

ORIGINAL RESEARCH

Functional Outcome of Fracture Neck Femur Fixed with 3 Cannulated Screws in Inverted Triangle Pattern

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ABSTRACT

Background: Intra-capsular femoral neck fractures account for about 50% of all hip fractures. The fracture of femoral neck have always been great challenge to orthopedic surgeons and still remain an unsolved fracture as far as treatment and results are concerned due to its complexity in anatomy & bio-mechanical circumstances. With the recent advances in the treatment, outcome of these fractures have remarkably changed.

Materials and Methods: This prospective randomized observational study was conducted on 30 patients with fracture neck of femur, fixed with 3 cannulated screws in inverted triangle pattern with aim and objective to assess the effectiveness of fixation in a skeletally mature patients to restore healing of fracture and to evaluate the functional outcome as well as complications if any, of the fracture fixation.

Results: Most of the fractures were displaced (Garden type 3 - 73.33%). Average time between injury and surgery was 45.77 hours with average duration of each surgery was 60 min and mean blood loss was 94.30 ml. According to Harris Hip Score, results were excellent in 20 (66.67%) patients, good was in 3 (10%) of cases, fair in 2 (6.67%) cases and poor outcome was observed in 5 (16.67%) patients. In present study, 83.33% cases had shown good outcome, while 10% of the cases developed avascular necrosis and 2 (6.67%) cases went into non-union and shortening was seen in 40% of patients.

Conclusion: We recommend cannulated screw fixation of fracture neck of femur with inverted triangle configuration is a viable treatment option in terms of operation time as well as hospital stay, less expensive as well as very effective treatment option especially in young patients with lower implant failure rate and speedy union with better functional results.

Keywords: Intracapsular, Cannulated, Inverted pattern

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INTRODUCTION

The fracture of femoral neck have always been great challenge to orthopedic surgeons and still remain an unsolved fracture as far as treatment and results are concerned. With the recent advances in the treatment, outcome of these fractures have remarkably changed and it looks as if the orthopedic surgeons have solved the puzzle and have planned definite treatment outline but, still the results are not comparable to other fractures due to its complexity in anatomy & bio-mechanical circumstances.

Intra-capsular femoral neck fractures account for about 50% of all hip fractures. The lifetime risk of sustaining a hip fracture is high and lies within the range of 40% to 50% in women and 13% to 22% in men.^[1] Since disruption of blood supply to the femoral head is dependent on the type of fracture and causes significant morbidity, diagnosis and classification of these fractures is important.^[2]

The more commonly used classification systems are- Garden classification, Pauwel's classification and Anatomical classification.

Garden Classification,^[3](based on AP radiographs)	
Type I	Incomplete, ie. valgus impacted
Type II	Complete fx. Nondisplaced
Type III	Complete, partially displaced
Type IV	Complete, fully displaced
Pauwels Classification,^[4](based on vertical orientation of fracture line)	
Type I	< 30 deg from horizontal
Type II	30 to 50 deg from horizontal
Type III	> 50 deg from horizontal(most unstable with highest risk of nonunion and AVN)

Anatomical classification:

1. **Subcapital:** femoral head/neck junction
2. **Transcervical:** midportion of femoral neck
3. **Basicervical:** base of femoral neck

AO/OTA Classification: This comprehensive classification of femoral neck is designated as 31B. The B1 group describes undisplaced, B2 group contains trans-cervical fractures, and the B3 group describes displaced sub-capital fractures.

The usual cause is a simple fall with an applied force being transmitted to the femoral neck via the greater trochanter, resulting in the fracture.^[5] Femoral neck is a well-recognized site for stress fractures, and these occur as a result of repetitive cyclical loading, which eventually exceeds the strength of normal bone.^[6,7] These fractures occur more commonly in older patients, mainly in postmenopausal women having risk factors. It is more common in females than males. In porous bone magnitude of load needed to cause a femoral neck fracture was reduced less than 10%.^[8,9] These are uncommon under the age of 60 years, but due to increased industrial and RSA incidents, its incidence is increasing in young patients. Mechanically human bone is an anisotropic material, meaning that the intrinsic stiffness (Young's modulus) varies with direction. Human bone being viscoelastic material during loading and function as a shock absorber.^[10,11] Humans show great variation in femoral anthropometry.^[12] These adaptations result in bone strains within the physiologic range.^[13] The hip joint resultant force (JRF) depends on the amount of weight-bearing and is mainly determined by bodyweight (BW) and muscular forces.

Single leg stance:

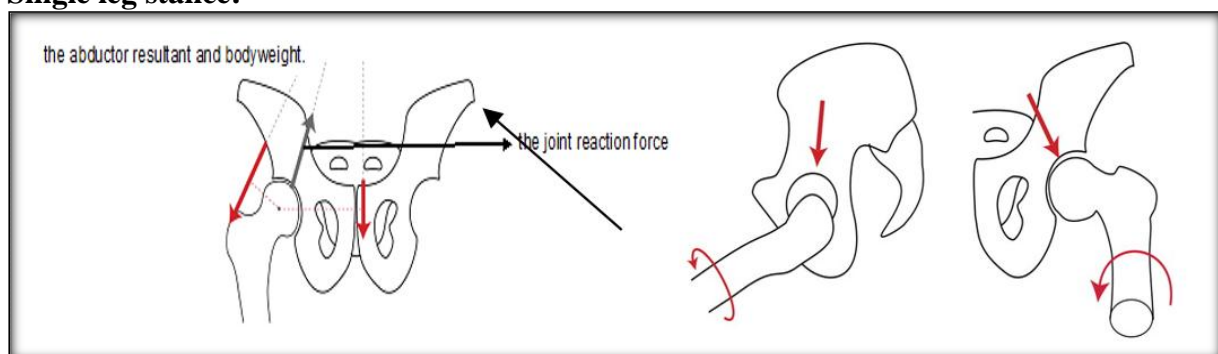


Figure 1: showing mechanism of injury

Anterior loading of the femoral head lead to an internally directed torque.

Absolute stability over the fracture leads to direct fracture healing with osteonal bridging which leads to endochondral woven bone formation preceding organized, and remodeled bone. Consequently, a fractured neck of femur must heal endosteally without the support of an external callus, which put great demand on the osteosynthesis to provide lasting stability.

It is advocated that fracture reduction and fixation should be performed as a surgical emergency to prevent complications such as non-union and avascular. Revision surgery or conversion surgery to hip replacement is reported to be between 20-36%.^[14] Surgical options for treatment of femoral neck fractures include prosthetic replacement and fixation of the proximal fragment. Rather than going for replacement, in our study, we tried to save the femoral neck with the multiple cannulated screws.

Aims and Objectives:

To assess the effectiveness of fixation of fracture neck femur by 3 cannulated screws in inverted triangle configuration in a skeletally mature patients to restore healing of fracture and to evaluate the functional outcome as well as complications if any, of the fracture fixation.

MATERIALS & METHODS

This prospective randomized observational study was conducted on patients with fracture neck of femur, admitted in the department of Orthopaedics, Government Medical College/ Rajindra Hospital, Patiala, fixed with 3 cannulated screws in inverted triangle pattern.

Inclusion Criteria:

- Fracture neck of femur in skeletally mature patients (15-60 years).
- Patient ambulatory before this fracture.
- Garden type 1, 2 and 3 fracture.
- Duration of fracture < 2 weeks.

Exclusion Criteria:

- Associated secondary degenerative conditions, i.e. osteoarthritis.
- Pathological fractures, open fractures and patients with known disorders of bone metabolism except osteoporosis (i.e., Paget's disease, renal osteodystrophy, osteomalacia);
- Associated infectious conditions of bone.
- Duration of fracture > 2 weeks.
- Garden type 4 fractures.
- Patients with skeletal immaturity.
- Patients who refused to give consent for surgery.

Pre-operatively antero-posterior view of pelvis with both hips, (in 15 degrees internal rotation) is taken along with lateral and other required views.

Surgical technique: Patient put in supine position on the fracture table. Anatomical reduction of fracture was done under fluoroscopy by closed method. Stability at site of fracture is maximized by placement of 3 screws in an inverted triangular configuration consisting of 1 inferior screw and 2 more superior screws, first inferior screw followed by posterior and anterior screws. Under fluoroscopy guidance, guide wire drilled into respective planned screw positions.

Inferior Screw: it is inserted first, and was placed midway between anterior and posterior cortices (as seen on lateral view) was placed as inferiorly as possible along the calcar, so that when the patient is upright, the inferior screw resists compression;

Two Superior Screws: Keeping inferior guide wire in place, and under image intensifier; posterior screw was inserted as far peripherally as possible in the lateral plane and centrally in the AP plane. Then the anterior screw was inserted, anteriorly in the lateral plane and centrally in the AP plane. The superior screws resist tension when the patient is upright and when sitting anterior screw resists tension, whereas the more posterior screw resists compression. Screws were tightened simultaneously, to apply uniform compression across fracture and to avoid tipping of femoral head into varus angulation. The surgical wound was then closed in layers and ASD was done.

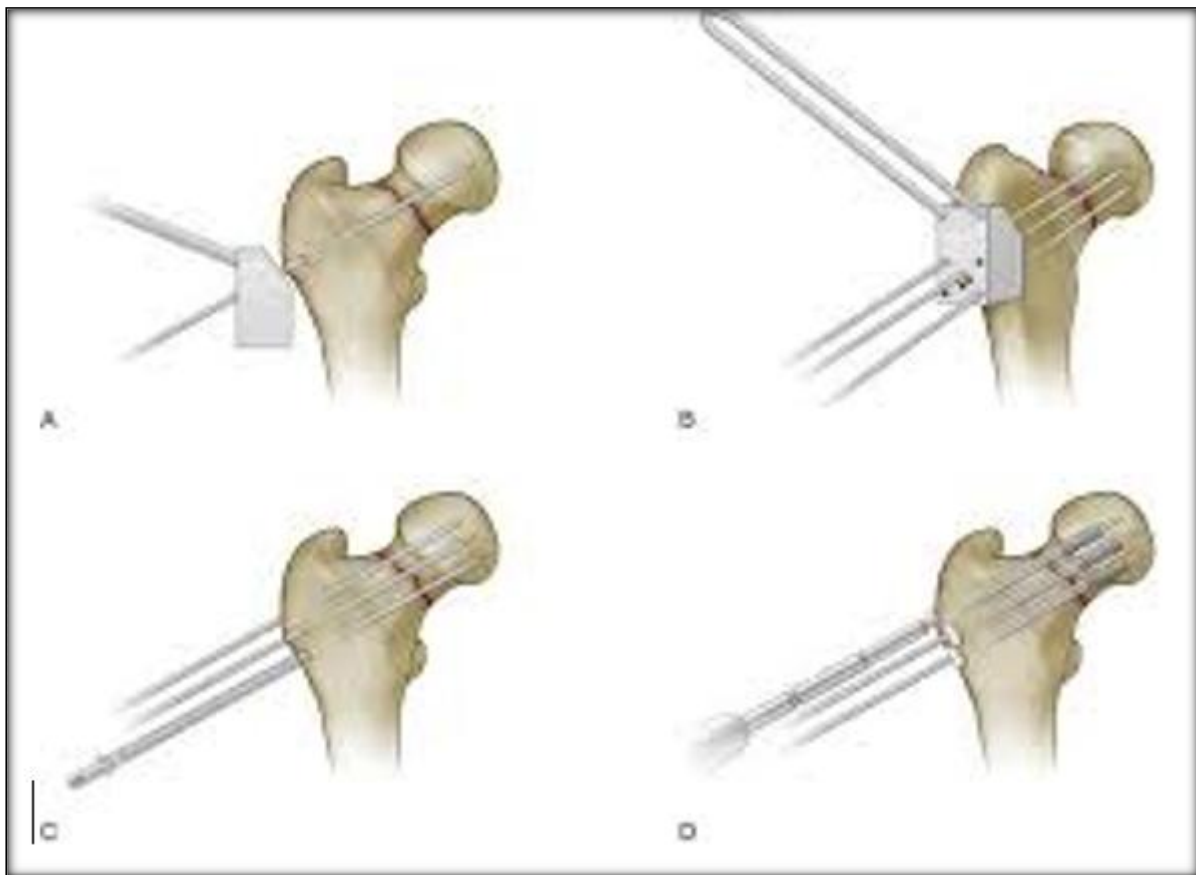


Figure 2: showing technique of inserting cannulated screws

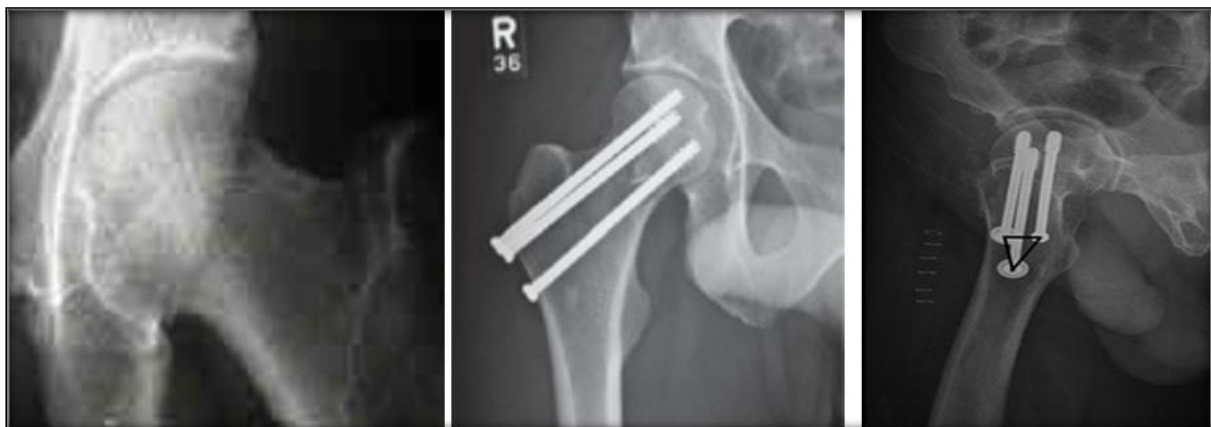


Figure 3: showing post-operative X-rays after technique

Postoperative: Post operatively, physiotherapy was started with toe touch walking. Regular follow up was done by clinical and radiological examination monthly for 3 months, then at 6th, 9th month respectively. Functional outcome was assessed using Harris Hip Score and Avascular necrosis of femur head was diagnosed according to criteria determined by Ficat and Arletscore.^[11,12]

RESULTS

During our study we have made following observations.

Table 1: showing age distribution

AGE (in years)	No. of patients	Percentage (%)
15-20	2	6.67
21-25	4	13.33
26-30	7	23.33
31-35	3	10
36-40	3	10
41-45	3	10
46-50	2	6.67
51-55	5	16.67
56-60	1	3.33
Total	30	100

In our study, neck femur fractures were more common in age group 26-30 years, (23.33%), and age group of 51-55 years, comprises of 5 (16.67%) out of total fractures. The mean age was 37.13 years and these were more common in males than females, comprising of 23 (76.77) of total 30 fractures. In our study, right side was involved more in fracture comprising of 16 (53.33%) of total fractures.

In our study, road traffic accidents were the more common mode of injury than fall, comprising of 23 (76.77%) of total fractures. Most of these fractures were result of high energy trauma and involving more number of young males. In our study, most of the fractures were Garden type 3 fractures (displaced), comprising of 22 (73.33%) of total fractures. Type 2 fractures were 6 in number (20%). type 1 fractures were 2 in number (6.67%).

Table 2: showing time duration between injury and surgery

Duration between injury and surgery (Hours)	No. of patients	Percentage (%)
Upto 6	3	10
7-12	9	30
13-24	8	26.67
25-168	10	33.33
169-336	0	0
Total	30	100

In our study, most of the cases 20 (66.67%) were operated within first 24 hours and about 10 cases operated between 25-168 hours. (1 day- 1 week). The average time duration between injury and surgery was 45.77 hours. In our study, 9 (30%) patients had hypertension, 4 (13.33%) had diabetes mellitus. Alcoholism and smoking each were present in 4 (13.33) patients.

Table 3: Showing duration of surgery

Duration Of Surgery (in min)	No. of patients	Percentage (%)
40-50	3	10
51-60	16	53.33
61-70	11	36.67
Total	30	100

In our study, maximum 16 (53.33%) cases were operated within 51-60 min and 3 (10%) cases were operated within 40-50 min. However 11 (36.67%) cases were operated within 61-70 min. The mean time for each surgery was 60 min. The average blood loss during surgery was 94.30 ml. The average period of stay in hospital was 10.10 days.

In our study, partial weight bearing was started at 8 weeks in 10 (33.33%) of patients, at 9 weeks in 7 (23.33%) of patients, at 10 weeks in 11(36.67%) patients and in 1 patient each (3.33%) at 12 and 14 weeks. The mean time period of partial weight bearing was 9.30 weeks.

Table 4: Showing full weight bearing

Full Weight Bearing Started At (weeks)	No. of patients	Percentage (%)
12	8	26.67
13	7	23.33
14	8	26.67
15	5	16.67
16	1	3.33
18	1	3.33
Total	30	100

Full weight bearing was started at 12 weeks in 8 (26.67%) patients, at 13 weeks in 7(23.33%) patients, at 14 weeks in 8 (26.67%) patients and at 15 weeks in 5 (16.67%) patients. In 1 (3.33%) patient each, weight bearing was started at 16 and 18 weeks. The mean time period of full weight bearing was 13.33 weeks.

Table 5: showing radiological union

Evidence Of Radiological Union Seen At (Weeks)	No. of patients	Percentage (%)
12	9	30
13	6	20
14	8	26.67
15	5	16.67
Total	28	93.33%

In our study, evidence of radiological union on x-rays was seen at 12 weeks in 9 (30%) patients, at 13 weeks in 6 (20%) patients, at 14 weeks in 8 (26.67%) patients, at 15 weeks in 5 (16.67%) patients. 2 (6.67%) cases went into non-union. The mean time period of radiological evidence of union was 13.32 weeks.

Table 6: showing Harris hip score

Harris Hip Score (at 9 months)	No. of patients	Percentage (%)
Excellent (90-100)	20	66.67
Good (80-89)	3	10
Fair (70-79)	2	6.67
Poor (<70)	5	16.67

Total	30	100
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In our study, Harris hip Score was excellent in 20 (66.67%) patients, good in 3 (10%) patients, fair in 2 (6.67%) patients and poor outcome was observed in 5 (16.67%) patients. The average score for each patient was 86.47 with a standard deviation of 4.95.

Table 7: showing complications

Complications	No. of patients	Percentage (%)
AVN	3	10
Non-union	2	6.67
Shortening	10	33.33
Infection	0	0
Failure	0	0

In our study total 10 (33.33%) patients had complications. 3 (10%) patients had AVN, 2 (6.67%) patients developed non-union and 10 (33.33%) patients had varied amount of shortening with mean shortening of 2.67 mm. None of the cases went into failure and no patient developed wound infection.

PRE AND POST PHOTOS



DISCUSSION

The mean age of fracture neck femur was 37.13 years in this study. Similar observations were found in the study by Nirmal Chandra Mohapatra et al,^[13] in which mean age was 36 years and Asgharemi et al had shown as 34.30 years.^[14] Deqing Luo et al,^[15] had shown mean was 37.2 years. In the current study, Incidence of these fractures was more in males. Similar observations were recorded in a study done by Schwartzmann et al and Robinson CM et al.^[16,17]

In the present study, Right side (52.47%) was found to be involved more than the Left side (47.67%). In the present study RSA was the more common (76.77%) mode of injury than fall (23.33%) which were comparable to Wang Hai-qiang et al Majority of the fractures were Garden type 3 (displaced) (73.33%), which were comparable to a study by CCH Khoo.^[18,19]

In the present study, the average time duration between injury and surgery was 45.77 hours. Similar results were observed by Asgharemi et al,^[14] In the present study, the mean duration of surgery was 60 min. and mean blood loss per surgery 94.32 ml, which were comparable to a study done by Lin Di et al,^[20] Mean duration of hospital stay in our study was 10.10 days. Similar findings were observed by C.R. Schwartzmann.^[21]

In our study, the partial weight bearing was started at a mean of 9.30 weeks and full weight bearing was started at mean of 13.33 weeks. Similar findings were observed by Cong Liu et al,^[22] and Patrick WendpouiréHamedDakouré et al.^[23]

In our study, mean time for radiological evidence of union was 13.33 weeks and similar results were obtained by Khizar H. Rai et al,^[24] In our study, mean Harris Hip Score was 86.47 with a standard deviation of 4.95 which was comparable to Cong Liu et al.^[22]

In our study the incidence of AVN and Non-union was 10% and 6.67% respectively. These findings were comparable to a study by Higgins GA.^[25] These patients had either Gardens and Pauwel's type 3 fracture or delayed presentation with comorbidities. None of these patients went into failure and no patient developed wound infection. Replacement Arthroplasty (non-cemented) was done in both patients with non-union. AVN patients were treated by vascularized fibular graft and one patient was treated by hemiarthroplasty.

In our study, 10 (33.33%) patients had varied average shortening of 8.90mm and 9 (30%) patients had shortening between 5-10 mm and one (3.33%) patient had shortening of 12 mm. Similar findings were observed by Zlowodzki M et al.^[26]

CONCLUSION

We recommend cannulated screw fixation with inverted triangle configuration is a viable treatment option for fixation of fractures neck femur that is less invasive in terms of operation time as well as hospital stay, less expensive as compared to Hemiarthroplasty or THR and very effective treatment option especially in young patients with lower implant failure rate and speedy union with better functional results. However, adequate reduction, stability and screw placement are the prerequisite for successful outcome.

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