

The Frequency of Nonunion and Avascular Necrosis in Fracture Neck of Femur in Young Adults, Treated With Cannulated Screws

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ABSTRACT

Objectives:- The objective of the study was to document frequency of nonunion and avascular necrosis in fracture neck of femur (NOF) in the young adults, treated with cannulated screws. **Methodology:** It is a descriptive case series study, carried out at Department of Orthopaedic Surgery Sheikh Zayed Hospital (PGMI) Lahore. Forty patients were included in this study, reported within two weeks of injury. All patients with Garden type I, II, III & IV fractures neck of femur, aged from 18 to 55 years, from May 2012 to November 2012 were included with the consent to undergo osteosynthesis with cannulated screws.

Results: KOFU (Japan) hip scoring system was used to evaluate results. Total 34 fractures (85%) achieved radiological union on an average of 3 months. Out of these 34 patients, 11 patients were with Garden type I, 10 patients Garden type II, 8 patients with Garden type III and 5 patients with garden type IV fractures had union of fracture. Total 6 patients (15.0%) had complications. Out of these total 6 patients, 2 patients were Garden type III and 4 patients were Garden type IV. All these 6 patients (15%) had nonunion, and 2(5%) patients ended in avascular necrosis of head of femur also but in 4 patients head of femur remained viable. There was no case reported with implant loosening in our all treated cases.

Conclusion: With cannulated screw fixation all garden type I and II fractures achieved union and garden type III fractures have minimal frequency of nonunion and garden type IV fractures have variable frequency of nonunion. So cannulated screw fixation is best method of treatment in fracture neck of femur in young adults.

Key Words: Fracture neck of femur, young adults, Osteosynthesis, cannulated screws.

INTRODUCTION

Neck of femur is the commonest site of fracture related to high energy trauma in young adults¹.

Fracture neck of femur has a highest incidence in postmenopausal women and relatively uncommon in both children and young adults. In elderly patients, with already weakened bones, even minimal trauma may be sufficient to cause femoral neck fracture. Due to its precarious blood supply, chances of nonunion are high.^{2,3} So it is a medical, social and economic challenge for orthopedic surgeons as well as society.

Fracture neck of femur can be treated in a number of ways depending on physiologic age, activity level of patient and on degree of displacement of fracture³. The Garden classification is routinely used to describe displacement and stability of femoral neck fractures. Impacted and undisplaced fractures (Garden type I & II) are treated by internal fixation with cannulated/cancellous screw or a compression screw with a side plate. Displaced fractures (Garden types III & IV) are treated by closed /open reduction and internal fixation below age of 55 years. In patients with pre-existing hip lesions, total hip

replacement (THR) is offered⁴. In case of neglected fracture neck of femur in young adults (<55 years), bone grafting with internal fixation is a reliable method with good long term functional outcomes⁵. Urgent fracture reduction is necessary to decrease the risk of nonunion and the gold standard is internal fixation with cannulated screws⁶. In a previous study the frequency of nonunion after treatment with cannulated screw was non-union was 16% and avascular necrosis 10%⁴.

While managing fracture neck of femur in young adult patients with less than 55 years of age, it is important that head of femur should be preserved as well to achieve union and prevent avascular necrosis. There is minimal blood loss, less operative time and decreased chances of avascular necrosis compared with compression screw and side plate⁷. Two screws fixation appears to be adequate⁸.

The purpose of carrying out this study was to actually determine the frequency of nonunion and avascular necrosis which occurs with this mode of treatment being practiced everywhere. Moreover, literature shows variability in the results and so I wanted to re-assess it in our setup.

Now there are two school of thoughts. One is preserving head of femur, using Cannulated screws, or Dynamic hip Screw, Second group is sacrificing head of femur, preferring Partial or Total Hip replacement. The Garden and Pauwel's classifications both are routinely used to describe displacement and stability of femoral neck fractures. Osteonecrosis and nonunion remain problematic because of the compromised blood supply to the femoral head in displaced fractures. Anatomic reduction is the single most important step in the treatment and fixation of these difficult fractures.

Because of the higher complication rate in patients physiologically older than 55 years, a prosthetic replacement may be considered for the treatment of displaced fractures. In patients who are low-level community ambulators or nursing home ambulators with comorbidities and who are not expected to live more than 5 years after injury, a hemiprostheses is indicated.

In active, elderly patients physiologically older than 65 years who are expected to live longer

than 5 years after injury, a total hip replacement is the treatment of choice. An algorithm that considers physiologic age and activity level of the patient is helpful when deciding whether to fix or replace the hip in a patient with a displaced femoral neck fracture.

MATERIALS AND METHODS

This is a descriptive case series study, conducted at Department of Orthopedic Surgery, Sheikh Zayed Hospital Lahore, from May 2012 to November 2012 with the prior approval of study protocol from the ethical committee of the institutional review board.

Sample size of 40 cases was calculated with 95% confidence level. Sample collection technique was Non probability purposive sampling.

Inclusion Criteria

- All patients with fracture neck of femur between ages 18-55 years of either sex.
- All types of fractures according to Garden classification *i.e.* type I, II, III & IV fractures.
- Closed fractures, reported within two weeks of injury.

Exclusion Criteria

- Pathological fractures diagnosed on radiograph (anteroposterior and lateral views) *i.e.* tumor, osteoporosis etc.
- Open or infected fractures
- Patients with co-morbidity like diabetes and hypertension as on serial blood pressure and random blood sugar monitoring.

Patients were thoroughly assessed in the in-door for any associated injury. Preoperative roentgenograms were taken to assess the fracture geometry in two planes (Fig. 1A). The fractures were classified accordingly with Garden's classification of fracture neck of femur. Routine investigations were carried out. No attempt was made to assess the viability of the femoral head by bone scanning or MRI studies. Skin traction was applied.

Operative technique: All fractures were fixed

in supine position. Under spinal anaesthesia, fracture was manipulated and reduced anatomically under C-arm by closed method usually by Leadbetter method. Operating limb prepared with routine standard antiseptic method by painting and draping. A 2-3cm incision was given at a site determined under C-arm. Guide wires were passed with the control in anterior, posterior and inferiorly, in an inverted triangle fashion (Fig. 1B), through the shaft to the neck and head of femur. Cannulated drill bit of 3.2mm were used to drill over the wires and measured 6.5 mm partially threaded 32mm and 16 mm cannulated screws were used to fix the fracture in compression mode. There was difficulty faced while reducing few of these fractures by closed method, then open reduction and internal fixation was done and surgery was accomplished through the Watson-Jones approach. Only few fractures were fixed with open reduction and internal fixation. The previous small incision is extended over the lateral proximal femur.

Derotation boot with plaster of paris (POP) was applied to prevent rotation so that no torsional force could act at the fracture site. Procedure time was 30 minutes on an average. All patients were given second generation cephalosporins pre and postoperatively for three to five days.

Data Collection

All patients fulfilling the inclusion criteria were admitted through outpatient and emergency department of Shaikh Zayed Hospital Lahore. Each case was followed up for a period of six months to observe nonunion or avascular necrosis after fracture neck of femur.

Variables like age and gender were noted. Patient's telephonic contact and addresses were taken to ensure follow-up. Informed consent was taken before including the patient's data in research and before surgery.

Data Analysis

All the data were analyzed in SPSS version 11. Mean±standard deviation was calculated for quantitative variables like age. Frequency and percentages were calculated for categorical variables like sex and nonunion. Results were

stratified among age and sex to see the effect modification. All the results are presented in the form of tables.

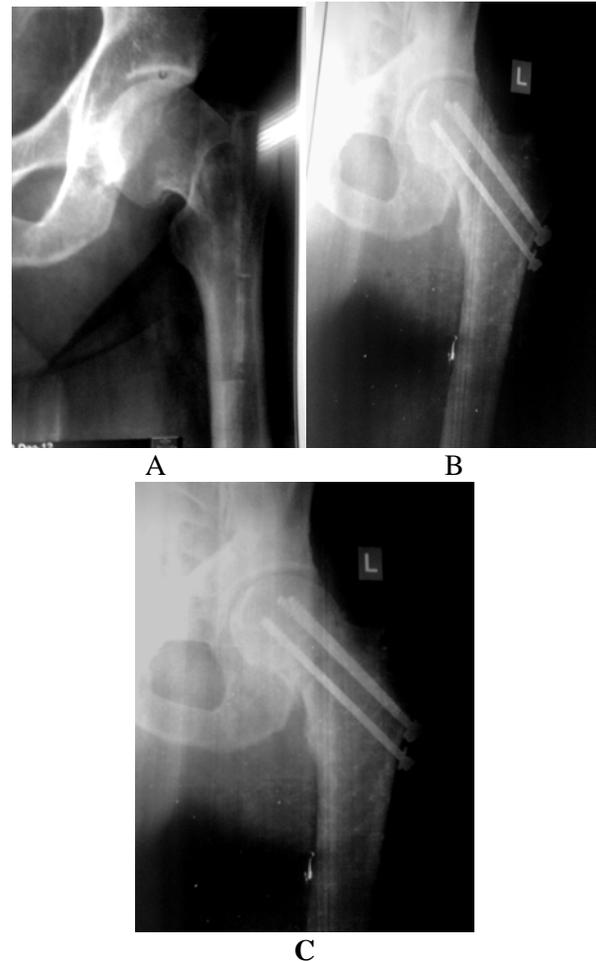


Fig. 1. A, AP radiograph of pelvis in a 28yrs old male shows displaced left femoral neck fracture; B, Postoperative AP hip radiographs after closed reduction and internal fixation with three cannulated screws; C, Lateral radiograph of the same patient at 3 months follow up.

Clinical and Radiological Follow-Up

After one week, sutures were removed, and rehabilitation programme began strengthening of the thigh muscles started and check x-rays were obtained (Fig. 1C). At six weeks, hip and knee range of motion was checked and derotation boot was removed. Partial weight bearing encouraged after six weeks which was increased gradually over

a couple of months to full weight bearing. Maximum follow-up was six months duration (Range 3 to 6 months).

RESULTS

The study included 40 cases of femoral neck fractures in young adults between 18–55 years of age. There were three main age groups *i.e.* 18–33 years having 18 patients and 34–48 years having 13 patients and >48 years having 9 patients. Majority of the patients (45.0%) in our study belonged to the age group 18–33 years, while rest 32.0% patients were between 34–48 years of age and 23% patients more than 48 years of age. Mean age of the patients was 35.47±12.51 years as shown in (Table 1).

Table 1: Age distribution of patients

Age (years)	No. of Patients	Percentage
18 – 33	18	45.0
34 – 48	12	30.0
>48	10	25.0
Total	40	100.0

Mean ± SD = 35.47±12.51

Table 2: Sex distribution of patients

Sex	No. of Patients	Percentage
Male	28	70.0
Female	12	30.0

Male to female ratio: 2.33:1

Table 3: Type of fracture according to garden classification

Garden type	No. of patients	Percentage
Type I	11	27.5%
Type II	10	25.0%
Type III	10	25.0%
Type IV	9	22.5%

There were 28 (70%) male and 12 (30%) female patients. Male to female ratio being 2.33:1 (Table 2). The type of fracture according to Garden classification was, 11(27.5%) fractures were type I, 10(25.0%) fractures were type II, 10(25.0%) fractures were type III and 9 (22.5%) fractures were

Garden type IV (Table 3).

Results were evaluated according to KOFU (Japan) hip scoring system. Total 34 fractures (85%) achieved radiological union on an average of 3 months. Out of these 34 patients, 11 patients were with Garden type I, 10 fractures Garden type II, 8 patients with Garden type III and 5 patients with garden type IV fractures had union of fracture. Total 6 patients (15.0%) had complications (Table 4). Out of these total 6 patients, 2 patients were Garden type III and 4 patients were Garden type IV. All these 6 patients (15%) had nonunion, and 2(5%) patients ended in avascular necrosis of head of femur along with nonunion but in 4 patients head of femur remained viable. There was no case reported with implant loosening in our all treated cases.

Table 4: Frequency of radiological union and complications of fractures

Radiological union	No.	%	P value
Union	34	85.0%	
Non-union	4	10.0%	
Complications			<0.001
Avascular necrosis + nonunion	2	5%	

Results in the form of percentage along with followup at four weeks interval is shown in Table 5.

Table 5: Percentage alongwith followup period in fortnightly.

	Follow up	Final Results	
		Frequency of union	Percent
Valid	4 week	6	14.3
	8 week	4	9.5
	12 week	8	19.0
	16 week	7	16.7
	20 week	6	14.3
	24 week	3	7.1
	Non-Union	4	9.3
	Avascular necrosis + nonunion	2	5.0
	Total	40	95.2
	Total	40	100.0

DISCUSSION

The fracture neck of femur is a common pathology addressed by the Orthopaedic Surgeons. The management of these fractures has a tremendous role in the patients care. To our surprise 85% (34) of the fracture united uneventfully and satisfactorily (with confidence of interval of 95%) (Table 4). Only 6 (15%) patients who needed hemiarthroplasty or THR, two patients were Garden type II and four patients were Garden type III fractures. In this study the frequency of non-union is 15% and avascular necrosis is 5%, which coincides with the rate documented in literature which is 10 to 30%. Early study by Garden confirmed that adequacy of reduction was directly related to osteonecrosis and late segmental collapse. In 4 of these 6 non-unions the head remained viable and hemiarthroplasty was performed despite having the option of valgus osteotomy and bone grafting and 2 fractures ended in avascular necrosis of head of femur along with nonunion and total hip replacement was performed. However the percentage of implant loosening in our study is 0.0%. The implant loosening is due to posterior comminution of the neck and inability to achieve anatomical reduction.

Fracture neck of femur continues to be a problem fracture from the point of view of its management¹⁴. Treatment of fracture neck of the femur has been changing from time to time. It has passed through stages of immobilization in POP, Internal fixation with Smith Peterson nail, nail plate, low angle nail before 1970. Now a day's popular fixation in adults is with cannulated or cancellous screws. Orthopaedic surgeons in developing countries like Pakistan had to treat patients from different economic strata from very rich to a very poor people. Majority of the patients have no health insurance. Government resources are limited and cannot at the most subsidize the treatment. The life style of the patients requiring them to squat or sit in Buddha position makes it desirable to preserve the patient's own hip joint. The range of movements at the hip required to adopt these postures are neither possible nor permissible in any artificial joint available at

present.

Quite often the patients report late for treatment may be after many weeks or even months when internal fixation alone has high failure rate. Under these circumstances internal fixation has to be combined with some type of bone graft or osteotomy. Good results have been reported with open reduction and muscles bone pedicle graft in addition to internal fixation.¹⁴ These grafts have improved the rate of union of fracture particularly if the treatment is delayed beyond 3 weeks or if closed reduction is not anatomical. The functional results after union are quite satisfactory.

Replacement arthroplasty (total hip arthroplasty, bipolar prosthesis and hemiarthroplasty) are very useful procedures and have to be carried out when it is not possible to achieve union of fracture or in old people who have to be put on their feet without loss of time. These procedures have to be offered to those who can afford and are capable of modifying their life style so that the artificial joint lasts for longer period. These have to be done extremely carefully and after due thought and consideration in young adults but should not be denied in those who need and want it.

McMurray's osteotomy, excision hip (Girdlestone) were very popular as salvage procedures before the advent of replacement arthroplasty. They are still useful in circumstances, living conditions and habits of people in developing countries. After these procedures patient can squat and may even be able to sit in cross legged position. Patient is able to walk without any aid though with some limp and remains free of pain for many years.

Complications of Femoral Neck Fractures

The two most challenging complications of femoral neck fractures in the young adult to deal with are femoral head avascular necrosis and nonunion. Avascular necrosis in a young patient is a devastating complication because of the limited options as compared to elderly patients with osteonecrosis of the femoral head. Osteonecrosis in the elderly is less likely to be symptomatic because of their lower functional demands and level of activity. Fortunately, total hip replacement is a good option and has consistent good results for the

elderly patient with symptomatic osteonecrosis. However, there is no good alternative treatment in the young patient with symptomatic osteonecrosis. Younger age and higher function demands make prosthetic replacement fraught with high complications and should be a last resort. Reconstructive options to preserve the hip include osteotomy to unload the segmental area of femoral head collapse, femoral head core decompression, free vascularized bone grafting, hemi-resurfacing of the femoral head and hip arthrodesis.¹⁰ However, the best method for treating this difficult complication of osteonecrosis is prevention. This entails doing everything possible under the surgeon's control to minimize further vascular injury to the femoral head. This includes prompt reduction, intracapsular decompression, anatomic reduction, stable fixation and close monitoring postoperatively for osteonecrosis.

Nonunion is another complication of femoral neck fractures which is difficult to deal with. The rate of nonunion is between 10 and 30%.¹¹ Fortunately, there are good surgical options available for this problem. The treatment that has consistent good results is valgus osteotomy.¹² The goal of treatment is to create an environment that allows for healing. This means converting the shear force to compressive forces at the fracture site. This is done by performing a valgus osteotomy. This results in changing the more vertical femoral fracture line to horizontal and thus allowing for compression.

RECENT ADVANCES

Recent advances in internal fixation have changed this pattern and promoted animated debate about the indications for and the methods of surgery. Any decision to operate on this fracture in young adults requires very careful analysis in terms of convenience, cost and complications.

CONCLUSION

With cannulated screw fixation all garden type I & II fractures achieved union. Garden type III fractures have minimal frequency of nonunion and

garden type IV fractures have variable frequency of nonunion. So cannulated screw fixation is best method of treatment in fracture neck of femur in young adults. Osteosynthesis with cannulated screws needs short hospital stay and operation time, no blood transfusion is required and relatively low cost of cannulated screws as compared to hemiarthroplasty or THR.

REFERENCES

1. Nayagam S., Injuries of hip & Femur. In Solomon I., Warwick D. Nayagam S., Apley's System of Orthopedics 7 Fractures 9th Edition, Hodder Arnold 2010; 847-53
2. Ly TV, Swinkowski MF. Treatment of Femoral neck fractures in young adults. Instr Course Lect 2009; 58:69-81.
3. LaVelle DG. Fracture and dislocations of hip. In: Canale ST (edi). Campbell's operative Orthopedics. 11th ed. Philadelphia: Mosby Elsevier 2008; 32371-308.
4. Nizami MA, Ahmed F, Shah MA, Khan TB. Fractures neck of femur treated with cannulated screws in middle aged patients. J Pak Orthop Assoc 2009; 21:45-51.
5. Roshan A, Ram S. The neglected femoral neck fracture in young adults : review of a challenge problem. Clin Med Res 2008; 6:33-9.
6. Xarchas KC, Staikos CD, Pelekas S, Vogiatzaki T, Kazakos KJ, Verettas DA. Are two screws enough for fixation of femoral neck Fractures? Open Orthop J 2007; 1:4-8.
7. Leighton RK. Fractures of the neck of femur. In: Bucholz RW, Heckman JD, Court-Brown CM (edi.). Rockwood and Green's fractures in adults. 6th ed. Philadelphia: Lippincott William & Wilkins 2006; 1753-92.
8. Walker E, Mukherjee DP, Ogden AL, Sadasivan KK, Albright JA. A biochemical study of simulated femoral neck fracture fixation by cannulated screws: effects of placement angle and number screws. Am J Orthop 2007; 36:6.
9. Malik AA, Kell P, Khan WS, Ihsan KM,

- Dunkow P. Surgical management of fractured neck of femur. *J Perioper Pract.* 2009; 19:100-4.
10. Gomez-Castresana F, Perez Caballer A, Ferrandez Portal L. A vascular necrosis of femoral head after femoral neck fracture. *Clin Orthop Relat Res.* 2002;399:87–109.
11. Upadhyay A, Jain P, Mishra P, Maini L, Gautum VK, Dhaon BK. Delayed internal fixation of fractures of the neck of the femur in young adults. *J Bone Joint Surg Br.* 2004; 86:1035–40.
12. Beris AE, Payatakes AH, Kostopoulos VK, Korompilias AV, Mavrodontidis AN, Vekris MD, et al. Non-union of femoral neck fractures with osteonecrosis of the femoral head: Treatment with combined free vascularized fibular grafting and subtrochanteric valgus osteotomy. *Orthop Clin North Am.* 2004;35:335–43.
13. Dickson JA. The unsolved fracture of protest against defeatism. *J Bone Joint Surg (Am).* 1953. 35: 805-822.
14. Mittal RL, Gupta RK, Singh B. Treatment of intracapsular fracture neck of femur by fixation with double cancellous screws and quadratus muscles pedicle graft. *J Bone Joint Dis.* 1996;12: 3-6
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