



## “ROLE OF CEPHALOMEDULLARY NAILING IN IPSILATERAL NECK AND SHAFT OF FEMUR FRACTURE IN ADULTS – A PROSPECTIVE STUDY”

### Orthopaedics

**Dr T H Prakashappa** Professor, Department of orthopaedics, Sanjay Gandhi Institute of Trauma and Orthopaedics, Byrasandra, Jayanagar, Bengaluru, Karnataka, India.

**Dr Likith Harson Fernandis\*** Junior Resident, Department of orthopaedics, Sanjay Gandhi Institute of Trauma and Orthopaedics, Byrasandra, Jayanagar, Bengaluru, Karnataka, India. \*Corresponding Author

**Dr Durgaprasad H Devihosur** Junior Resident, Department of orthopaedics, Sanjay Gandhi Institute of Trauma and Orthopaedics, Byrasandra, Jayanagar, Bengaluru, Karnataka, India.

**Dr Manjunatha Swamy S H** Junior Resident, Department of orthopaedics, Sanjay Gandhi Institute of Trauma and Orthopaedics, Byrasandra, Jayanagar, Bengaluru, Karnataka, India.

### ABSTRACT

**Aim:** To analyse the functional outcome of cephalomedullary nailing clinically, radiologically and complications in the treatment of ipsilateral fractures of neck and shaft of femur in adults. **Methodology:** Our study consists of 20 cases of ipsilateral neck and shaft of femur fracture of adults treated with cephalomedullary nailing at Sanjay Gandhi Institute of Trauma and Orthopaedics, Bangalore from January 2021 to January 2023. Functional outcome was assessed through Harris Hip score. **Results:** Mean age of the patients was 36.6 years. 14 cases involved the right femur and 6 left sided Femur was involved. The mean Time For Union of Neck fracture was  $14.60 \pm 1.73$  weeks. The mean Time For Union of shaft fracture was  $24.80 \pm 4.41$  weeks. Mean Harris Hip score was  $86.25 \pm 5.33$ . **Interpretation And Conclusion:** Cephalomedullary nails are commonly used surgical devices for treating combined fractures. A closed technique can minimize bleeding and wound complications, thus can significantly improve operating time and technical faults.

### KEYWORDS

Cephalomedullary nails; Reconstruction intramedullary nails ; Harris Hip score; delayed union

### INTRODUCTION

Ipsilateral fractures of the femoral neck occur in 2% to 6% of patient with femoral shaft fractures<sup>1</sup>. Ipsilateral hip and femoral shaft fractures are problematic because of their high complication rates. These bifocal femoral fractures are usually encountered in young patients. They are associated with high velocity injuries. They are usually accompanied by multisystem involvement<sup>2</sup>.

Despite the rule of taking x-rays of the pelvis for all femoral fractures, we still see cases where femoral fractures are managed without diagnosis of femoral neck fractures. The incidence of missed injuries, notably fractures of the femoral neck is significant. They are reported to range between 20-30%<sup>1,2</sup>. Early recognition of this injury is required to prevent the inherent disabling complications like non union or avascular necrosis of head of femur<sup>3</sup>.

Treatment options include<sup>4,5,6</sup>:

- Antegrade femoral nailing** of the shaft with cancellous screws placed anterior to the nail for fixation of the neck
- Reconstruction-type intramedullary nailing**
- various plate combinations** (including a hip screw and long side plate configuration, a hip screw with short side plate for the neck and separate plate for the shaft, or cancellous screws for femoral neck and a plate for the shaft,
- retrograde intramedullary nailing for shaft fixation with cancellous lag screws for femoral neck.**

The objective of this study is to analyse the functional outcome of cephalomedullary nailing clinically, radiologically and complications in the treatment of ipsilateral fractures of neck and shaft of femur in adults

### Methodology

The study was conducted in the Department of Orthopaedics, Sanjay Gandhi Institute of Trauma and Orthopaedics, Bangalore. This study consisted of 20 patients visiting outpatient department, emergency department of the hospital. Patients diagnosed with ipsilateral neck and shaft of femur fracture were included in the study who were operated during the period from January 2021 – January 2023. The follow up duration range varied from 8 months to 18 months. All the fractures in the study group were post-traumatic.

**Source of data:** Data collected from patients presenting with

ipsilateral neck and shaft of femur fractures operated with cephalomedullary nailing satisfying inclusion and exclusion criteria admitted in Sanjay Gandhi Institute Of Trauma and Orthopaedics, Bangalore.

### Method Of Collection Of Data:

**Study Design:** Prospective study.

**Study Period:** January 2021 – January 2023.

**Place Of Study:** Sanjay Gandhi Institute of Trauma and Orthopaedics, Bangalore.

**Sample Size:** It was a hospital based study with sample size of 20 (calculated based on previous studies) who were fulfilling the inclusion criteria.

**Statistical analysis Plan:** Statistical Package for Social Sciences [SPSS] for Windows Version 22.0 Released 2013. Armonk, NY: IBM Corp., will be used to perform statistical analyses.

### Inclusion Criteria:

- Patients with femoral neck fracture -subcapital or transcervical or basicervical and a concomitant shaft fracture extending from proximal third to distal third including transverse or spiral or oblique or segmental or comminuted patterns
- Age more than 18 years and less than 60 years.
- Patient should have sufficient muscle strength and motivation to carry out rehabilitation programme.
- Willing for cephalomedullary nailing with written, signed and informed consent

### Exclusion Criteria:

- Age less than 18 years and more than 60 years.
- Pathological fractures
- Patients with supracondylar or intercondylar extension of fractures of femur.
- Severe medical co-morbidities and unfit for surgery
- compound fractures above grade IIIA according to Gustillo Anderson classification.
- Patients with neurological disorders like polio, cerebral palsy, Parkinson's disease etc.
- Patients with fractures in contralateral limb.

8. Patients not willing for surgery.

**Informed Consent**

After informing the patient about diagnosis, treatment options, possible complications & obtaining prior written consent, the patient was subjected to relevant investigations and interventions as indicated for treatment.

**Preoperative Planning**

All study patients were put on skeletal traction and approximately 10 % of body weight was applied over the Bohler-braun splint to maintain the length of the lower limb and facilitate subsequent procedure. Adequate medical management of associated co-morbid conditions like Diabetes Mellitus, Systemic Hypertension, Chronic Obstructive Pulmonary Disease and Heart Diseases were initialized to optimize patient's fitness for anesthesia AO classification criteria (shaft) and Gardens classification (neck) was used to classify fracture based on radiographic study. Preoperative templating of the radiograph was done to assess the length of nail.

**Anaesthesia, Positioning And Image Intensifier:**

- All cases were operated under regional anaesthesia (spinal or epidural).
- Patients were put on Supine position on a fracture table.
- Excellent AP and lateral images of the femoral head and neck were taken before the procedure .
- Access to the greater trochanter was improved by
  - bending the torso away from the affected extremity
  - adducting the affected limb
- Reduction of the fractures was attempted before beginning the surgical procedure

**Surgical Technique And Intraoperative Images**

Closed reductions of both fractures were attempted initially in all cases.

**1) Incision:**

We used a small incision of around 3 cm with its distal end on the tip of the trochanter in case of PFN. A slightly longer incision was used with Recon nails. The entry point is identified after careful dissection. If open reduction of the shaft fracture is required it is done through a standard lateral approach.



Fig-1-incision

**2) Entry Point:**

The entry point was either the tip of trochanter for PFN or the piriformis fossa for Recon nails.

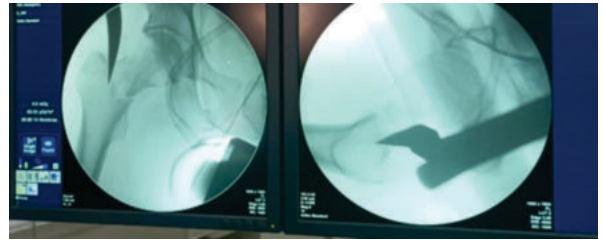


Fig 2- Entry Point

**3) Guide Wire Insertion & Reaming:**

The ball tip guide wire is inserted and is passed into the distal shaft fragment after reducing the shaft fracture. After C – arm confirmation the entry point is widened using a 14 mm cannulated proximal reamer. Distal reaming of the canal is done with graded cannulated flexible reamers. Ball tip guide wire exchanged with straight guide wire.



Fig-3-guide Wire Insertion And Reaming

**4) Nail insertion & Proximal locking:**

The nail is inserted with the help of the jig over the guide wire. Fluoroscopic images are taken to look for any displacement of the neck fracture. The nail is inserted by hand using gentle rocking movements. Once the nail is positioned appropriately, the guide wire is removed and drill sleeves are attached to the jig and through a lateral stab incision they are pushed upto the lateral cortex. The guide pin is passed and advanced to 5 mm from the articular surface of the femoral head. Proximal locking is done with two cannulated cancellous screws ( compression screw and anti rotation screw) of various lengths as measured. The anti rotation screw is also chosen 15 mm short to prevent screw cut out. Two 6 mm recon screws were used for proximal locking in case of RECON. Only two screws through the nail were used for all neck fractures.

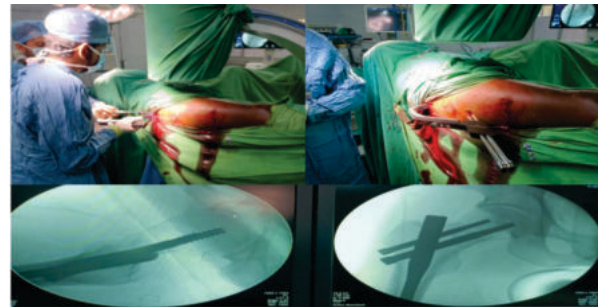


Fig-4- Proximal Locking

**5) Distal Locking:**

Distal locking is done by free hand technique using one or two 4.9 mm locking bolts with the help of image intensifier.

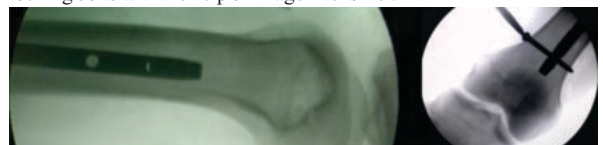


Fig-5- Distal Locking

**Intraoperative Assesment Of Fracture Reduction**

**1) Gardens Alignment Index ( Neck Of Femur Fracture)**

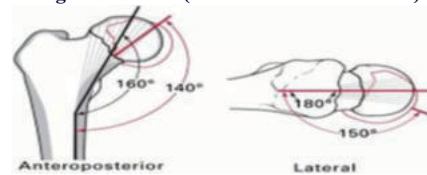
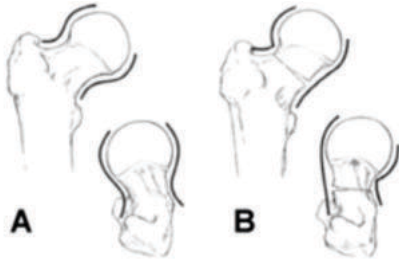


Fig-6-gardens Alignment Index

Angle of 160° to 180° on both anteroposterior and lateral radiographs considered satisfactory. The black arrows indicate anatomical reduction, with the red arrows representing unacceptable reduction positions.

**2) Lowell Index**

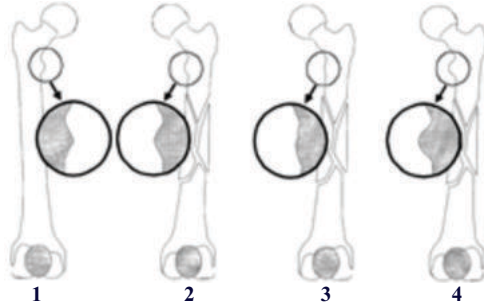


**Fig-7-lowell Index**

- A- Anatomically aligned femoral neck ; on both AP and Lateral xrays projected as shallow S or reverse S pattern.
- B- Flattening of one curve and a sharp apex on the opposite side demonstrates Malalignment

**3) Lesser Trochanter Shape Sign**

Used To Assess The Rotation Of Distal Fragment Of Femur Intra Operatively



**Fig-8- Lesser Trochanter Shape Sign**

- 1) The shape of the lesser trochanter on the opposite side is obtained and stored in image intensifier screen.
- 2) The shape of lesser trochanter on both sides are matched so that the proximal segment rotation before distal locking
- 3) If proximal segment is internally rotated means , lesser trochanter will appear as small in shape.
- 4) If proximal segment is externally rotated means , lesser trochanter will appear larger in shape.

**Criteria For Evaluation Of Results**

**HARRIS HIP SCORE**

Patient's name:

IP Number:

Diagnosis:

Date:

1. Pain	
None or ignores it	44
Slight, occasional pain with no compromise in activities	40
Mild pain, no effect on average activities, rarely moderate pain with unusual activity	30
Moderate pain, tolerable but makes concession to pain. Some limitation of ordinary activity or work, may require occasional pain medication stronger than aspirin	20
Marked pain, serious limitation of activities	10
Totally disabled, crippled and bed-ridden with pain at rest	0

2. Limp	
No limp	11
Slight limp	8
Moderate	5
Severe	0

3. Support	
None	11
Cane for long walks	7

Cane most of the time for support	5
One crutch	3
Two canes	2
Two crutches or unable to walk	0

4. Distance walked	
Unlimited	11
Six blocks	8
Two or three blocks	5
Indoors only	2
Bed and chair only	0

5. Sitting	
Comfortable in an ordinary chair for 1 hour	5
On a high chair for 30 minutes	3
Unable to sit comfortably in any chair	0

6. Enter public transportation	
Yes	1
No	0

7. Stairs	
Normally without using a railing	4
Normally with use of railing	2
In any manner	1
Unable to use stairs	0

8. Put on shoes and socks	
With ease	4
With difficulty	2

Unable	0
--------	---

9. Absence of deformity (All yes = 4, Any No = 0)		Yes	No
Less than 30 degrees of fixed flexion contracture			
Less than 10 degrees of fixed abduction			
Less than 10 degrees of fixed internal rotation in extension			
Limb length discrepancy less than 3.2cm			

10. Range of motion (Indicates normal)			
A	B	D	E
Flexion (40 degrees)		External rotation (40 degrees)	
Abduction (40 degrees)		Internal rotation (40 degrees)	
Adduction (40 degrees)			

211-300 degrees	5
161 - 210	4
101-160	3
61-100	2
31-60	1
0-30	0

Total range of motion score = A + B + C + D + E = \_\_\_\_\_

Total Harris Hip score = 1+2+3+4+5+6+7+8+9+10 = \_\_\_\_\_

Harris Hip Score is a measure of dysfunction , so higher the score, better the outcome for the individual. Maximum score possible is 100.

- Poor result = <70
- Fair = 70-80
- Good = 80-90
- Excellent = 90-100

**Follow up**

Patients follow up visits at every 4 weeks upto 3 months post-operatively and then on monthly until 6 months and on 9th month and 1 year.

**RESULTS**

Twenty patients with ipsilateral combined fractures of the femoral neck and femoral shaft were treated surgically with Cephalomedullary nailing technique and analysed with average follow up of 12 months ranging from 8 months to 18 months.

The following observations were made.

- 1) Out of 20 patients 16 are male and 4 are female
- 2) Among 20 patients , seven patients were between 18-30 years (35%), four patients were between 31-40 years (20%), seven

patients were among 41 to 50years (35%), two patients were among 51 to 60 years (10%).

- 3) All patients were victims of high velocity Road traffic accident
- 4) There were no cases in which the neck fracture was missed at initial diagnosis.
- 5) Of the femoral neck fractures 14 were undisplaced remaining 6 were displaced fractures;
- 6) Eight patients had associated other skeletal injuries. One patient had head injury, one patient had rib fracture and haemothorax.
- 7) In contrast to pelvic injuries, all patients were hemodynamically stable at the time of admission.
- 8) In our study the average surgical time delay was 5 days ranging from 2 to 8 days.
- 9) The average operating time was 121.45 +/-18.40 minutes
- 10) The average blood loss was 125.60 +/-13.53 ml
- 11) Of these closed reduction of fracture was in 15 cases and open reduction was done among 5 cases (3-neck fractures and 2 shaft fractures)
- 12) Two patients have encountered intra-operative complications. There was shattering of the proximal femur during nail insertion. Both of these patients showed good fracture union at the proximally shattered site.
- 13) 1 patient had fracture distraction at the site of shaft fracture. This showed good union on follow up.
- 14) Two patients had superficial infection which settled with antibiotics
- 15) The average followup period was for 12 months (range 8 months - 18 months)
- 16) There was no varus or valgus malunion of neck or shaft fractures.
- 17) Limb shortening of 1.5cms was seen in 1 patient.
- 18) None of the patients had deep vein thrombosis or pulmonary embolism
- 19) Three cases of shaft fracture showed delayed union which went on unite well within 9 months without second intervention.
- 20) The average union time was 14.60 +/-1.73 weeks for neck of femur fractures and 24.80 +/- 4.41 weeks for shaft of femur fractures.
- 21) Twelve patients had full range of motion at hip joint, five patients had 0-110 degrees. Range of Motion and three had ROM of 0-100 degrees. None of the patients had fixed flexion deformity at hip.
- 22) The functional outcome according to Harris Hip score was excellent in 3 patients, good in 14 patients and fair in 3 patients. The mean of Harris Hip Score (1 Year) was 86.25 +/-5.33.

Basic Details	Mean ± SD	Median (IQR)	Min-Max	OR	N (%)
Age (Years)	36.60 ± 10.96	38.00 (25.75-44.25)	19.00 - 55.00		
Age					
18-30 Years				7 (35.0%)	
31-40 Years				4 (20.0%)	
41-50 Years				7 (35.0%)	
51-60 Years				2 (10.0%)	
Gender					
Male				16 (80.0%)	
Female				4 (20.0%)	
Mode Of Injury (RTA)				20 (100.0%)	
Side					
Right				14 (70.0%)	
Left				6 (30.0%)	
Neck Fracture - Gardens Classification					
Class 2				14 (70.0%)	
Class 3				6 (30.0%)	
Shaft Fracture - AO Classification					
32A1				1 (5.0%)	
32A2				2 (10.0%)	
32A3				7 (35.0%)	
32B2				6 (30.0%)	
32B3				3 (15.0%)	
32C2				2 (10.0%)	
32C3				2 (10.0%)	
33A2				1 (5.0%)	
Implant					
PFN				18 (90.0%)	
RECON				2 (10.0%)	
Operative Time (Minutes)	121.70 ± 18.83	124.00 (108.00-132.75)	90.00 - 155.00		
Operative Time					
<100 Minutes				3 (15.0%)	
100-125 Minutes				7 (35.0%)	
125-150 Minutes				8 (40.0%)	
>150 Minutes				2 (10.0%)	
Blood Loss (ml)	125.60 ± 13.53	130.00 (120.00-132.50)	100.00 - 140.00		
Blood Loss					
100-125 mL				7 (35.0%)	
125-150 mL				13 (65.0%)	
Hospital Stay (Days)	8.35 ± 1.57	8.50 (7.00-10.00)	6.00 - 10.00		
Any Complication (Yes)				7 (35.0%)	
Complications					
None				13 (65.0%)	
Delayed union				3 (15.0%)	
Superficial Infection				2 (10.0%)	
Persistent Hip Pain				1 (5.0%)	
Shortening				1 (5.0%)	
Time For Union (Neck) (Weeks)	14.60 ± 1.73	14.00 (14.00-16.00)	12.00 - 18.00		
Time For Union (Neck)					
<12 Weeks				3 (15.0%)	
13-16 Weeks				15 (75.0%)	
>17 Weeks				2 (10.0%)	
Time For Union (Shaft) (Weeks)	24.80 ± 4.41	23.50 (22.00-26.00)	20.00 - 35.00		
Time For Union (Shaft)					
17-20 Weeks				3 (15.0%)	
21-24 Weeks				8 (40.0%)	
25-30 Weeks				6 (30.0%)	
>30 Weeks				3 (15.0%)	
Harris Hip Score (1 Year)	86.25 ± 5.33	86.00 (84.25-89.25)	75.00 - 96.00		
Harris Hip Score Impression (1 Year)					
Excellent				3 (15.0%)	
Good				14 (70.0%)	
Fair				3 (15.0%)	

Chart-1 Summary Of Observations

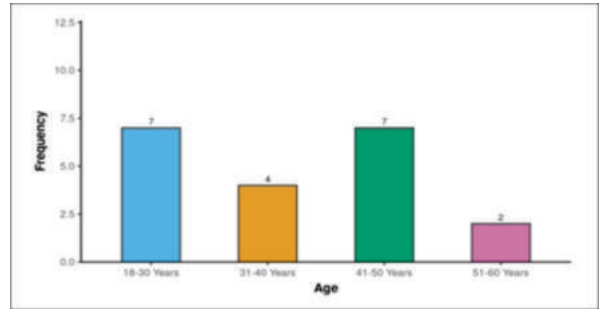


Chart-2-age Incidence And Distribution

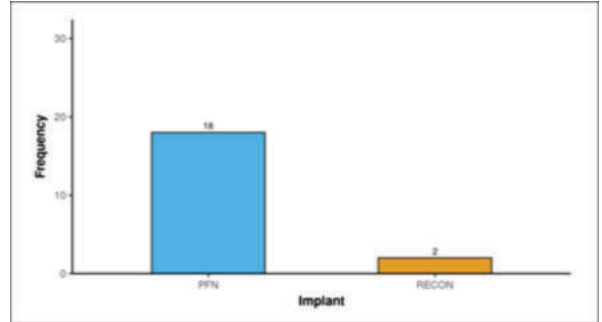


Chart-3- Implant Used

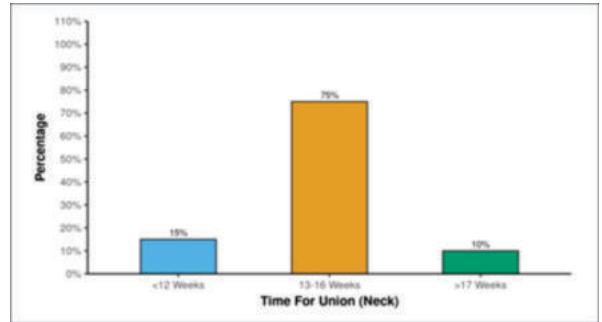


Chart-4-time For Union Of Neck Of Femur Fracture

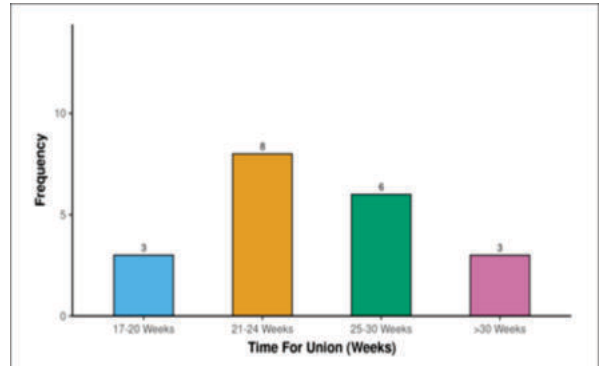


Chart-5-time For Union Of Shaft Of Femur Fracture

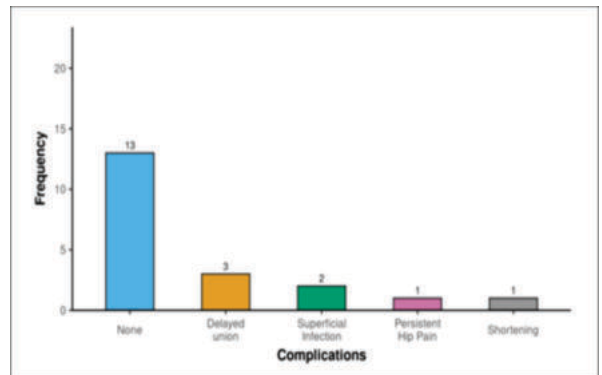


Chart-6-complications

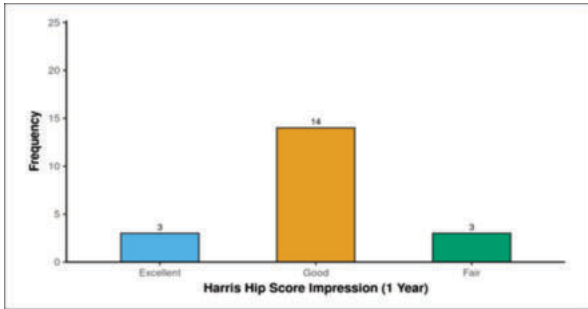


Chart-7-harris Hip Score Outcome At 1 Year.

**Illustrative Cases- Case 1**

- KARIM 47/male
- H/O RTA
- Neck Of Femur With fracture With Shaft Of Femur Fracture left Side
- GARDENS TYPE 3 ; AO SHAFT 32B3
- CRIF WITH LONG PFN

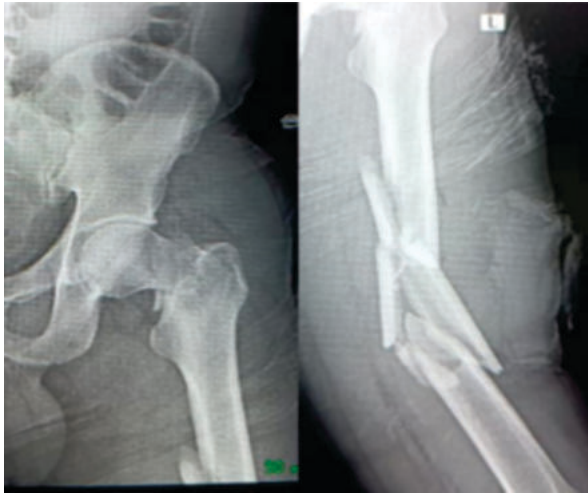


Fig-9-pre-operative Xrays

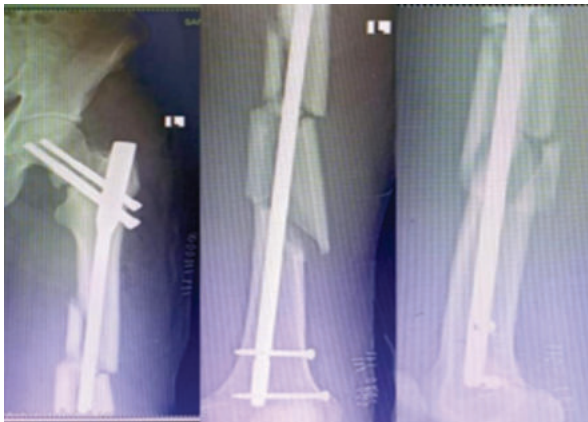


Fig-10-immediate Post Operative Xrays

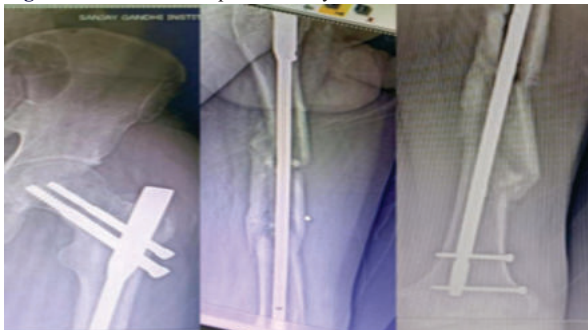


Fig-11-6 Months Follow Up Xrays



Fig-12-functional Outcome At 1 Year

**Illustrative Case-2**

- RAJESH 44Y/male
- H/O RTA
- Neck Of Femur With fracture With Shaft Of Femur Fracture Right Side
- GARDENS TYPE 2 ; AO SHAFT 32B2
- CRIF WITH LONG PFN

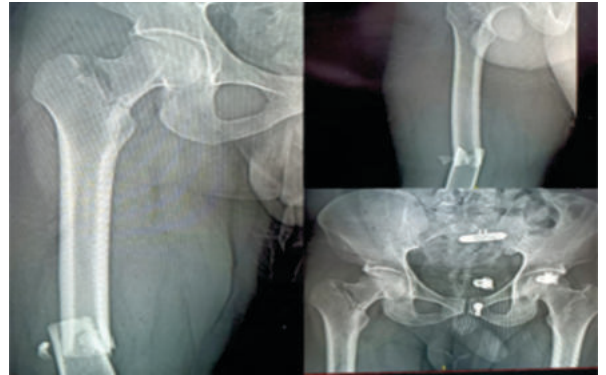


Fig-13-pre-operative Xrays



Fig-14-1 Month Follow Up Xrays



Fig-15-7 Months Follow Up Xray



Fig-16-functional Outcome At 1 Year

**DISCUSSION**

Complex femoral fractures continue to be challenging for the operating surgeon and patient. These fractures are definitely best managed by surgical stabilization. Early stabilization of long-bone fractures followed by early mobilization has been shown to decrease morbidity and mortality, especially in polytrauma patients<sup>5</sup>.

However controversies still remain regarding the most appropriate internal fixation device and which fracture should be given surgical priority. Several surgeons recommend immediate reduction and stabilization of the femoral neck fracture, as an orthopedic emergency because of potential consequences of femoral neck fractures such as avascular necrosis, nonunion, and secondary displacement<sup>7</sup>.

However, a delay in fixation does not seem to increase the complication rate<sup>7</sup>. Controversy also exists as to which internal fixation device to use for stabilization of the shaft fractures. The key for union is to obtain stable fixation regardless of the type of fixation technique used. Avoiding complications of plate fixation like a large surgical dissection and significant soft-tissue trauma, considerable blood loss, potentially higher infection risk, refracture, and implant failure; cephalomedullary nailing seems to be a good option to stabilize these fractures<sup>9</sup>.

We achieved **100% union in our series**. Except for three cases of delayed union in shaft fractures there were no incidences of non union. Recent studies have also shown 100% union rate inspite of initial displacement. It is easier to maintain reduction in minimally displaced fractures. But achieving reduction in displaced and comminuted fractures is challenging even for the most experienced surgeons<sup>10</sup>.

Chandru et al studied outcome analysis of ipsilateral neck and shaft femur fractures treated with cephalomedullary nail with an average follow up of 12 months. As per Wilde et al's scoring system, 5 patients had excellent results, 7 patients had good results and 3 patients had fair results. All fractures were united in their study.<sup>11</sup>

Jain et al retrospectively studied the management of 23 cases of ipsilateral hip and shaft fractures treated with cephalomedullary nail with average follow up of 30 months. Mean time for union of femoral neck was 15 weeks and shaft was 22 weeks. Overall, they found good results done by this study.<sup>12</sup>

In 2011, **Tsarous et al** reported treating 11 patients of combined ipsilateral femoral neck and shaft fractures with reconstruction nail over a period of 4 years from 2004 to 2008. The mean union time was 4 months for the neck fracture and 8 months for the shaft fracture. The mean Harris Hip score was 85.<sup>13</sup>

S.Vidyadhara et al, studied in 2008 with 43 cases of combined ipsilateral femoral neck and shaft fractures treated with cephalomedullary nails said that all cases except one achieved union of both fractures and excellent or good functional outcome.<sup>14</sup>

Ahmad et al prospectively studied cases of ipsilateral femur neck and

shaft fractures treated with reconstruction intramedullary nailing between 2006 and 2015. 18 cases were studied and concluded that functional outcome was good in most of the cases.<sup>15</sup>

Hsuan-Kai Kao et al in his 2005 study comprised of 15 combined fractures in 15 patients treated with Russel Taylor reconstruction intramedullary nails. The union rates for neck and shaft fractures were 100 and 84% respectively. They concluded that Reconstruction nails are alternative acceptable devices to treat combined fractures.<sup>16</sup>

We compared our study with the following studies

Authors	Number Of Cases	Follow Up	Union Rate	Functional Outcome
Desai et al	20	2 years	100% neck 85% shaft	Good (Harris Hip score)
Chandru et al	15	1 year	100% neck and shaft	Good (wilde et al scoring system)
Jain et al	23	2.5 years	96%-neck 83%-shaft	Good
Ahmad et al	18	3.5 years	94%-neck 94%-shaft	Good (Freidman-Wyman score)
Tsarouhas et al	11	3 years	100%-neck 81%-shaft	Good (Harris Hip score)
Rana et al	13	1 year	92%-neck 100%-shaft	Good (Harris Hip score)
Sahoo et al	10	1.5 years	100 % neck 90 %- shaft	Good to Excellent ( Harris Hip score)
Vidyadhar a et al	43	4 years	97 % neck 90 %- shaft	Excellent ( Harris Hip score)
Our study	20	1 year	100%neck and shaft	Good (Harris Hip Score)

**CONCLUSION**

In conclusion, a locked intramedullary nail with two proximal screws in the femoral neck and one or two distal locking screws seem useful for extended indications in complex femoral fractures, wherein previous techniques have not yielded uniformly good results. We suggest that the surgical stabilization of these bifocal fractures should be done as early as possible. Though the union rate was not affected by the timing of surgery, patients undergoing early surgery had better long term functional results.

The learning curve associated with cephalomedullary nailing may be long and results improve with surgical experience as shown by our study.

To summarize,

- Early surgical stabilization yields better long term results
- Results improve with surgical experience
- The limitations of our study were the small sample size and the duration of follow up.
- We would suggest cephalomedullary nails are effective for shaft fractures with undisplaced or displaced fractures of the femoral neck. In case of displaced neck fractures retrograde nailing with cancellous screw fixation of the neck appears promising and long term results are awaited.
- Cephalomedullary nailing in this complex fracture yields good results if the technique is meticulously implemented.

**REFERENCES**

- 1) De Lee TC. Fractures & dislocation of the hip. In Rockwood, CA. Jr & Green D J. (eds.) Fractures in adults. Vol 2. Philadelphia; JB Lippincott. 1984; 112-356.
- 2) Garg R, Bassi JL, Yamin M. Analysis of the results of ipsilateral hip and shaft femur fractures treated with reconstruction nail. Indian J Orthop 2006;40:238-42
- 3) Clawson GK, Smith RF. Closed intramedullary nailing of the femur. J Bone and Joint Surgery 1991;53-A;681-92.
- 4) Alho A (1997) Concurrent ipsilateral fractures of the hip and shaft of the femur. A systematic review of 722 cases. Ann Chir Gynaecol 86:326-336.
- 5) Alho A, Ekeland A, Groggaard B et al (1996) A locked hip screw-intramedullary nail (cephalomedullary nail) for the treatment of fractures of the proximal part of the femur combined with fractures of the femoral shaft. J Trauma 40:10-16.
- 6) Bone LB, Johnson KD, Weigelt J, Scheinberg R (1989) Early versus delayed stabilization of femoral fractures. A prospective randomized study. J Bone Joint Surg Am 71:336-340.
- 7) Bose WJ, Corcos A, Anderson LD A preliminary experience with the Russell-Taylor reconstruction nail for complex femoral fractures. J Trauma 32:71-76.
- 8) Kao HK, Wu CC Journal of orthopedic trauma 2006 Apr; 20(4): 240 - 6
- 9) Pavelke T, Lihart M Zentrabl chirurg 2005 Apr; 130(2): 148 - 52
- 10) Tsarouhas A, Hantes ME, Reconstruction nailing for ipsilateral femoral neck and shaft fractures, Strategies Trauma Limb Reconstr. 2011 6(2):69-7538.
- 11) Ganesan GR, Kumar CA. Outcome Analysis of Ipsilateral Neck with Shaft of Femur Fractures Treated by Cephalomedullary Nail. J Orthop Jt Surg. 2020;2(1):1-3.
- 12) Jain P, Maini L, Mishra P, Upadhyay A, Agarwal A. Cephalomedullary interlocked nail for ipsilateral hip and femoral shaft fractures. Injury. 2004;35(10):1031-8.

- 13) Tsarouhas A, Hantes ME. Reconstruction nailing for Ipsilateral femoral neck and shaft fractures, *Strategies Trauma Limb Reconstr.* 2011 6(2):69-7538.
- 14) Vidyadhara S, Rao SK. Cephalomedullary nails in the management of ipsilateral neck and shaft fractures of the femur-One or two femoral neck screws? *Injury.* 2009;40(3):296-303
- 15) Ahmad S, Shaan ZH, Faizan M, Jilani LZ, Asif N, Abbas M. Role of reconstruction intramedullary nailing in the treatment of ipsilateral femoral neck and shaft fractures. *Saudi J Sports Med* 2018;18:22-6
- 16) Kao H, Wu C, Lee P, Su C, Fan K, Tseng I. *Methods : Results : 2005;6-8.*