

Research Article

Cannulated cancellous screws fixation in intracapsular fracture neck femur: a study with an emphasis on result of osteosynthesis

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ABSTRACT

Background: Fracture neck of femur has always presented a great challenge to the orthopaedic surgeons. It is rightly called as “unsolved fracture” as far as treatment and results are concerned. Results generally depend upon time period elapsed from fracture to surgery, adequacy of reduction and fixation. Fixation with cannulated cancellous screw is usually adequate for femoral neck fractures. The aim of the study was to analyse the results of treatment of fracture neck of femur with cannulated cancellous screw fixation and to compare the results with others in the literature using the same modality.

Methods: 25 patients with intra capsular neck of femur fracture were followed for a period of two years post-surgery and their functional outcome was assessed based upon harris hip scoring system.

Results: According to harris hip scoring system, we had excellent results in 72% cases, good in 16% cases, fair in 8% and poor in 4%. One patient went into non-union and two developed avascular necrosis of femoral head.

Conclusions: Management of intracapsular fracture neck of femur with cannulated cancellous screw fixation is a very good method of treatment being a surgically easy procedure. Use of multiple cannulated cancellous screw have a compression effect at the fracture site. It also avoids re displacement and rotation.

Keywords: Intra capsular fracture neck of femur, Cannulated cancellous screw, Osteosynthesis, Osteonecrosis

INTRODUCTION

Since the recognition of the existence of intracapsular fracture neck femur by Ambrose Pare almost 400 years ago, the management of intracapsular neck femur fracture has undergone many changes.¹ The multitude of various implants designed and techniques available for its treatment themselves indicate the inadequacy of the various methods of treatment. No single method of treatment has been able to achieve 100% result.

In addition, even after the fracture gets united there is a risk of avascular necrosis and late segmental collapse

leading to poor functional result. This fracture hence, has been called "Unsolved fracture" by Dickson in 1953.²

With improved medical facilities and improving care there has been a significant increase in the life expectancy of the general population. With the increasing number of geriatric patients, the incidence of risk of the fracture is also increasing. The present study is undertaken keeping in mind the increasing trend of the fracture. This study is only a small step to solve the big problem with means and methods easily available to and by a very simple surgical procedure. The aim of the study was to analyse the results of treatment of fracture neck of femur with

cannulated cancellous screw fixation and to compare the results with others in the literature using the same modality.

METHODS

Prospective study was carried out at Integral Institute of Medical Sciences And Research, Lucknow from September 2013 to August 2015. A series of 25 patients was included in this study with intracapsular fractures of the neck femur.

Inclusion criteria

- Both male and female patients between ages of 20 to 90 years of age.
- All non pathological intracapsular femoral neck fractures.
- All Garden stage I to IV fractures

Exclusion criteria

- All patients below 20 yrs of age
- Pathological fractures
- All fractures more than 3 weeks duration

The fractures were classified using Garden's classification.³



Figure 1: 1. Guide wire with T handle, 2. Long tap, 3. Small tap, 4. Screw with washer, 5. T handle holding the screw, 6. Measuring scale, 7. Drill with drill bit.

Management after Admission

In all the patients an AP and lateral X-rays of the hip joint were taken to assess the fracture. After the admission fracture was preliminarily reduced and immobilized in Thomas' Splint.

The patients were investigated routinely for pre surgical profile. The anaesthesiologist and physician were consulted to determine the relative risk of anaesthesia. The anaesthesia generally used was epidural, spinal or general in the order of frequency. All the patients were explained about the procedure, the nature of complications expected therein, the period of follow up and the cooperation expected from them. Appropriate preoperative antibiotics were given.

The patients were operated as early as possible after getting the fitness for surgery from the physician and anaesthesiologist.

Operative procedure

Reduction technique

In the operation theatre the patient was given appropriate anaesthesia. Garden stage I and II fractures were fixed in situ after the patient was taken on the fracture table.

The Garden stage III and IV fractures were reduced with the patient supine on a fracture table. Traction was applied with hip in neutral flexion and rotation and in approximately 10° of abduction. The limb was rotated internally as far as possible with moderate force and was then allowed to roll back, leaving the hip in approximately 20° of internal rotation.

The reduction was confirmed with fluoroscopy, and if alignment was deemed satisfactory (even if there was some distraction of fracture fragments) the operation was performed.

The distraction at the fracture site was corrected during the operation by the lag effect of the parallel cannulated cancellous screws.

Reduction assessment

No more than two attempts were given. The goal of reduction was to obtain a position as close as possible to a garden alignment index of 160 / 180.^{3,4} The Garden Index is an expression of the angle of the compression trabeculae on the anteroposterior roentgenogram in relation to the longitudinal axis of the femoral shaft over the angle of the compression trabeculae on the lateral roentgenogram in relation to the femoral shaft (Figure 2). Garden believes that an alignment index after reduction within range of 155° to 180° on both the frontal and lateral views is an acceptable reduction resulting in a higher percentage of union and a low rate of late segmental collapse.^{4,5}

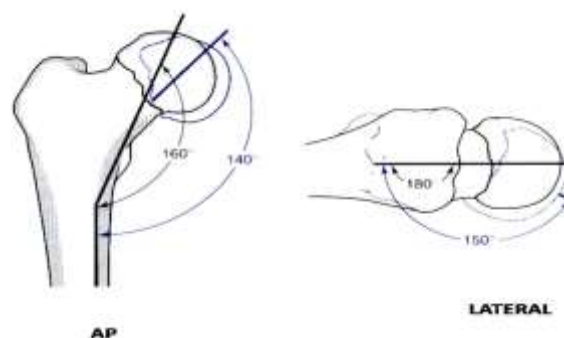


Figure 2: Garden alignment index in AP and lateral view.

Following points were considered before undergoing fixation

- A reduction was considered satisfactory when the medial part of the femoral neck and head were well supported by the medial cortex of the femoral neck either anatomically or with the cortex slightly medial to the neck.
- Slight valgus angulation was acceptable when the superior aspect of the femoral neck was impacted beneath the subchondral bone of the superior part of the femoral head, and this usually provides a very stable configuration.
- Varus angulation was not acceptable.
- On the lateral roentgenogram, alignment is again important; the posterior part of the femoral neck that is attached to the distal fragment should support the head-neck fragment.⁶

Post-operative protocol

The patient was given intravenous antibiotics till third postoperative day. Then the patient was shifted to oral antibiotics. Third generation cephalosporin's were generally used. The wound was inspected on second, fifth and eighth day. Sutures were removed on eleventh day.

Mobilisation

- In garden type I or II fractures the patient was mobilized in bed after the postoperative pain had decreased. As soon as the patient gained the ability to do straight leg raise and the active abduction, he was taken out of the bed; at about 8-10 days and non-weight bearing crutch walking was started. Check X-rays were taken and if the position was satisfactory then the partial weight bearing was started at about 10-15 days. Full weight bearing was started at about 3-5 weeks depending upon the progress.
- In garden type III and IV fractures, patient was immobilized for about 2-3 weeks. Then mobilization was started non weight bearing. After 4-5 weeks partial weight bearing was started, progressing to full weight bearing by 8-12 weeks depending upon the clinical and radiological progress.

After discharge from hospital patients were followed up on OPD basis four weekly for first 6 months and then 2 monthly till 1 year. Then patients were called six monthly till 2 years. At each follow up clinical evaluation was done and mobilization was assessed. AP and lateral X-rays of the hip were taken for radiological evaluation to know

- The occurrence of fracture union / non union.
- Rate of osteonecrosis.
- Other complications

The results were assessed using harris hip score.⁷

RESULTS

In our series 17 patients (68 %) were below 60 years of age with an average age of 50 years. (Table 1)

Table 1: Age distribution.

Age of the patient	No. of patients	Percentage
20-29	2	8%
30-39	6	24%
40-49	5	20%
50-59	4	16%
60-69	3	12%
70-79	3	12%
80-90	2	8%
Total	25	

Of 25 patients, 18 patients (72 %) were male and 7 patients (28 %) were female (Table 2).

Table 2: Male-female ratio.

Sex of the patient	No. of patients	Percentage
Male	18	72%
Female	7	28%
Total	25	

In our series out of 25 patients, 13 patients (52%) had fracture of neck femur on the right side and 12 patients (48%) had fracture on the left side (Table 3)

Table 3: Side of fracture.

Side of the fracture	No. of patients	Percentage
Right	13	52%
Left	12	48%
Total	25	

Four patients (16%) out of 25 patients in our series had associated injuries (Table 4).

Table 4: Associated injuries.

Assoc. injury	No. of patients	Percentage
Fracture L/E radius	1	4%
Fracture shaft femur and bil. tibia	1	4%
Fracture L/E femur and tibia	1	4%
Head injury	1	4%

In our series, 11 patients (44%) had undisplaced fractures i.e.: garden stage I and II, and 14 patients (56%) had displaced fractures i.e.: Garden stage III and IV (Table 5).

Table 5: Type of fracture (based on the Garden's staging).

Garden's Stage	No. of patients	Percentage
Stage I	4	16%
Stage II	7	28%
Stage III	11	44%
Stage IV	3	12%
Total	25	

Out of the 25 patients, 5 patients (20%) were operated on first or second day, 18 patients (72%) on 3rd or 4th day and only in case of 2 patients (8%) the delay for surgery since fracture was five days or more (Table 6).

Table 6: Interval between injury and surgery.

Interval	No. of patients	Percentage
1st and 2nd day	5	20%
3rd and 4th day	18	72%
5th day onwards	2	8%
Total	25	

Garden's alignment index was good in 23 patients (92%) at the time of fixation and two patients (8%) had a poor garden's alignment index (Table 8). After the assessment of patients with harris hip score, 22 patients (88%) had excellent or good results, and 3 patients (12%) had fair or poor results (Table 9).

In our series two patients (8%) had definitive evidence of osteonecrosis within 24 months of fracture (Table 10). In our case series, 22 patients (88%) were operated within four days of fracture and gave excellent to good results at final follow up while the remaining 3 patients (12 %) were operated after five days of fracture and had only fair to poor results

Table 11: Relation of interval between fracture and surgery with result.

Interval between fracture and surgery	Excellent	Good	Fair	Poor
1st and 2nd day	5	0	0	0
3rd and 4th day	13	4	1	0
5th and onwards	0	0	1	1
Total	18	4	2	1

DISCUSSION

Intracapsular fractures of the femoral neck can be treated with either immediate prosthetic replacement of the femoral head or internal fixation, however, prosthetic replacement is associated with a higher rate of morbidity and mortality than is internal fixation.^{8,9} Studies have shown that rate of dislocation is higher in replacement group.^{10,11} The most important objective in the treatment of displaced intracapsular fracture of the hip is to obtain

Table 7: Grade of osteoporosis-singh's index.

Grade of osteoporosis	No. of patients	Percentage
Grade I	0	0
Grade II	3	12%
Grade III	4	16%
Grade IV	10	40%
Grade V	6	24%
Grade VI	2	8%
Total	25	

Table 8: Reduction assessment.

Garden's alignment index	No. of patients	Percentage
Good	23	92%
Poor	2	8%
Total	25	

Table 9: Results (according to harris hip score).

Results	No. of patients	Percentage
Excellent	18	72%
Good	4	16%
Fair	2	8%
Poor	1	4%
Total	25	

Table 10: Complications.

Complications	No. of patients	Percentage
Non union	1	4%
Avascular necrosis	2	8%
Implant failure	0	0%
Superficial infection	1	4%

stable osseous support on the femoral neck. The fixation is used to increase stability by compressing the fracture and then maintaining the reduction by neutralizing forces acting on the hip.

Age and sex distribution

In our series 17 patients (68 %) were below 60 years of age with an average age of 50 years (Table 1). Of 25 patients, 18 patients (72 %) were male and 7 patients (28

%) were female (Table 2). Most of the patients in our series were young, and were involved in road traffic accident. The patients in older group developed fractures commonly after household trauma.

Asnis S E et al reported 79% female and 21% male patients in a series of 141 patients and 28% patients were below 60 years of age.¹²

Sankaran B. et al has reported peak occurrence of fracture neck femur in the age group above 40 years, both in men and women, except that in men there is a peak in the third decade as well, probably because of severe trauma.¹³ In his analysis of 784 cases of fracture neck of femur he found almost similar number of cases both in males and females except that in 60-70 years of age group, the incidence of fracture neck femur in females is 1.2 times more than in men. The percentage of fracture of the neck of femur above 40 years is 52% in males and 48% in females. These figures are very different from those of the developed countries, as the activities of daily living of women in developing countries like India are very different from those of the western world.

Side of the fracture

In our series out of 25 patients, 13 patients (52%) had fracture of neck femur on the right side and 12 patients (48%) had fracture on the left side (Table 3).

Asnis SE et al reported 47% fractures on right side and 53% fractures on left side in his series.¹² The findings are quite comparable.

Associated injuries

Majority of the patients with fracture neck femur did not have other associated injuries. Four patients (16%) out of 25 patients in our series had associated injuries (Table 4). One patient had fracture lower end radius on the same side. Another one patient had fracture shaft femur on the same side and fracture bilateral tibia. One patient had fracture lower end of the femur and fracture shaft tibia on the same side. One patient had mild head injury. Fixation was done at the same time for fracture neck femur and the associated fracture/fractures. Patient with head injury was treated conservatively. Mobilization was delay in patients with associated injuries. There is no mention of associated injuries in the literature.

Garden staging

In our series, 11 patients (44%) had undisplaced fractures i.e.: garden stage I and II, and 14 patients (56%) had displaced fractures i.e.: Garden stage III and IV (Table 5). We observed excellent or good result in all Garden stage I and II fractures. As expected garden stage III and IV fractures were associated with less satisfactory results and more complications. Two patients from this group

developed osteonecrosis and one patient developed non-union.

Asnis SE et al reported 35% undisplaced and 65% displaced fractures.¹² So we had slightly lower number of displaced fractures.

Interval between fracture and surgery

Out of the 25 patients, 5 patients (20%) were operated on first or second day, 18 patients (72%) on 3rd or 4th day and only in case of 2 patients (8%) the delay for surgery since fracture was five days or more (Table 6). Delay in case of two patients was due to the associated medical problems. One of the patients operated late developed osteonecrosis and other had good result.

Garden's alignment index

Garden's alignment index was good in 23 patients (92%) at the time of fixation and two patients (8%) had a poor garden's alignment index (Table 8). The reason of two patients having poor garden alignment index was comminution at fracture site making the fracture unstable in spite of best efforts. Both the patients developed osteonecrosis later on.

After the assessment of patients with harris hip score, 22 patients (88%) had excellent or good results, and 3 patients (12%) had fair or poor results (Table 9). The average harris hip score was 90. Maximum score was 100 and minimum was 60. Asnis SE et al determined harris hip score for forty-four of the fifty-five patients and it averaged 94 points with range from 58 to 100.¹² Patients with fair or poor results had displaced fractures i.e. garden stage III and IV. All the patients with undisplaced fractures i.e. garden stage I and II, had excellent or good results.

The timing of surgery after fracture is also an important determinant in the final result of surgery. In our case series, 22 patients (88%) were operated within four days of fracture and gave excellent to good results at final follow up while the remaining 3 patients (12 %) were operated after five days of fracture and had only fair to poor results (Table 11). Out of the three patients, surgery was delayed in 2 patients because of associated medical condition and one patient reported late to us after sustaining fracture.

Complications

Osteonecrosis

Osteonecrosis remains the main complication following internal fixation of intracapsular fractures. In many of the studies on intracapsular fractures, the rates of osteonecrosis were based on the assumption that if segmental collapse were to occur, it would be evident within two years. In our series two patients (8%) had

definitive evidence of osteonecrosis within 24 months of fracture (Table 10). Both these patients had displaced fractures i.e.: Garden stage III and IV. Thus out of 14 displaced fractures, we had 2 patients who developed osteonecrosis. Therefore the rate of osteonecrosis in displaced fractures was 14.2% in our series. Both the patients in our series with osteonecrosis were treated with bipolar hemiarthroplasty.

Asnis SE et al reported thirteen patients (11%) with evidence of osteonecrosis at the end of 2 years in his series of 141 patients. Out of this, 10 patients had displaced fractures.¹²

Skinner et al reported 10.2% rate of osteonecrosis in 107 patients treated with Dynamic Hip Screws.¹⁴ Hogg et al in 1982 reported 14.3% rate of osteonecrosis in 98 patients treated with AO screws.¹⁵

Non-union

There was one case (4 %) of non-union in our series (Table 10). Thus we had a 96% rate of union. The patient with non union was a young patient of 25 years and had garden stage III fracture. He was treated with McMurray's osteotomy. Fracture united after the osteotomy.

Asnis SE et al reported 5 patients (4%) of non-union in a series of 141 patients.¹² Skinner et al in 1986 reported 18.8% rate of non union in a series of 107 patients with displaced fractures treated with DHS.¹⁴ Hogg et al in reported 24.5% rate of non-union in 98 patients treated with AO screws.¹⁵

Baker et al reported 9.7% rate of non-union in 165 patients treated with multiple pins.¹⁶

Infection

Since this procedure is carried out through a small incision and is relatively atraumatic the chances of infection are minimal. In our series we had only 1 case of superficial infection. The infection cleared off with debridement and antibiotics. There was no case of deep sepsis in our series.

Wood et al in 1991 reported 0% rate of deep sepsis in 84 patients treated with ASNIS guided system.¹⁷

Fixation in osteoporotic bone

When the screws are tighten, occasionally the inferior screw will spin in the osteoporotic patient. This is because the bone in the inferior head is the weakest. The remaining screws in the mid and upper portions of the head will achieve excellent hold of the femoral head. The lower screw will still prevent inferior motion of the head fragment as the screw rest on the endosteum of the femoral neck. Thus cannulated cancellous screws provide

stable fixation even in osteoporotic bones as well. We had significant percentage (28%) of cases who demonstrated osteoporosis (Table 7). Out of these eight patients, mild screw back out was seen in only two patients. The fracture united with some collapse at fracture site.

Screw configuration

The triangle pattern of screws fixation adapts well to the different forces applied to the hip in different body positions. When the patient is standing the inferior screw is on the side of the compression, resting on the medial part of the femoral neck, while the superior screw holds the side of the tension. When the patient is sitting the posterior screw rests on the side of the compression while the anterior screw holds the side of the tension.

With cannulated cancellous screws compression can be achieved at the fracture site by gently tightening the screws. Placement of two or three cannulated cancellous screws peripherally around the femoral neck to compress the fracture is atraumatic and also provides excellent rotatory stability. The parallel configuration of the cannulated cancellous Screws and the smooth shaft allows controlled collapse to occur at the fracture site on ambulation. This maintains bone to bone support and prevents posterior and varus migration of the femoral head.

Number of screws

Cannulated cancellous screws are thick in diameter. Diameter of the neck of the femur and the width of the lateral cortex is relatively smaller in Indian patients. Therefore it is not always possible to fix femoral neck fractures with three cannulated cancellous screws. So we had to use only two screws for fixation in some cases. In five patients we could use only two cannulated cancellous screws for fixation. In only one case we could use the quadrangular pattern of screw fixation (four screw fixation). Springer et al suggested that the fourth screw adds little in additional fixation.¹⁸

The fracture of the femoral neck is associated with injury to the blood supply of the femoral head.¹⁹ It is believed that revascularization of the femoral head occurs after internal fixation.²⁰ We believe that most patients maintain independent functional mobility even though large area of the femoral head may remain partially avascular, without associated segmental collapse or clinical signs of avascular necrosis. The present study suggests that intracapsular fractures of the femoral neck are best treated with internal fixation with cannulated cancellous screws. Fixation with multiple cannulated cancellous screws is associated with low operative mortality and morbidity and a very high rate of union. Osteonecrosis remains the major operative complication after the fixation of an intracapsular fracture of the hip and it continues to present itself even years after fracture

healing. In those patients whose fractures have healed without osteonecrosis maintain excellent function long after the injury.



Figure 3: A) Pre surgical AP view showing fracture neck of femur. FIGURE 2B:6 months follow up x-ray. C, D) 2 years follow up x-ray in AP and lateral view showing complete healing of fracture.



Figure 4: A) Flexion at operated hip joint, B) Patient able to squat completely. C) Patient able to do straight leg raise.

CONCLUSION

This method of management of intracapsular fracture of neck femur with cannulated cancellous screw fixation is a very good method of treatment. There are several reasons for use of cannulated cancellous screw.

- Easy surgical procedure.
- Smaller diameter guide pins can be used to determine the screw position and length accurately.
- Cannulated cancellous screw system improves accuracy of screw placement.
- Parallel screws allow excellent compression to occur atraumatically by the lag effect of the screws.
- In this series cannulated cancellous screw fixation represents a procedure with low operative mortality and morbidity and very high rate of fracture union (96%)
- Osteonecrosis remains to be the major surgical complication following internal fixation of intracapsular hip fracture. It continues to present years after fracture healing. Segmental collapse can be treated with well-planned total hip arthroplasty.
- Function long after the injury.

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