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Study to assess malalignment of neck shaft angle in intramedullary fixation of intertrochanteric femur fracture

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Abstract

Early surgical fixation and early mobilization are basic recommendations for an optimal recovery of hip fracture patients. The goal of management plan is to achieve union with minimal complications [(1)]. This can be achieved by reasonable choice of implant for fracture type, identifying complex fracture patterns and performing proper reduction with ideal implant placement. Intramedullary nailing is gradually emerging as the treatment of choice for peritrochanteric femoral fractures. The present study was done in patients who came to the Department of Orthopaedics, Gandhi Medical College and associated Hamidia Hospital, Bhopal presenting with intertrochanteric fractures from December 2019 to June 2021. This was a prospective interventional study. The sample size was 30 patients with 20 to 90 years of age group who were willing to undergo intramedullary fixation for intertrochanteric fractures. It can be concluded from our study, that an insignificant difference in neck shaft angle occurs during first 6 months post operatively in inter trochanteric fractures of femur managed by implants.

Keywords: Intertrochanteric, Fractures, Surgical Fixation.

Introduction

Hip fractures are an important health-care concern in the elderly population. Currently, hip fractures affect 18% of women and 6% of men globally.[(1)] Hip fractures in the elderly usually result from trivial trauma and often are associated with osteoporosis and other associated medical conditions that may increase the prevalence of falls.[(2)] While in young adults hip fractures are rare and are due to high velocity trauma and are associated with other injuries.[(3)] Elderly patients with hip fracture have poor quality of life, reflected by impaired mobility and balance and reduced functional and social independence. Many patients never return to their pre-fracture lifestyle.[(4)]

Non-operative treatment of an intertrochanteric fracture is rare now a days and is used only in medically unfit patients.[5][6] With conservative treatment coxavara deformity and shortening are common complications. Internal fixation is considered appropriate for intertrochanteric fractures.[6] Early surgical fixation and early mobilization are basic recommendations for an optimal recovery of hip fracture patients.[7][8]The design of implants with multiple options for fixation of intertrochanteric fracture has evolved over the years but still, there is a conflict as to which implant is better for which type of trochanteric fractures.[9] Implant choice is largely based on the stability of the fracture pattern and the integrity of the lateral cortex. A stable intertrochanteric fracture has an intact or well-reduced posteromedial cortical calcar to redistribute stress and resist medial compressive loads. In contrast, unstable intertrochanteric fracture patterns are unable to maintain appropriate reduction of the proximal femur when using extramedullary fixation options. These patterns often include fractures with a compromised medial calcar via comminution or a large posteromedial fragment, fractures that extend into the subtrochanteric region, reverse obliquity fractures, or transtrochanteric fractures that involve the lateral cortical wall.[10] Compared to sliding hip screws, intramedullary devices offer greater biomechanical stabilization that is especially important in the setting of unstable intertrochanteric fractures.[10]In these situations, the lack of contact between the posteromedial osseous fragments would result in transfer of greater medial compressive loads to the implant.[11] The intramedullary device is closer to the force vector line of action through the center of the femoral head and has a shorter lever arm. Thus for the same force, the nail experiences less moment and can resist greater loads to failure.(11) The goal of management plan is to achieve union with minimal complications[1]. This can be achieved by reasonable choice of implant for fracture type, identifying complex fracture patterns and performing proper reduction with ideal implant placement. Intramedullary nailing is gradually emerging as the treatment of choice for peritrochanteric femoral fractures. Nevertheless, prospective randomised trials have failed to demonstrate the assumed superiority of cephalomedullary nails over the traditional treatment with the sliding hip screw. On the contrary, the gamma nail has been implicated in predisposing to secondary femoral fractures, although this seems to be rectified by newer techniques and nail designs.[12] Hip adductors, flexors and extensors pull the distal fragment proximally resulting in a varus and external rotation. Due to this, there is possible internal malrotation if fracture is not adequately reduced intraoperatively.[13] Rotational malalignment or torsional deformity of the femur is expressed as a difference in femoral anteversion between the operated and normal limb. Variations in femoral anteversion have been well known in populations.

Materials and Methods

The present study was done in patients who came to the Department of Orthopaedics, Gandhi Medical College and associated Hamidia Hospital, Bhopal presenting with intertrochanteric fractures from December 2019 to June 2021. This was a prospective interventional study. The sample size was 30 patients with 20 to 90 years of age group who were willing to undergo intramedullary fixation for intertrochanteric fractures. A total of 30 patients with intertrochanteric fractures were chosen and sampling based on the inclusion and exclusion criteria and included to the study.

Inclusion criteria

1. All patient of intertrochanteric fracture femur managed by intramedullary fixation.
2. Non pathological acute traumatic intertrochanteric fracture femur.
3. Normal femoral anatomy which allowed osteosynthesis.
4. Skeletally mature patients
5. All patients giving consent and able to come for repeated follow up.

Exclusion Criteria

1. Polytrauma patients
2. Paediatric patient with growing bones with open physics.
3. Patients not giving consent and unable to come for repeated followup.
4. Patients with severe comorbities and high anaesthetic risk.
5. Bilateral intertrochnateric femur fracture
6. Previous surgery of ipsilateral hip or femur
7. Those who are unable to cooperate in post-operative rehablitation programme because of senility, phychosis or Parkinsonism.
8. Pathological fracture.

Surgical Technique

In both PFN & PFN A-II, the minimally invasive approach to the proximal femur was used for the insertion of intramedullary nails. In both PFN & PFNA-II, the patient was placed in supine position on a Radiolucent traction table. Reduction: In both PFN & PFNA-II, all fractures were tried closed reduction with alignment of the medial cortex. In those failed to achieve closed reduction fracture was reduced by open reduction and with help of steinman pin and reduction clamps. Reduction was done under fluoroscopy guidance by Traction, Abduction and Internal rotation.

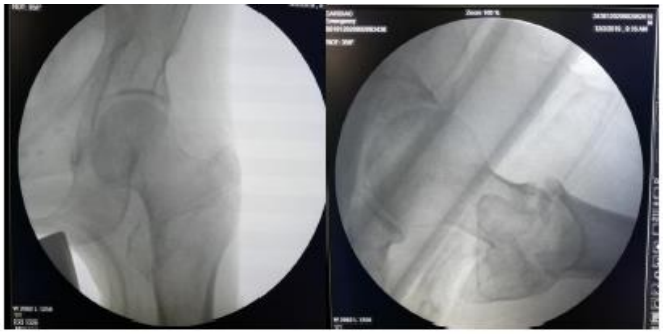

Figure 1: Intra-op C-arm images showing reduced fracture

Incision: In both PFN & PFNA-II, incision was made over the lateral aspect of the proximal thigh over the greater trochanter extending up to 5cm proximally. Incision was deepened to split the subcutaneous layer and fascia and then gluteus muscles were split apart using a curved clamp with cauterisation of bleeding vessels.

Figure 2: showing incision

Entry Point

The superior and medial aspect of greater trochanter is palpated using a finger. In PFN, the entry was made directly over the tip of greater trochanter. In PFNA-II, the entry was made over the medial border of the greater trochanter. Entry was made using an entry owl under C-

Arm guidance in both AP & Lateral view. Then initially a guide wire was inserted through the entry point onto the proximal end of the femur, The wire was lined up within the intramedullary canal on both anterior–posterior and lateral planes. Reaming of canal was done with graded canulated reamers. The nail was inserted with the help of the jig over the guide wire under C-arm in both AP & Lateral view. The basic difference between PFNA-II and PFN was that a single helical blade screw was used in fracture fixation in PFNA-II and 2 screws (1 Compression screw & 1 de-rotation screw) were used in the latter for proximal locking Additionally, coupling screw and proximal cap were used in PFNA-II. Proximal locking with the compression screw along the inferior part of the neck was done first followed by the superior de-rotation screw of appropriate length as measured preoperatively &Intra-operatively. Distal Locking: In both Short PFN & PFNA-II, distal locking was done with the aid of jig and two distal locking screws under C-arm in both AP & Lateral view. For long PFN&PFNA-II distal locking was done with free hand technique. Skin Closure: In both PFN & PFNA-II, after thorough wash with Normal Saline, suturing done in layers under sterile conditions. Dressing done under sterile conditions.

Post-Operative Protocol

Post-operative rehabilitation plays a major role in recovery of range of movement and improving the functions of Hip and knee joint. If fracture fixation was stable, early rehabilitation was started. Increased and useful range of motion was achieved, within first week of postoperative period. Weight bearing was started in 2nd Postoperative day. Static &Dynamic Quadriceps strengthening and Hamstring stretching, Hip, knee and ankle range of motion exercises started.

Follow UP: All Patients were advised to review at 1month then at 3 months, 6 months.

In each visit neck shaft angle were measured by radiographs and their functional outcome analysed by ROM at injured Hip, VAS score, Harris Hip Score and also digital x ray of the operated Hip taken to assess the union of fractures. Time for fracture healing was evaluated according to radiographic and clinical criteria. Clinically Union was assessed by the absence of Tenderness (or) pain with full weight bearing. Radiologically union of the fracture was assessed by the Standard Digital Antero-posterior& Lateral Radiograph of the Pelvis with operated hip.

NSA Measurements

The Neck-shaft angle (NSA) of femur is the angle between the axis of the femoral shaft and femoral neck. X-ray of pelvis with both hips Antero- posterior view was taken after fixation of fracture using the standardized protocol in 15 degrees of internal rotation of the hips in the supine position with a film-focus distance of 100 cm, and the beam centered on the symphysis pubis under our supervision.

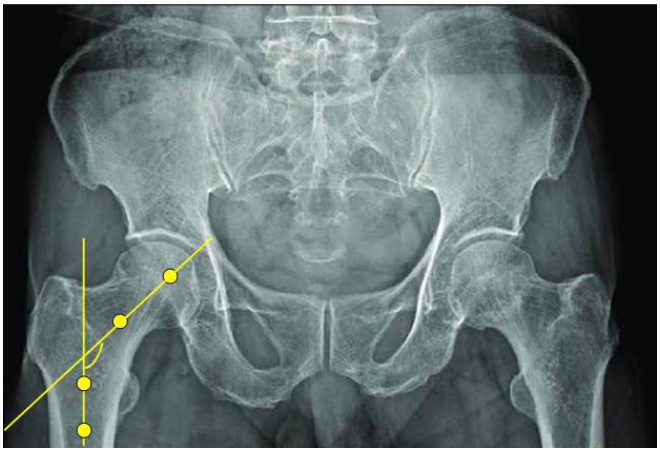

Figure 3: showing measurement of Neck Shaft Angle

The method of measuring the NSA in this study was as follows: The neck axis was drawn by measuring two points, one in the center of the head and the other at the

end of the middle part of the narrowest part in the neck (highest pressure in the neck). The two points were then connected, showing the axis of the neck. The shaft axis was determined by considering two midpoints, one at the upper end in the shaft and the other at the middle of the shaft. The two points connected and extend at the upper end of the same line. We used a goniometer modality for measuring the NSA of patients. It should also be noted that all measurements were performed by an expert orthopedic surgeon. NSA was also measured in all control cases in order to compare with patients.

Statistical Analysis

Microsoft office was used to prepare the graphs. Student t- test was used to compare the means. Chi Square test was used to compare the categorical data. P value of < 0.05 is considered as significant.

Observation and Results

Distribution of patients according to age and gender shows that majority were males, i.e., 86.7%. Among the total male patients, 57.7% belonged to the age group of 51-70 years, followed by ≤50 years constituting to 23.1%. Among females 13.3%, majority were from the age group of 51-70 years.

Majority, i.e., 14 (46.7%) of the patients belonged to type 2 Boyd and Griffins type, followed by 10 (33.3%) patients with type 3 fracture, followed by 6 patient in type 4. None of the patients were having type I fracture. No comorbidities were reported in 23 (76.7%) patients. Hypertension was reported in 4 (13.3%), while DM was observed in 3 (10.0) patients. The mean pre op VAS score was reported to be 7.66 with a SD of 0.95.

Table 1: Distribution of Patients According To Neck Shaft Angle of Normal and Abnormal Side Post Operatively

S No	NSA (in degrees)	Side	
		Normal	Affected
		Freq (%)	Freq (%)
1	120-124	1 (3.3)	0 (0.0)
2	125-129	9 (30.0)	4 (13.3)
3	130-134	20 (66.7)	24 (80.0)
4	≥135	0 (0.0)	2 (6.7)
Total		30 (100.0)	30 (100)

Neck Shaft angle of 130-134 degrees was observed among 20 (66.7%) patients on the normal side, while on the affected side, 24 (80.0%) patients were having neck shaft angle 130-134 degrees. 2 patients had an angle of above 135 degrees on the affected side post operatively.

The Mean Neck Shaft Angle post operatively on normal side was noted to be 129.80 degrees with a SD of 2.18 degrees.

The mean Neck Shaft Angle on the affected side post operatively was observed to be 130.76 degree with a SD of 2.19 degree.

Sn.	VAS Score	Follow up			
		Post Op	1 month	3 months	6 months
		Freq (%)	Freq (%)	Freq (%)	Freq (%)
1	0-2	0 (0.0)	11 (36.7)	25 (83.3)	30 (100.0)
2	3-5	0 (0.0)	19 (66.3)	5 (16.7)	0 (0.0)
3	6-8	24 (80.0)	0 (0.0)	0 (0.0)	0 (0.0)
4	≥9	6 (20.0)	0 (0.0)	0 (0.0)	0 (0.0)
Total		30 (100.0)	30 (100.0)	30 (100.0)	30 (100.0)

Table 2: Distribution of Patients According To Visual Analogue Scale Scores at Various Follow UPS

Distribution of VAS scores of patients at various follow ups depicts that as the time period is increasing the VAS score is tending to be on the better side, owing to the resolve of post-operative morbidities.

Sn.	Number of Patients	Mean VAS Score				F statistic	P value
		Immediate Post Op	1 month follow up	3 month follow up	6 month follow up		
1	30	7.66 (0.95)	3.1 (0.95)	1.8 (0.71)	0.13 (0.34)	507,23	<0.001

Table 3: Distribution of Patients According To Mean Visual Analogue Scale Scores at Various Follow UPS

On comparing the mean VAS scores immediate post operatively and at various follow ups depicts that the mean VAS scores at various follow ups shows significant difference. The mean VAS score at immediate post op period was 7.66 with a SD of 0.95, while at last follow up, mean score was found to be 0.13 with a SD of 0.34.

Table 4: Distribution of Patients According To Neck Shaft Angle at Affected Side at Various Follow UPS

Sn.	Neck Shaft Angle in degree (affected side)	Follow up			
		Immediate Post Op	1 month	3 months	6 months
		Freq (%)	Freq (%)	Freq (%)	Freq (%)
1	120-124	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
2	125-129	4 (13.3)	4 (13.3)	3 (10.0)	3 (10.0)
3	130-134	24 (80.0)	25 (83.3)	27 (90.0)	27 (90.0)
4	≥135	2 (6.7)	1 (3.3)	0 (0.0)	0 (0.0)
Total		30 (100.0)	30 (100.0)	30(100.0)	30 (100.0)

Distribution of patients according to the Neck shaft angle on affected side depicts that at immediate post op, 80.0% patients had normal neck shaft angle between 130-134 degrees, while at 6 month follow up 90.0% had Neck shaft angle of 130-134, followed by 10.0% patients with of 125-129 degrees.

Table 5: Distribution of Patients According To Mean Neck Shaft Angle of Affected Side at Various Follow UPS

Sn.	Number of Patients	Mean Neck shaft Angle in degrees				F statistic	P value
		Immediate Post Op	1 month follow up	3 month follow up	6 month follow up		
1	30	130.76 (2.19)	131.0 (2.21)	131.10 (2.04)	131.06 (1.94)	0,154	0,926

The mean Neck Shaft Angle on affected side at various follow ups on comparison shows that the difference between mean values was insignificant statistically on analysing with ANOVA test

Table 6: Distribution of Patients According To Difference in Neck Shaft Angle (Affected – Normal) At Various Follow UPS

Sn.	Difference in Neck shaft Angle (in degrees) (Affected- Normal)	Follow up				Chi Square Statistic P Value
		Post Op	1 month	3 months	6 months	
		Freq (%)	Freq (%)	Freq (%)	Freq (%)	
1	< 0	12 (40.0)	12 (40.0)	11 (36.7)	10 (33.3)	1.244 0.998
2	0	1 (3.3)	1 (3.3)	1 (3.3)	2 (6.7)	
3	0-4	15 (50.0)	15 (50.0)	15 (50.0)	15 (50.0)	
4	>4	2 (6.7)	2 (6.7)	3 (10.0)	3 (10.0)	
Total		30 (100.0)	30 (100.0)	30 (100.0)	30 (100.0)	

Distribution according to the difference in Neck Shaft Angle of affected and normal side at various follow up depicts that the differences observed between the visits in the selected subjects were not significant statistically.

Sn.	Number of Patients	Mean difference between Neck Shaft Angle between affected and normal side in degrees				F statistic	P value
		Immediate Post Op	1 month follow up	3 month follow up	6 month follow up		
1	30	1.2 (3.3)	1.2 (3.3)	1.4 (3.4)	1.3333 (3.2)	0,026	0.994

Table 7: Distribution of Patients According To Mean Difference in Neck Shaft Angle between Affected and Normal Side At Various Follow UPS

The mean difference of Neck Shaft Angle between affected and normal side at various follow ups on comparison shows that the difference between mean values were insignificant statistically on ANOVA test.

Sn.	HHS	Frequency	Percentage
1	≤75	4	13,3
2	75-80	12	40,0

3	>80	14	46,7
Total		30	100,0

Table 8: Distribution of Patients According To Harris Hip Score Values

Distribution of patients according to HHS show that 46.7% patients have HHS values of over 80, followed by 40.0% with HHS between 75 to 80. The mean HHS was obtained as 79.20 with a SD of 3.15

Sn.	Shortening (in cm)	Frequency	Percentage
1	0	11	36,7
2	1,0	16	53,3
3	1,5	2	6,7
4	2,0	1	3,3
Total		30	100,0

Table 9: Distribution of Patients According To Shortening of Limb at the End of Follow UP

No shortening was observed in 11 (36.7%) patients. 1 cm shortening was obtained in 16 (53.3%) patients and the rest 3 had shortening of over 1 cm. The mean shortening was obtained as 0.70 cm with a Sd of 0.58

Table 10: Distribution of Patients According To Clinico-Radiological Union Time

Sn.	Clinico radiological union time in weeks	Frequency	Percentage
1	<12	2	6,7
2	12-16	19	63,3
3	>16	9	30,0
Total		30	100,0

19 (63.3%) patients had clinic radiological union time of 12-16 weeks, while 9 (30.0%) had union time of over 4 months. The mean clinic radiological union time was noted as 15.2 weeks with a SD of 2.9 weeks.

Sn.	Complications	Frequency	Percentage
1	Wound Infection	2	6,7
2	Knee Stiffness	2	6,7
3	Persistent pain	1	3,3
4	Nil	25	83,3
Total		30	100,0

Table 11: Distribution of Patients According to the presence of complications at the end of 6 months no significant post op complication was evident in 25 (83.3%) patients. Wound infection and knee stiffness was noted in 2 patients each, while persistent pain was seen in 1 patient.

Discussion

The present prospective interventional study was undertaken among the patients admitted to Orthopedics department with inter trochanteric fracture of femur. A total of 30 patients were included and were followed up. All the patients were then followed up after the operative intervention to assess union as well as changes occurred in neck shaft angle during the due course. Neck Shaft Angle The Mean Neck Shaft Angle post operatively on normal side was noted to be 129.80 degrees with a SD of 2.18 degrees. The mean Neck Shaft Angle on the affected side post operatively was observed to be 130.76 degree with a SD of 2.19 degree. The average immediate post-operative neck shaft angle is 133.36 deg was reported by Bhavik Dalal et.al[13](2013). M. J. O'Malley et.al[14] reported that in their study the neck-shaft angle of the operative hips was 129 deg as compared to 133 deg on the intact side (p = 0.009). The femoral neck angle averaged 128.0° ± 5° was described by Martin F. Hoffmann et.al[15]. Neck Shaft Angles at Follow UPS.

In the present study, at immediate post op, 80.0% patients had normal neck shaft angle between 130-134 degrees, while at 6 month follow up 90.0% had Neck shaft angle of 130-134, followed by 10.0% patients with of 125-129 degrees. Mean Neck Shaft Angle on affected side at various follow ups on comparison shows that the difference between mean values was insignificant statistically. During the first 6 weeks after the operation, a mean decrease of 4.6° was observed in the neck-shaft angle, but there was not a significant difference between the treatment groups in the study by J. Pajarinen et.al[16]. It was around 1.3 degrees in the subjects included in our study. Average difference of neck shaft angle during the period of union is 1.52 was noted by Bhavik Dalal et.al[13]. The mean anteversion was 14.2◦ for the healthy side and 23◦ for the operated side. The mean rotational malalignment was 15.3◦. in the study undertaken by M. Ramanoudjame et.al[17].

Harris Hip Score

46.7% patients have HHS values of over 80, followed by 40.0% with HHS between 75 to 80. The mean HHS was obtained as 79.20 with a SD of 3.15 in our study. 86% of the patients had excellent to good results and 14% had fair and poor results in the study conducted by Bhavik Dalal et.al[13], which is in line with our work. Excellent to good results were accounted for 78% of cases according to Harris hip score in the study by G N Kiran Kumar et.al[18]. However, no significant difference was noted between the groups in HHS in the work undertaken by Yogesh Sharma et.al [18].

Conclusion

The present study entitled "To assess malalignment of neck shaft angle in intramedullary fixation of intertrochanteric fracture" was undertaken among 30 patients with intertrochanteric fracture of femur admitted to the department of Orthopaedics. It can be concluded from our study, that an insignificant difference in neck shaft angle occurs during first 6 months post operatively in inter trochanteric fractures of femur managed by implants. Among implants, it can be realised that short PFN implants was associated with much greater number of complications than others.

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