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Functional outcome of displaced femoral neck fractures in young patients treated by dynamic hip screw with CC screws

Sujay Mahadik[1], Chandra Prakash Singh[2], Akshay Phule[3], Nikunjkumar Kheni[4], Shrikant Deshpande[5]

[1]Assistant Professor, [2,3,4]Junior Resident, [5]Professor, Department of Orthopaedics, Bharati Vidyapeeth (Deemed to be University) Medical College and Hospital, Sangli, Maharashtra, India

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ABSTRACT

Background: Although femoral neck fractures are common in elderly individuals, it is an uncommon occurrence in young patients. It is crucial to achieve anatomical reduction as well as stable fixation so as to avoid complications in young individuals who are expected to have considerable functional demand in post-surgical period. Dynamic hip screws are commonly used for internal fixation of these fractures. Although satisfactory functional outcomes have been reported in the patients treated by DHS, complications such as malunion and osteonecrosis remain an area of concern. **Aims and Objectives:** The aims of the study were to study the functional outcome of young patients with femoral neck fractures treated by DHS with CC screws and to study the complications in young patients with femoral neck fractures treated by DHS with CC screws. **Materials and Methods:** This was a prospective cohort study in which 80 young adults (below the age of 45 years) having femoral neck fractures and treated by DHS with 2CC screws were included in this study on the basis of a predefined inclusion and exclusion criteria. Gender and distribution, nature of injury, type of fracture, functional outcome, and complications were studied in studied cases. Open reduction and internal fixation was done using dynamic hip screw. The functional outcome was assessed using modified Harris hip score. All patients were assessed for complications such as non-union, malunion, and osteonecrosis. Statistical analysis was done using SSPS 21.0 software and $P<0.05$ was taken as statistically significant. **Results:** Out of 80 studied cases having femoral neck fractures, there were 54 (67.50%) males and 26 (32.50%) females with an M: F ratio of 1:0.48. The mean age of male and female patients was found to be 38.37 ± 4.62 and 38.80 ± 4.97 years, respectively. The most frequent cause of fracture was fall from height (48 cases) followed by road traffic accident (31 cases). Forty-six patients had complete fracture with partial displacement (Type III) and remaining 34 patients had complete fracture with total displacement (Type IV). Associated injuries were seen in 9 (11.25%) patients. Nine (11.25%) cases of avascular necrosis of femoral head were seen in our study. Surgery more than 48 h after injury and complete fracture with total displacement were associated with increased risk of avascular necrosis of femoral head ($P<0.05$). **Conclusion:** Femoral neck fractures in young patients treated by dynamic hip screws with CC screws have found to have excellent functional results in majority of cases. The complications such as osteonecrosis of femoral head can be minimized by decreased time duration between fracture and surgical intervention.

Key words: Femoral neck fracture; Dynamic hip screw; Functional outcome; Osteonecrosis

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INTRODUCTION

Femur neck fractures are one of the common causes for emergency orthopedics consultations. Elderly people are more prone for the development of femoral fractures due to various factors including presence of osteoporosis, impaired vision predisposing for falls, living in old homes, and presence of neurological diseases such as dementia and

Address for Correspondence:
Nikunjkumar Kheni, Junior Resident, Department of Orthopaedics, Bharati Vidyapeeth (Deemed to be University) Medical College and Hospital, Sangli, Maharashtra, India. **Mobile:** 9376761061. **E-mail:** nkheni358@gmail.com

Parkinson's disease.[1] Certain drugs such as corticosteroids, phenytoin, carbamazepine, and phenobarbitone taken over prolonged period of time may also cause femoral neck fractures following trivial trauma due to their osteoporosis inducing properties.[2] One of the important factors which have also contributed to increased incidence of femoral fractures is increased life expectancy of individuals. Advancing age is directly proportional to increased chances of femoral fractures following trivial trauma.[3] In many instances of older individuals with femoral fractures, hip replacement surgeries are undertaken as these elderly individuals are not expected to have high functional demands following surgeries.[4]

On the contrary, femoral neck fractures are uncommon in young individuals and usually occur secondary to high-velocity trauma.[5] Not only the mechanism of injury is different in cases of young individuals with femoral neck fractures but also the management strategy as well as management goals also differ as young patients are more likely to have high functional demand. It is for this purpose that more hip preserving surgeries such as proximal femoral nailing as well as dynamic hip screws are used in young individuals as compared to older individuals in whom surgeries such as hip hemiarthroplasty or total hip arthroplasty may be preferred.[6] Femoral neck fractures in young patients are commonly associated with complications such as osteonecrosis and malunion; therefore, it is of utmost importance to achieve anatomical reduction as well as stable fixation so as to avoid these complications in young individuals who are expected to have considerable functional demand in post-surgical period.[7]

The young individuals usually sustain femoral neck fractures as a result of high-velocity trauma, and in these cases, multiple fractures as well as associated injuries are a common occurrence, and hence, a thorough search for more sinister life-threatening injuries must be undertaken and must be treated accordingly. These patients usually present with a history of high-energy trauma such as fall from height or road traffic accidents followed by pain and loss of function of affected hip. On examination, the leg is typically externally rotated with restricted and painful movements. The diagnosis is usually confirmed by imaging such as X-ray anteroposterior and lateral views. Computerized tomography has a distinct advantage of 3D reconstruction and may help in accurately defining the fracture and associated injuries. Once the diagnosis is confirmed, the management is essentially surgical and may consist of procedures such as open reduction and internal fixation by proximal femoral nailing, dynamic hip screws, and screw plate fixation. In older individuals, surgeries such as hemiarthroplasty or total hip arthroplasty may be undertaken.[8]

Dynamic hip screws work on the principle of tension band which is associated with sliding of screws within barrel which is responsible for compression of fracture when weight-bearing ensues. Some studies have reported that dynamic hip screws are associated with increased risk of malunion as well as osteonecrosis of femoral head.[9] Further, addition of CC screws will reduce the toggling forces and achieve an additional compression at the fracture site and also reduce the rotational forces. We undertook this study to analyze functional outcome as well as complication in young patients having femoral neck fracture who were treated by dynamic hip screws.

Aims and objectives

The aims of the study were as follows:

1. To study the functional outcome of young patients with femoral neck fractures treated by DHS with CC screws.
2. To study the complications in young patients with femoral neck fractures treated by DHS with CC screws.

MATERIALS AND METHODS

This was a prospective cohort study conducted in the Department of Orthopedics Bharati Vidyapeeth (Deemed to be University) Medical College and Hospital, Sangli, India. The Institutional Ethical Committee approved the study and 80 young adults (below the age of 45 years) having femoral neck fractures and treated by DHS with CC screws were included in this study on the basis of a predefined inclusion and exclusion criteria. The duration of study was 2 years (from August 2019 to July 2021). A written informed consent was obtained from patients to be part of this study. The Institutional Ethical Committee approved study. Keeping power (1-Beta error) at 80% and confidence interval (1-alpha error) at 95%, the minimum sample size required was 60 patients; therefore, we included 80 (more than minimum required number of cases) patients in this study.

Demographic details of all the patients such as age, gender, occupation, socioeconomic status, as well as their area of residence were asked for and noted. History pertaining to mechanism of injury and exact duration from injury to consultation was noted. A thorough search to look for more sinister injuries which may endanger life of the patient was looked for. Vitals such as pulse rate, respiratory rate, and blood pressure were checked and noted down. All patients underwent X-ray both hips anteroposterior as well as cross-table lateral views.

The fractures were classified on the basis of Gardens classification of hip fractures into incomplete fractures (Type I), complete and undisplaced fractures (Type II), complete and partially displaced fractures (Type III), and complete fracture with total displacement (Type IV).[10] All patients underwent basic investigations such as complete blood count, renal function tests (blood urea and serum creatinine levels), hepatic function test (serum bilirubin, SGOT, and SGPT), blood group and Rh typing, bleeding time, clotting time, and prothrombin time. Intravenous antibiotics were given as per institutional protocol (first dose was given just before surgery and intravenous antibiotics were given till the 3rd post-operative day). Open reduction and internal fixation was done using dynamic hip screw. Patients were followed up at 3, 6, and 12 weeks and finally at 6 months postoperatively for functional outcome. The functional outcome was assessed using modified Harris hip score. All patients were assessed for complications such as non-union, malunion, and osteonecrosis. A final follow-up visit for diagnosis of osteonecrosis was done at 12 months.

Statistical analysis was done using SSPS 21.0 software and Pearson's Chi-square test was used for test of significance. P<0.05 was taken as statistically significant.

Inclusion criteria

The following criteria were included in the study:

1. All patients having femoral neck fracture partial or complete displacement and treated by dynamic hip screws with two CC screws.
2. Age equal to or less than 45 years of age.
3. Those who gave informed written consent to be part of study.

Exclusion criteria

The following criteria were excluded from the study:

1. Patients who refused consent.
2. Age <18 or above 45 years.
3. Patients having polytrauma and other life-threatening injuries requiring urgent ICU management.
4. Patients having conditions likely to affect functional assessment such as pre-existing arthritis, psoriatic arthropathy, and rheumatoid arthritis.

RESULTS

Out of 80 studied cases having femoral neck fractures, there were 54 (67.50 %) males and 26 (32.50%) females with an M: F ratio of 1:0.48. The analysis of age distribution of patients showed that maximum number of patients were between 41 and 45 years (47.50 %) followed by 36–40 years (30%) and 31–35 years (16.35%). Very few patients (6.25%) below 30 years were found to have femoral neck fractures. The mean age of male patients was found to be 38.37±4.62 years whereas mean age of female patients was 38.80±4.97 years. There was no significant difference in the mean age of male and female patients presenting with femoral neck fracture in our study (Table 1).

In this study, the most frequent cause of fracture was fall from height (48 cases) followed by road traffic accident (31 cases). There was one patient who had femoral neck fracture following direct assault (1.25%). Most of the patients had left-sided femoral fracture (63.75%) of the femur followed by right side (36.25%). There was no case with bilateral femoral neck fractures. The analysis of the cases on the basis of type of fractures showed that out of 80 studied cases, 46 (57.50%) patients had complete fracture with partial displacement (Type III) and remaining 34 (42.50 %) patients had complete fracture with total displacement (Type IV). Associated injuries were seen in 9 (11.25%) patients. The most common associated injury was rib fractures which were seen in 3 (3.75%) patients whereas humerus fracture and anterior cruciate ligament tear were seen in 2 (2.50%) patients each. Meniscal tear and tibial fracture were seen in 1 (1.25%) patient each. Forty-nine (61.25%) patients were operated within 48 h of injury whereas remaining 31 (38.75%) patients were operated after 48 h of injury. Mean duration of surgery was found to be 124±35 min (Table 2).

The analysis of the cases for complications showed that out of 80 cases operated and internal fixation done by dynamic hip screws, local surgical site infection was seen in 6 (7.50%) patients whereas varus reduction and shortening of affected limb were seen in 4 (5.00%) and 3 (3.75%) patients, respectively. Non-union was seen in 2 (2.25%) cases. Nine (11.25%) cases of avascular necrosis of femoral head were seen in our study (Table 3).

Out of these nine cases, there were 7 (77.78%) males and 2 (22.22 %) females. Out of nine patients with avascular necrosis of femoral head, 8 (88.89%) were

Table 1: Age distribution of the studied cases

Age in years	Gender distribution			
	Males		Females	
	No	%	No	%
<30 years	4	5.00	1	1.25
31–35 years	8	10.00	5	6.25
36–40 years	18	22.50	6	7.50
41–45 years	24	30.00	14	17.50
Total	54	67.50	26	32.50
Mean age (in years)	38.37±4.62		38.80±4.97	
P value	P= P = 0.7047 (not significant)			

Table 2: Mechanism of injury, affected side, type of fracture, and fracture to surgery time in cases

Characteristics	Type	Number of cases	Percentage
Mechanism of injury	Fall from height	48	60.00
	Road traffic accidents	31	38.75
	Assault	1	1.25
	Total	80	100
Affected side	Right	32	36.25
	Left	48	63.75
	Total	80	100
Type of fractures Garden's classification	Complete fracture with partial displacement (Type III)	46	57.50
	Complete fracture with total displacement (Type IV)	34	42.50
	Total	80	100
Associated injuries	Anterior cruciate ligament tear	2	2.50
	Rib fracture	3	3.75
	Humerus fracture	2	2.50
	Tibial fracture	1	1.25
	Meniscal tear	1	1.25
	Total	9	11.25
Fracture to surgery time	Within 48 h	49	61.25
	After 48 h	31	38.75
	Total	80	100.00
Mean duration of surgery	124±35 min		

Table 3: Complications in studied cases

Complications	Number of patients	Percentage
Local surgical site infection	6	7.50
Varus reduction	4	5.00
Shortening of affected limb	3	3.75
Non-union	2	2.25
Avascular necrosis of femoral head	9	11.25
Total	24	30.00

operated after 48 h of injury whereas only one (11.11%) patient was operated within 48 h of injury. All patients with avascular necrosis were complete fracture with total displacement (Type IV). Avascular necrosis of femoral head was more common in males as compared to females; however, there was no statistically significant difference (P=0.7104). Avascular necrosis of femoral head was more common in patients in whom surgery was done more than 48 h after injury as compared to those in whom surgery was done earlier than 48 h after injury and the difference was statistically significant (P=0.0018). All patients were avascular necrosis which had complete fracture with total displacement (Type IV) (Table 4).

Post-Operative X-Ray was taken (Figure 1). Patients were allowed partial weight-bearing and walking with support immediately after surgery. Full weight-bearing was allowed during follow-up on the basis of radiographs after the assessment of callus formation. Modified Harris hip score was used to asses functional outcome in studied cases. At the end of last follow-up, functional outcome was excellent to good in 47 (58.75 %) patients whereas fair and poor

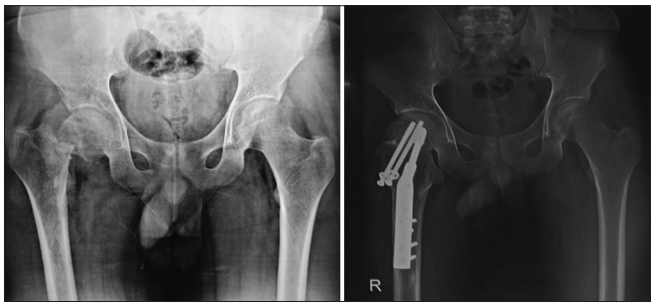

Figure 1: Femoral neck fracture with complete displacement (left), post-operative X-ray following fixation by dynamic hip screws with two CC screws (right)

outcome were seen in 23 (28.75 %) and 7 (8.75%) patients, respectively. Very poor outcome was seen in 3 (3.75%) patients (Figure 2).

DISCUSSION

Various treatment modalities are used for surgical management of femoral neck fractures that include dynamic hip screws, proximal femoral nailing, and hip replacement surgeries. While more radical surgeries such as hip hemiarthroplasty or total hip arthroplasty may be preferred in old age, in young patients, more conservative approaches are desirable. Dynamic hip screws are commonly used in young patients having femoral neck fractures. It works on the principal of tension band which permits the screw to slide within the barrel and enables compression of the fracture at the time of weight-bearing. It is particularly important in young patients where radical surgeries such as hip hemiarthroplasty or total hip

Table 4: Osteonecrosis and its correlation with gender, duration from injury to surgery, and type of fracture

	Complications	Number of patients	Percentage	P value
Gender of patients	Male	7	77.78	0.7104 Not significant
	Female	2	22.22	
Duration from injury to surgery	<48 h	1	11.11	0.0018 Significant
	More than 48 h	8	88.89	
Garden classification	Complete fracture with partial displacement (Type III)	0	0.00	0.0009 Significant
	Complete fracture with total displacement (Type IV)	9	100.00	

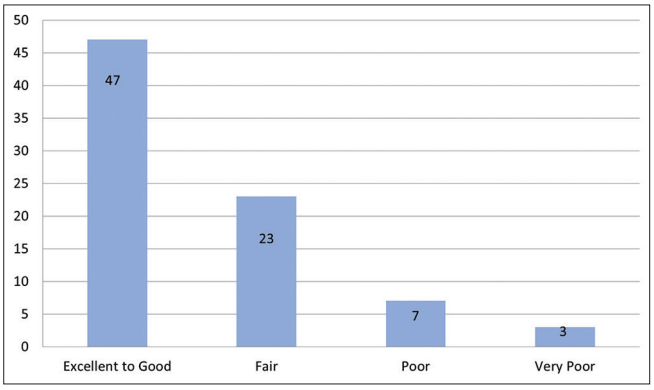

Figure 2: Functional outcome in studied cases

arthroplasty are usually avoided. We have used two dynamic hip screws for internal fixation. Although in majority of cases, a single screw is used for fixation, many authors such as Schwartsmann et al., have used and recommended more than 1 screws for internal fixation.[11]

In our study, out of 80 cases having femoral neck fractures, there were 54 (67.50 %) males and 26 (32.50%) females with an M: F ratio of 1:0.48. The male preponderance is understandable as in young patients, the cause of femoral neck fracture is usually fall from height or road traffic accidents. Manoj et al., conducted a study to analyze the functional and radiological outcome of femoral neck fractures treated by calcar buttressed screw fixation. In this study, out of 43 patients, there were 31 males and 12 females with an M: F ratio of 1:0.38.[12] Similar male preponderance was also reported by the authors such as Soeharno et al.,[13] and El Naggar et al.[14]

The mean age of male and female patients was found to be 38.37±4.62 and 38.80±4.97 years, respectively. In a retrospective study, Gumustas et al., studied young patients with femoral neck fractures.[15] The mean age in this study was found to be 40.04±9.63 years which was similar to our study.

In this study, the most frequent cause of fracture was fall from height (48 cases) followed by road traffic accident (31 cases). Unlike in older individuals, where trivial trauma can cause femoral neck fracture, the usual cause in young adults is usually high-energy trauma such as fall from height or road traffic accidents. The studies such as those done by Raj et al.,[16] and Pauyo et al.,[17] found that the common causes of femoral neck fracture in young adults were road traffic accidents and fall from heights. Unlike in young adults, the most common cause of femoral neck fractures in old patients is low-energy falls.[18]

In our study, 49 (61.25%) patients were operated within 48 h of injury whereas remaining 31 (38.75%) patients were operated after 48 h of injury. Avascular necrosis of femoral head was more common in patients who had been operated after 48 h of fracture ($P<0.05$). Moreover, patients with complete fracture with total displacement (Type IV) were found to have a significantly higher rate of AVN as compared to patients with complete fracture with partial displacement (Type III), mean duration of surgery was found to be 124±35 min. The time duration from fracture to surgery is an important factor in determining the outcome of patients having femoral neck fracture. Many studies have found that those patients who had been operated early were having better outcome and reduced complications such as avascular necrosis of femoral head as compared to those patients who had been operated late. Karaeminogullari et al., conducted a study of patients with femoral neck fractures in which 28 patients with 30 femoral neck fractures who underwent internal fixation and completed a minimum of 2 years' follow-up were retrospectively analyzed.[19] The rates of avascular necrosis as well as non-union were 12.5% and 25%, respectively, among patients who underwent surgery before 12 h had elapsed and 14% and 27% among those who underwent surgery after that time. The rates of avascular necrosis and non-union associated with fracture displacement were 6% and 18%, respectively, among patients with undisplaced (Garden Stages 1 and 2) fractures and 23% and 38% among those with displaced (Garden Stages 3 and 4) fractures. The increased incidence of AVN in patients with complete fracture with total displacement (Garden Stage 4) and in those cases in whom surgery was delayed were found to be similar to our study. However, the author such as Upadhyay et al., concluded that delay of

more than 48 h before surgery did not influence the rate of union or the development of AVN when compared with operation within 48 h of injury.[20]

Limitations of the study

We have studied only one method of managing displaced femoral neck fractures. A comparative study which compares other methods of managing displaced femoral neck fractures such as proximal femoral nailing and CC screw stand alone would have been further beneficial in comparing the complication rates, particularly osteonecrosis of femoral head.

CONCLUSION

Femoral neck fractures in young patients treated by dynamic hip screws and augmented with two CC screws have found to have excellent functional results in majority of cases. Increased time duration between fracture and surgical interventions as well as complete fracture with total displacement were the factors associated with increased risk of avascular necrosis.

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Authors Contribution:
SM- Concept and design of the study, interpreted the results, prepared first draft of manuscript, and critical revision of the manuscript; **CS-** Statistically analyzed and interpreted, reviewed the literature, and manuscript preparation; **AP and NK-** Design of the study, statistically analyzed and interpreted, preparation of manuscript, and revision of the manuscript; and **SD-** Concept and coordination of the overall study.

Work attributed to:
Department of Orthopedics, Bharati Vidyapeeth (Deemed to be University) Medical College and Hospital, Sangli, Maharashtra, India.

Orcid ID:
Sujay Mahadik - https://orcid.org/0000-0002-9184-0720
Chandra Prakash Singh - https://orcid.org/0000-0002-5969-8170
Akshay Phule - https://orcid.org/0000-0002-8154-8603
Nikunjkumar Kheni - https://orcid.org/0000-0001-6495-9139
Shrikant Deshpande - https://orcid.org/0000-0001-8304-1796

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