department of Orthopedics, ESIC Medical college and Hospital, Bihta, Patna, Bihar from May 2021 to Feb 2024. Out of 837 cases of femur fracture, 25 cases of concomitant ipsilateral femoral neck and shaft fractures were identified and included in the study.

Results: The mean age was 36.9 ± 10.3 years, with males representing most of the cases (84%). The mechanism of injury was fall from height in 21 cases (84%), while 4 cases (16%) had fractures secondary to road traffic accident. All cases were operated on within an average of 5.6 ± 6.3 days after injury. Femoral neck fractures were basicervical in 12 cases (48%) and transcervical in 13 cases (52%). Displacement was found in 9 cases of neck fractures (36%), while the remaining 16 (64%) were either Garden's grade I or II. The mean Pauwels's angle was 61.7 ± 12.5 degrees. Regarding the shaft fractures, they were located in mid-shaft in the majority of the cases (72%). The average neck- shaft angle was 126.9 ± 4.7 degrees. Upon comparing the patients who were managed with single (N = 16) versus dual (N = 9) implants, none of our prognostic factors showed significant difference.

Conclusion: Ipsilateral femoral neck and shaft fractures are uncommon high-energy trauma that required a high level of suspicion and planned early management. Early surgical fixation of both fractures was associated with good outcome results. Single versus dual implant fixation were not found to significantly affect the radiological outcomes or complications.

Keywords: Femur fracture; Concomitant; Ipsilateral; Neck fracture; Union

Introduction

Concomitant ipsilateral fractures of the femoral shaft and neck are uncommon and present complex clinical challenge. These injuries occur in 3% to 10% of cases, predominantly due to high-energy trauma. [1] Diagnosis of associated neck fractures can be overlooked or delayed in up to one-third of cases [2,3], emphasizing the need for thorough evaluation in polytrauma patients with diaphyseal femoral fractures. [4-6] With advancements in trauma care and increased survival rates among polytrauma patients, the incidence of these injuries is likely to rise.

The injury mechanism typically involves axial compression against the acetabulum, often with concurrent adduction or abduction of the hip. [7] The femoral shaft fracture tends to be more comminuted, absorbing the brunt of the energy, while the neck fracture usually sustains less displacement. There is ongoing debate regarding the optimal fixation technique for these combined injuries. [2,8] Surgeons prioritize early anatomical fixation of the femoral neck to mitigate the heightened risk of avascular necrosis associated with delayed treatment.

The role of single versus dual implants in achieving optimal fixation remains contentious. It is theorized that the femoral shaft absorbs the majority of the energy during injury, evidenced by its comminution, thereby reducing the force transmitted across the neck. [8] Most experts agree that prompt treatment of the femoral neck is crucial for long-term patient outcomes. While separate implants for the femoral neck and shaft may potentially reduce the need for reoperations, this approach is supported by limited evidence from case series. [9]

Treatment options for ipsilateral femoral neck and shaft fractures include various surgical techniques such as reconstruction nails, antegrade nails, and combinations of screws with nails or plates. Each method presents unique advantages and disadvantages. Key management issues include determining the optimal timing of surgery, prioritizing which fracture to address first, and selecting the most suitable implant strategy. [10] The aim of the present study was to assess the outcome of concomitant fixation of the ipsilateral femoral neck and shaft fracture using single versus dual surgical implants.

Materials and Methods

This retrospective study was conducted in the Department of Orthopedics, ESIC Medical college and Hospital, Bihta, Patna, Bihar from May 2021 to February 2024. This study has been reported in line with strengthening the reporting of observational studies in epidemiology (STROBE) guidelines. [11] After receiving institutional review board approval with a waiver of consent all cases who underwent femoral shaft fixation were reviewed. Out of 837 cases, 25 cases of concomitant ipsilateral femoral shaft and neck fractures were identified and included in the study. The inclusion criteria included patients between 18 to 60 years who underwent surgical fixation of ipsilateral femoral shaft and neck fractures with at least 6 months of follow-up.

Demographic and surgical characteristics were reviewed and included patients' age, gender, mechanism of injury, location of femoral neck fracture (basicervical or transcervical), displacement of femoral neck fracture classified as nondisplaced (Garden classification grade one and two) or displaced (Garden classification grade three and four), location of femoral shaft fracture (proximal, midshaft or distal), time to surgery, surgical positioning, methods of reduction, number of implants used, postoperative complications, postoperative union time, implant removal/failure, malunion/nonunion and duration of follow-up. The decision whether to fix the fractures using one or two implants was made by the primary surgeon. Several factors affected the selection process, including the patient's general condition, the amount of displacement of a neck fracture and the surgeon's preference.

The primary outcome was fracture radiographic union defined by evidence of bridging callus on three out of four cortices on anteroposterior and lateral radiographs. The secondary outcome is the accuracy of reduction which was evaluated for both femoral neck and shaft fractures. The reduction of femoral neck fracture was assessed radiographically based on two parameters according to Haidukewych et al [12]: the degree of residual angulation and the amount of displacement (cortex apposition regardless of direction). Excellent reduction was defined as < two mm of displacement and < five degrees of angulation in any plane, good as two to five mm displacement and/or five to ten degrees of angulation, fair as > five to ten mm of displacement and/or > 10–20° of angulation and poor as > 10 mm of displacement and/or > 20° of angulation. Similarly, femoral shaft mal reduction was defined as > 5° of angulation in the coronal plane or > 10° of angulation in the sagittal plane.[13] In addition, implant failure was defined as femoral neck screws cut out, breakage of nail or breakage of proximal or distal locking screws.

Statistical Analysis

Continuous variables were reported as a mean ± SD and categorical variables as frequency (%). A p-value of ≤ 0.05 was considered statistically significant. Data were analyzed using SPSS version 22.0 statistic software package.

Results

Table 1: Demographic and surgical characteristics of 25 patients with ipsilateral femoral shaft and neck fractures

Variable	Measurement
Age (years), mean ± SD	36.9 ± 10.3
Male gender (% total)	21 (84%)
Mechanism of injury (% total)	
Fall from height	21 (84%)
Road traffic accident	4 (16%)
Time to surgery (days), mean ± SD	5.6 ± 6.3
Surgical positioning (% total)	
Supine	18 (72%)

Lateral	7 (28%)
Reduction method (% total)	
Closed	22 (88%)
Open	3 (12%)
Number of implants (% total)	
One	16 (64%)
Two	9 (36%)
Union time (months), mean ± SD	
Femoral neck	3.7 ± 2.1
Femoral shaft	4.9 ± 3.6
Implant failure (% total)	2 (8%)
Malunion/nonunion (% total)	2 (8%)
Duration of follow-up (months), mean ± SD	9.5 ± 6.1

The mean age was 36.9 ± 10.3 years, with males representing most of the cases (84%). The mechanism of injury was fall from height in 21 cases (84%), while 4 cases (16%) had fractures secondary to motor vehicle collisions. All cases were operated on within an average of 5.6 ± 6.3 days after injury.

Table 2: Fracture characteristics

Variable	Measurement
Location of femoral neck fracture (% total)	
Basicervical	12 (48%)
Transcervical	13 (52%)
Displacement of femoral neck fracture (% total)	
Non-displaced	16 (64%)
Displaced	9 (36%)
Femoral neck Pauwels's angle (degrees), mean ± SD	61.7 ± 12.5
Location of femoral shaft fracture (% total) Proximal	4 (16%)
Midshaft	18 (72%)
Distal	3 (12%)
Neck-shaft angle (degrees), mean ± SD	126.9 ± 4.7

Femoral neck fractures were basicervical in 12 cases (48%) and transcervical in 13 cases (52%). Displacement was found in 9 cases of neck fractures (36%), while the remaining 16 (64%) were either Garden's grade I or II. The mean Pauwels's angle was 61.7 ± 12.5 degrees. Regarding the shaft fractures, they were located in the mid-shaft in the majority of the cases (72%). The average neck- shaft angle was 126.9 ± 4.7 degrees.

Table 3: Comparison of single versus dual implant osteosynthesis for the management of ipsilateral femoral shaft and neck fractures

Variable	Single implant (N = 16)	Dual implants (N = 9)	p value
Age (years), mean ± SD	38.7 ± 12.9	36.1 ± 9.4	0.5
Male gender (total)	14	7	0.6
Postoperative complications (total)	4	3	0.2
Union time (months), mean ± SD			
Femoral neck	3.3 ± 2.1	4.5 ± 2.3	0.4
Femoral shaft	5.0 ± 4.7	4.8 ± 2.1	0.7
Implant failure (total)	1	1	0.6
Malunion/nonunion (total)	1	1	0.6
Displacement of femoral neck fracture (total)			
Non-displaced	10	6	0.5
Displaced	6	3	
Location of femoral shaft fracture (total)			
Proximal	2	2	0.4
Midshaft	12	6	
Distal	1	2	

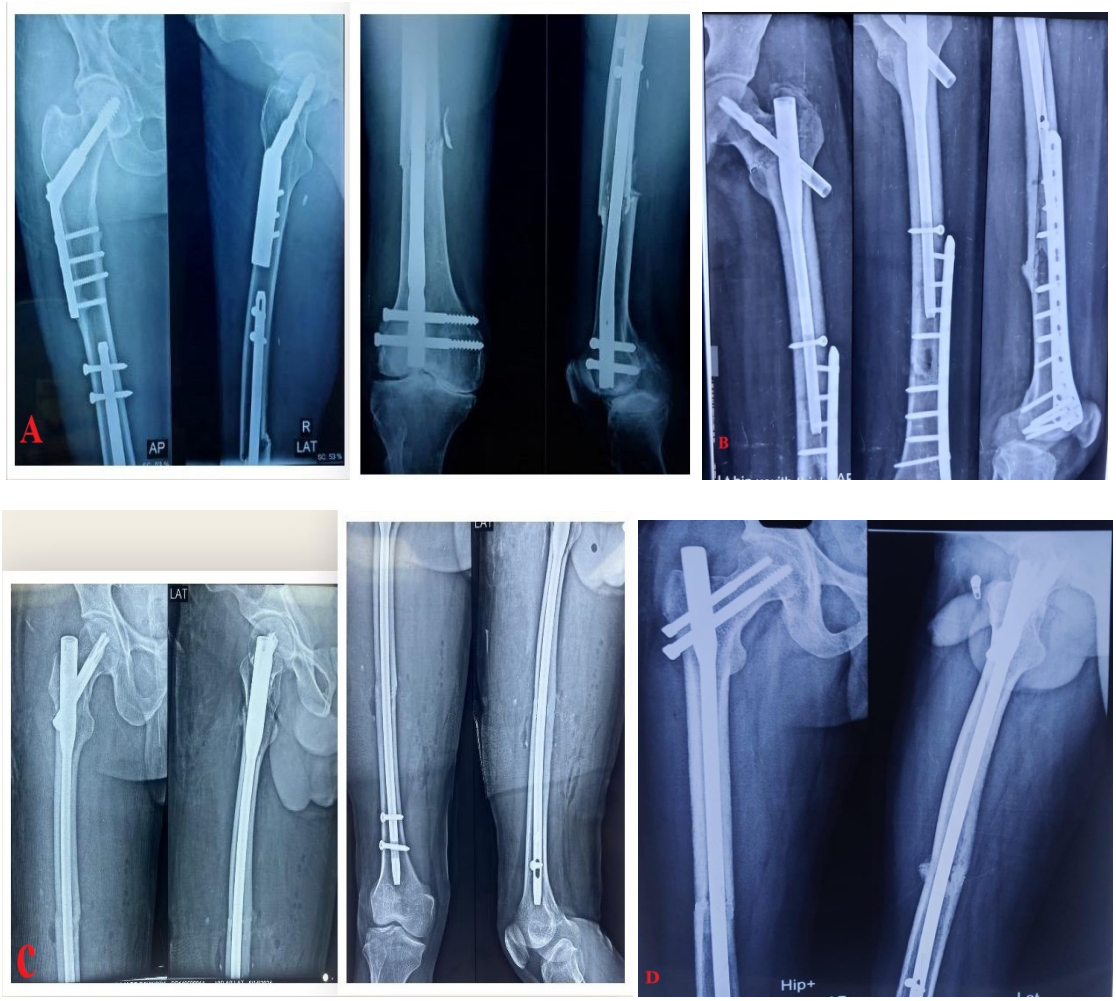

Figure: X-ray showing treatment using dual implant (A & B); and single implant osteosynthesis (C & D)

Upon comparing the patients who were fixed with one implant (N = 16) versus two implants (N = 9), none of our prognostic factors showed statistical significance. However, the femoral neck fractures showed a shorter union time in patients treated with one implant compared to patients treated with two implants (3.3 ± 2.1 months vs 4.5 ± 2.3 months). Similar percentages of implant failure and malunion/nonunion were seen in patients of both group. The average follow-up period was 9.5 ± 6.1 months

Discussion

Although combined ipsilateral femoral neck and shaft fractures are relatively uncommon injury pattern, it is critical to recognize the presence of an associated ipsilateral femoral neck fracture occurring in conjunction with the more obvious femoral shaft fracture. Associated ipsilateral femoral neck fractures have been reported to occur in 1% to 9% of femoral shaft fractures. [14] These are challenging injuries to manage and often require modification of the routine shaft fracture treatment approach. Failure to recognize an associated ipsilateral femoral neck fracture may result in fracture displacement, delayed treatment, and a poorer outcome. [15]

Wei et al [16] reported no significant difference in fractures reduction or complications in 22 patients treated with single versus dual implants. Upon comparing the patients in two groups, none of our prognostic factors showed statistical significance. However, the femoral neck fractures showed a shorter union time in patients treated with single implant compared to patients treated with two implants. In one of the largest series on this topic, Oh et al. reported on 74 cases of ipsilateral femoral neck and shaft fractures. The rate of avascular necrosis was 6.8% with higher risk with displaced femoral neck fractures. The authors also reported a high rate of femoral shaft nonunion of 20%. [17] Although Hung et al [18] reported that the order of fixation of the fractures may not be important, others gave priority to fixation of the femoral neck fractures first especially if displaced. Some authors even support fixing the femoral shaft fracture first as it will aid in the fixation of the femoral neck. [19-21] Recently, The American Academy of Orthopedic Surgeons published an article in which they described a preferred approach to guide

surgeons in fixing ipsilateral femoral neck and shaft fractures. [19] If the femoral neck fracture was displaced, it is preferred to use two implants to fix the fractures starting with fixing the neck of femur. Regarding femoral shaft fracture, after fixation, surgeons should take radiographs of the contralateral side to evaluate for length, alignment and mal reduction. If there is no obvious neck of femur fracture preoperatively, an intraoperative fluoroscopic examination should be done to assess for fracture. Prophylactic measures should be taken if there is no femur neck fracture.

Similar percentages of complications like implant failure and malunion/nonunion were seen in both groups in this study. The average follow-up period was 9.5 ± 6.1 months. Multiple surgical fixation techniques are used based on patients' factors, fracture characteristics and surgeon preference, with controversial clinical outcomes reported in the literature. Treatment options include single constructs (e.g. CMN, long sliding hip screw) and dual constructs (e.g. retrograde nail with sliding hip screw, proximal femoral locking plate or cannulated screws). [19] While each has its own merits and demerits, the goal of any treatment plan should be an anatomic reduction of neck fracture and stable fixation of both fractures so patients can be early mobilized. [22]

Conclusion

Ipsilateral fractures of the femoral neck and shaft, which are uncommon occurrence often resulting from high-energy trauma, necessitate early detection and prompt surgical intervention. Early prompt fixation of both fractures either with single or dual implant osteosynthesis resulted in relatively low rate of complications, successful union and favorable outcomes. Nonetheless, conducting comprehensive multicenter studies with long-term follow-up remains imperative to define the optimal management approaches for these intricate injuries.

References

1. Mohapatra G, Sethy RR. Ipsilateral fracture neck and shaft of femur: a prospective analysis of two methods. J Orthop Traumatol Rehabil. 2017;9:17–20.
2. Daine OC. Ipsilateral femoral neck and shaft fractures. Ortho Rheum Open Access. 2017;5 (3):555661.
3. Hak DJ, Mauffrey C, Hake M, Hammerberg EM, Stahel PF. Ipsilateral femoral neck and shaft fractures: current diagnostic and treatment strategies. Orthopedics. 2015;38(4):2 47–251.
4. Tornetta P, 3rd, Kain MS, Creevy WR. Diagnosis of femoral neck fractures in patients with a femoral shaft fracture. Improvement with a standard protocol. J Bone Joint Surg. 2007;89(1):39–43. Wolinsky PR, Johnson KD. Ipsilateral femoral neck and shaft fractures. Clin Orthop Relat Res. 1995;318:81–90. [Pub Med] [Google Scholar]
5. Riemer BL, et al. Clandestine femoral neck fractures with ipsilateral diaphyseal fractures. J Orthop Trauma. 1993;7(5):443–449.
6. Sengodan VC, et al. Management of ipsilateral fracture of hip and shaft of femur. IJCRR. 20 15;7(17):7.
7. Barei DP, et al. Noncontiguous fractures of the femoral neck, femoral shaft, and distal femur. J Trauma. 2003;55(1):80–86.
8. McDonald LS, Tepolt F, Leonardelli D, Hammerberg EM, Stahel PF. A cascade of preventable complications following a missed femoral neck fracture after antegrade femoral nailing. Patient Saf Surg 2013;7:16.
9. Alho A. Concurrent ipsilateral fractures of the hip and femoral shaft: a meta-analysis of 659 cases. Acta Orthop Scand 1996;67(1):19-28.
10. Ritchey SJ, Schonholtz GJ, Thompson MS. The dashboard femoral fracture: pathomec hanics, treatment, and prevention. J Bone Joint Surg Am 1958;40:1347-1358.
11. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP, Initiative STROBE. The strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. J Clin Epidemiol. 2008; 61(4):344–349.
12. Haidukewych GJ, Rothwell WS, Jacofsky DJ, Torchia ME, Berry DJ. Operative treatment of femoral neck fractures in patients between the ages of fifteen and fifty years. J Bone Joint Surg. 2004;86(8):1711–1716.
13. Bedi A, Karunakar MA, Caron T, Sanders RW, Haidukewych GJ. Accuracy of reduction of ipsilateral femoral neck and shaft fractures–an analysis of various internal fixation strate gies. J Orthop Trauma. 2009;23(4):249–253.
14. Peljovich AE, Patterson BM. Ipsilateral femoral neck and shaft fractures. J Am Acad Orthop Surg 1998;6(2):106-113.
15. Watson JT, Moed BR. Ipsilateral femoral neck and shaft fractures: complications and their treatment. Clin Orthop Relat Res 2002;399:78-86.
16. Wei YP, Lin KC. Dual-construct fixation is recommended in ipsilateral femoral neck fractures with infra-isthmus shaft fracture: A STROBE compliant study: a STROBE compliant study. Medicine (Baltimore) 2021;1 00(17):e25708.
17. Oh C-W, Kim J-W, Park KC, Apivatthakakul T, Luo C-F, Wong MK, et al. Clinical outcomes and affecting factors of ipsilateral femoral neck and shaft fractures - Multination, multicenter analysis. J Orthop Sci. 2022.

18. Hung S-H, et al. Surgical treatment for ipsilateral fractures of the hip and femoral shaft. Injury. 2004;35(2):165–169
19. Jones CB, Walker JB. Diagnosis and management of ipsilateral femoral neck and shaft fractures. J Am Acad Orthop Surg. 20 18;26(21):e448–e454.
20. Swiontkowski MF, et al. Ipsilateral fractures of the femoral neck and shaft. A treatment protocol. J Bone Joint Surg. 1984;66(2):260.
21. James P, Waddell (2011) Fractures of the proximal femur: improving outcomes, pp 91–96.
22. Alho A, Ekeland A, Grøgaard B, Dokke JR. A locked hip screw-intramedullary nail (cephalomedullary nail) for the treatment of fractures of the proximal part of the femur combined with fractures of the femoral shaft. J Trauma. 1996;40(1):10–16.