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Original Research Article

Functional and Radiological Outcome of Periprosthetic Femoral Fractures Following Hip Hemiarthroplasty: A Single Centre Analysis of 22 Cases

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Abstract

Aim: The aim of this retrospective study was to determine the functional and radiological outcomes of the treatment of periprosthetic femoral fractures following hip hemiarthroplasty.

Materials and Methods: This retrospective study was conducted on a series of 22 patients with periprosthetic femoral fractures after hip hemiarthroplasty. PFF was classified according to the Vancouver Classification system. The characteristics of patients, fractures and treatment outcomes in terms of complications, mortality and functionality were analysed. Radiological results were evaluated using the Beals and Tower's criteria and Harris Hip Score (HHS) was used to evaluate the functional outcome.

Results: The mean age was 74.2 years. Thirteen (59.1%) fractures occured in women while 9 (40.9%) in men, and the left hip was the most commonly involved (63.6%). As for comorbidities, 8 patients (36.4%) had a American Society of Anesthesiologists (ASA) score of 1-2 and 14 (63.6%) had ASA score of 3-4. The great majority of fractures were caused by slip down (81.8%), followed by spontaneous fractures (13.7%) and road traffic accident (4.5%). According to the Vancouver classification, there were 5 (22.8%) type A, 10 (45.4%) type B1, 2 (9.1%) type B2, 1 (4.5%) type B3 and 4 (18.2%) type C fractures. HHS showed good to excellent result in 31.9 % patient and fair to poor result in 68.1 % patients at final assessment.

Conclusion: Periprosthetic femoral fractures after hemiarthroplasty are more common in women, and usually occur in patients with significant morbidity. The Vancouver classification is widely used to deal with these fractures and it has been emphasised that a proper assessment is important to avoid incorrect methods of treatment.

Keywords: Periprosthetic femoral fractures, Hip hemiarthroplasty, Vancouver Classification, Beals and Tower's criteria, Harris Hip Score

Introduction

Periprosthetic femoral fracture (PFF) after hip arthroplasty in elderly patients is a serious complication and their management is a difficult challenge. Also, it is technically demanding and associated with various serious complications .[1] Its incidence varies between 2% and 14%. [2] The treatment of PFF is multifaceted and depends on factors like fracture morphology, stability of the implant, quality and quantity of bone stock, patient's factors (as age, comorbidities and functional demands), and surgical expertise. [3]

Relatively little has been published on periprosthetic fractures that occur around hemiarthroplasty prosthesis performed for hip fracture and no such study has been done in our institution till now. The aim of this study was to determine the functional and radiological outcomes of the treatment of PPF after hip hemiarthroplasty (HA).

Materials and Methods

A retrospective review was performed of 22 PFF after a HA treated in the Department of Orthopaedics, ESIC Medical College & Hospital, Bihta, Patna from November 2021 to March 2024.

Intraoperative fractures and patients followed-up for less than 6 months were excluded from study. This retrospective case-control study was approved by institutional review board, and informed consent was not required.

PFF was classified according to the Vancouver Classification system[4] and managed according to the location of the fracture, the stability of the prosthesis within the femur and the surrounding bone stock. The clinical records and radiographs of each patient were reviewed.

Clinical results were evaluated using the Beals and Tower's criteria (e.g., implant stability, fracture healing and onset of complications). [5] Fracture union was defined radiologically (anteroposterior and lateral) as the time of callus formation and capacity for weight-bearing without pain. Stem stability was determined based on the appearance of radiolucent lines around the stem, and subsidence and loosening were examined. [6] Harris Hip Score (HHS) was used to evaluate the functional outcome. [5]

Statistical Analysis: Continuous variables were reported as a mean ± SD and categorical variables as frequency (%). Data were analyzed using SPSS version 22.0 statistic software package.

Results

A total of 26 patients were identified, of which 22 fulfilled the inclusion criteria. One of the patients excluded were lost to follow-up, and the other three died after less than 6 months of follow-up. Among those included in the analysis, the mean age at the time of presentation was 74.2 years old (range 55-90). Thirteen (59.1%) fractures occured in women while 9 (40.9%) in men, and the left hip was the most commonly involved (63.6%). The mean follow-up time was 15.3 months (range, 6-30 months). Ten (45.5%) patients were obese having body mass index (BMI) more than 25 kg/m^2. As for comorbidities, 8 patients (36.4%) had a American Society of Anesthesiologists (ASA) score of 1-2 and 14 (63.6%) had ASA score of 3-4.

The mean time from hip fracture surgery to PFF was 18.2 months (range 2-55 months). Local risk factors were identified in 15 (68.2%) of the patients, principally osteoporosis (45.4%), followed by loosening of the stem (13.7%) and osteolysis (9.1%). The great majority of fractures were caused by slip down (81.8%), followed by spontaneous fractures (13.7%) and road traffic accident (4.5%). Fracture union was achieved in 19 (86.3%) fractures, with a mean union time of 5.3 months (range, 3–8 months). (Table 1)

According to the Vancouver classification, there were 5 (22.8%) type A, 10 (45.4%) type B1, 2 (9.1%) type B2, 1 (4.5%) type B3 and 4 (18.2%) type C fractures. Twelve fractures (54.5%) occurred around cemented prosthesis (Monopolar prosthesis= 3, Bipolar prosthesis= 9), and 10 fractures (45.5%) were around noncemented prosthesis (Monopolar prosthesis= 3, Bipolar prosthesis= 9). Two of the type A (AG) fractures were treated using ORIF with cerclage wires, the remainder were treated nonoperatively. All except one of the B1 fractures were treated using ORIF with plating and cables. The remainder was undisplaced and treated non-operatively. One case of type B2 fracture was treated with revision surgery using cementless long stem prosthesis; second type B2 and only Type B3 underwent ORIF plating and bone grafting. All four type C cases underwent ORIF with plating. All of the patients treated surgically received one or more units of blood transfusion during their perioperative course. The radiological results according to Beals and Tower's criteria were excellent in 7 (31.9%) patients, good in 9 (40.9%), and poor in 6 (27.2%). HHS showed excellent result in 2 (9.1%) patients, good in 5 (22.8%), fair in 8 (36.3%) and poor result in 7 (31.8%) patients at final assessment. (Table 2)

There were major or minor complications in 13 patients (59.1%). The most frequent complications were superficial wound infection (three), urinary tract infection (three), refracture (two), chest infection (two), deep vein thrombosis and pulmonary embolism (two), and hip dislocation (one). (Table 3)

Table 1: Demographic characteristics of patients

Variables	Data
Total number (n)	22
Age (yr)	74.2 (55-90)
Gender, male/female	9 (40.9%)/13 (59.1%)
Side, left/right	14 (63.6%)/8 (36.4%)
BMI (kg/m^2) > 25	10 (45.5%)
ASA classification	
1-2	8 (36.4%)
3-4	14 (63.6%)
Interval of fracture	18.3 (2-55) month
Cause	
Slip down	18 (81.8%)

No trauma	3 (13.7%)
RTA	1 (4.5%)
Local risk factor	
Osteoporosis	10 (45.4%)
Loosening of stem	3 (13.7%)
Osteolysis	2 (9.1%)
No risk factor	7 (31.8%)
Fracture union	
Rate (%)	86.3
Time (month)	5.3 (range 3–8)

Table 2: Fractures details. Vancouver classification, treatment and outcomes

No.	Vancouver	Treatment	Beals-Towers	HHS
1	AG	ORIF	Good	72
2	B1	ORIF	Poor	51
3	AL	Nonoperative	Excellent	87
4	B1	ORIF	Good	79
5	B3	ORIF + bone grafting	Poor	64
6	B2	ORIF + bone grafting	Good	92
7	B1	ORIF	Poor	73
8	B1	Nonoperative	Good	67
9	C	ORIF	Poor	75
10	AG	Nonoperative	Excellent	77
11	C	ORIF	Poor	82
12	B1	ORIF	Good	61
13	B2	Revision	Excellent	67
14	AG	ORIF	Excellent	88
15	B1	ORIF	Excellent	77
16	B1	ORIF	Poor	49
17	C	ORIF	Good	85
18	AL	Nonoperative	Excellent	72
19	B1	ORIF	Good	93
20	B1	ORIF	Good	59
21	C	ORIF	Good	75
22	B1	ORIF	Excellent	88

Figure 3: Complications

Complications	No. of patients	%
Dislocation	1	4.5
Wound infection	3	13.7
Refracture	2	9.1
Urinary tract infection	3	13.7
Chest infection	2	9.1
Deep vein thrombosis and pulmonary embolism	2	9.1

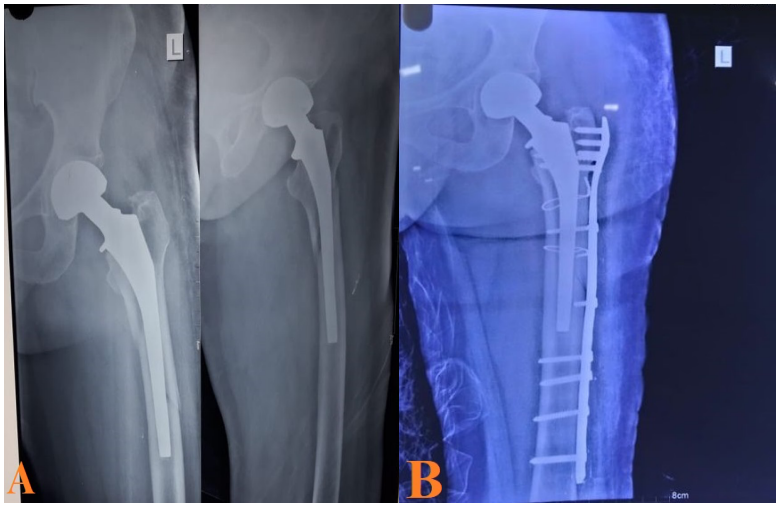

Figure 1: X-ray showing Vancouver B1 fracture treated by ORIF with plating and cerclages; A (pre-OP) & B (post-OP)

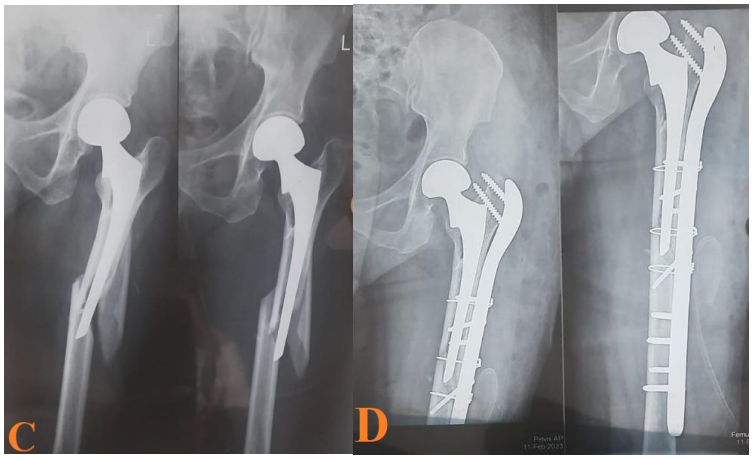

Figure 2: Pre-OP (C) and post-OP (D) x-ray of Vancouver B2 fracture treated successfully by ORIF with plating, cerclages and bone grafting

Discussion

PFF are complex orthopedic issues that carry significant morbidity and mortality. These fractures are more common in elderly people and the patient is usually female, as seen in our study. [7] Cause for greater risk of PFF in women are attributed to decreased bone strength compared to men, especially after menopause. This condition is more frequently seen in femurs with bipolar implants than in unipolar, although it has been impossible to specify if this finding was incidental or related with some unknown factor. [8] Most frequent among PFF are those of type B (Vancouver classification), representing 30-80% of the total. [9] In a series of McGraw et al., who analysed 15 patients with fractures on Austin-Moore type cementless prostheses, 13 (87%) were of type B2. [10] In contrast with our series, those researchers did not find any type C fractures. Mean time interval between hemiarthroplasty and PFF has been found 24-35 months, although those diagnosed during the first month were possibly unnoticed intraoperative fractures. [9] In our series, fractures occurred at an average interval of 18.2 months after index surgery.

Several risk factors have been associated with these fractures. We found osteoporosis as most common risk factor (45.4%) in this study. In such patients, various preventive strategies should be established, such as pharmacological treatment of osteoporosis or fall prevention. Beals and Tower noted osteoporotic fractures or osteopenia in 38% of their patients. [11] Loosening of the prosthesis is another well-known risk factor. We noticed aseptic loosening in 13.7% of cases. Most common cause of PFF in Lindahl study was prosthesis loosening which occurred in 70% of cases. [12] The majority of PFF are the result of low-energy falls from a seated or standing position. [7]

Treating a periprosthetic femoral fracture in a patient with a hemiarthroplasty is difficult and expensive, and requires precise therapeutic planning with respect to indication and method. Various factors determine the success of management of PFF, like general condition of the patient (often

fragile), any underlying infection and fracture type and implant stability, the surgeon's experience. For earlier mobilization and faster recovery, it is necessary to achieve and maintain fracture reduction, ensure implant stability and accelerate osseous healing. [13,14]

As described by various authors, type A fractures are usually treated with conservative measures. However, they could compromise implant stability with large fragments or significant periprosthetic osteolysis. Type B1 fractures are normally treated with open reduction and internal fixation using plates or cerclages. Types B2 and B3 are generally treated by replacing the prosthesis with another, cemented or not, combined with internal fixation or not. Finally, type C fractures are usually treated with hybrid plates with proximal unicortical screws and cables and distal bicortical; intramedullary devices are reserved for cases in which lesser surgical aggression is desired, attempting to overlay the stem and the nail to avoid stress zones between them. In all Vancouver classification fractures, structural cortical homografts could be used as additional stabilizing elements. [10,15,16] Patient condition, as well as functionality, consequently affects the therapeutic decision in that a procedure of greater morbidity can be rejected for another that might yield lower morbidity.[14] In our series, 14 of the 22 patients (63.6%) had elevated anaesthesia risk of ASA 3 or 4.

Many complications have been reported after surgical treatment of periprosthetic fractures. In hemiarthroplasty series, complications are expected to occur in 42% of the patients, with 3-25% infections, 1-8% haemorrhages and 1-8% assembly failures. [10] In the series of Phillips et al., there were 55% medical complications, 4.5% deep infections, 3% pseudoarthrosis cases, 1 luxation and 11% revision operations. [9] In our study, major or minor complications were seen in 13 patients (59.1%). The most frequent complications were superficial wound infection (3), urinary tract infection (3), refracture (2), chest infection (2), deep vein thrombosis and pulmonary embolism (2), and hip dislocation (1).

Postoperative functional recovery among the survivors is unpredictable. In the McGraw et al. series, 75% of patients had a significant reduction of mobility. Functional results are equally poor in more than half of the patients with B2 fractures treated with isolated internal fixation. [17] HHS was used to evaluate the functional outcome. In our study, HHS showed good to excellent result in 31.9 % patient and fair to poor result in 68.1 % patients at final assessment. The radiological results according to Beals and Tower's criteria in this study were excellent in 7 (31.9%) patients, good in 9 (40.9%), and poor in 6 (27.2%) which is comparable to the study by Jesus Moreta. Limitations of this study are: 1) It is a retrospective study, 2) Small number of cases with shorter duration of follow up, 3) Absence of control group for comparison.

Conclusions

Patients presenting with periprosthetic fractures are at high risk for complications associated with surgical treatment. The Vancouver classification is widely used to deal with these fractures and it has been emphasised that a proper assessment is important to avoid incorrect methods of treatment. Further, multicentric prospective randomised trials with larger number of patients and longer duration of follow up is required to precisely confirm the functional outcome after treatment.

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