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LONG PFN NAILING IN COMMINUTED HIGH SUBTROCHANTERIC FRACTURES OF FEMUR IN ELDERLY PATIENTS- A HOSPITAL BASED CLINICAL TRIAL

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Abstract:
Background: The various types of adult proximal femoral fractures require different treatment strategies that depend on a variety of considerations, including the location, morphologic features, injury mechanism, and stability of the fracture, as well as the patient's age and baseline functional status. Subtrochanteric fractures are femoral fractures occurs below the lesser trochanter to 5 cm distally in the shaft of femur.
Objectives: To study the functional outcome of proximal femoral fractures treated with Long Proximal femoral nail in elderly patients.
Methods: This was a prospective clinical trial of femoral Subtrochanteric fracture performed on 300 patients of 40-90 year of age range in three years. All the patients were surgically treated with long proximal femoral nail. Regular follow-up of all cases was done at 2 weeks, 4 weeks and 2 months. At each follow-up, patients were evaluated clinically using the Harris hip score and radiologically with appropriate X-rays.
Results: In our study of 300 cases, Male preponderance and left sided hip fracture was found to be mostly predominant. In our study hospital stay ranges from 1-20 days with a mean average of 10.2 days. Harris hip score was found to be excellent in 81 (27%); good in135 (45%); fair in 50 (16.67%) and poor in 16 (5.4%) patients. All the results showed statistically significant. Five deaths were reported which were not related to the surgical repair.
Conclusion: From our study, we conclude that long proximal femoral nail is a reliable implant for subtrochanteric fractures leading to big rate of bone union and minimal soft tissue damage. Intramedullary fixation has biological and biomechanical advantages but the operation is technically demanding. Gradual learning and great patience are needed in order to make this method truly minimally invasive.
Keywords: Long Proximal Femoral Nail (PFN), Subtrochanteric Fractures, Boyd and Griffin Classification, Harris hip score.

Introduction

These fractures occur typically at the junction between trabecular bone and cortical bone where the mechanical stress across the junction is highest in the femur, which is responsible for their frequent comminution. Incidence of proximal femoral fractures is increasing now a days due to rapid industrialization & high energy trauma due automobiles.[1] It is one of the common cause of morbidity & mortality in elderly patients. Biomechanical test have also confirmed that the subtrochanteric region of the femur is subjected to concentrated high stress and compressive stress in the medial cortex is significantly, greater than tensile stress in the lateral cortex.[2] Treatment of both these fractures is challenging not only in terms of obtaining anatomical reduction but also in terms of selection of treatment modality.[3] The conservative option is associated with very high complications rate, as pneumonia and thromboembolism which come from prolonged immobilization and contribute directly to the high mortality rate. Decubitus ulcer, joint contractures, malunion in varus deformity and shortening is common.[4] Non operative treatment in the form of traction needs prolonged bed rest which might lead to complications like bed sores, Deep vein thrombosis, aspiration pneumonitis which is poorly tolerated specially in elderly. So early stable fixation & mobilization is key to success.[6,7]

Internal fixation and early mobilization is an indication for trochanteric fractures of the femur in elderly. It is accepted by all as the only way not only to reduce the complication and mortality rates from prolonged immobilization.[8] Internal fixation gives also good functional results through avoidance of malunion which can result from conservative

treatment.[9] The treatment of choice is still controversial. The development of the DHS was a revolution in the management of unstable fractures.

The aim of our study was to assess the functional outcomes of subtrochanteric fractures with this newer method of intramedullary fixation with the long proximal femoral nail. We assessed the results with respect to intraoperative details, post-operative results and functional outcome.

MATERIAL AND METHODS

This was a prospective clinical trial performed on 300 patients of 40-90 year of age range in three years from January 2016 to January 2019 in Suraaj Orthopaedic Hospital, Bhilai, Chhattisgarh. All the patients visited to our OPD were having femoral fracture in either leg, were taken into urgent consideration and admitted and consent was taken from each patient before initiation of the treatment.

Patients with dementia, non ambulatory, pathologic fracture, and additional acute lower extremity fractures were excluded from the study.

The **Boyd and Griffin classification** is based on the involvement of subtrochanteric region as shown in atlas at the end of literature.

- Type I linear intertrochanteric
- Type II with comminution of trochanteric region
- Type III with comminution associated with the subtrochanteric component
- Type IV oblique fracture of the shaft with extension into the subtrochanteric region

Once patient admitted to the hospital, all essential information was recorded in the Performa prepared for this study. They were observed regularly during their hospital stay till they get discharged. They were asked to come for follow up regularly to the outpatient department.

Procedure

Exposure of entry point:

- Adequate incision just proximal to greater trochanter was taken. Deepen through tensor fascia lata. Cut Gluteus medius insertion in line with middle of trochanter and palpate the tip of trochanter. Dead AP is 10 degree tilt of C arm. Entry by guide wire and special sleeve with multiple options at the trochanteric tip.
- Distal incision onto the lateral aspect of upper thigh corresponding to the future entry point of guide wires, onto head and neck and window for reduction of fracture or medial pushing of fracture/ fragments to facilitate guide wire entry.
- C-arm was used to determine nail length position, to verify fracture reduction. Read nail length directly from the measuring device image, selecting the measurement that is at or just proximal to the physeal scar, or at the chosen insertion depth. Consider the nail range of 340, 380, and 420 mm. Determine nail insertion point and insert guide wire.

Internal fixation:

- Cannulated 17.0 mm Drill Bit (357.005) through th e Protection Sleeve 20.0/17.0 (357.001) was used over the guide wire, and reamed manually with the Universal Chuck with T-Handle (393.100) as far as the stop on the protection sleeve.
- Particularly careful drilling is required with unstable multifragment fractures. Specifically, avoid varus displacement of the medial fragment by making sure that thehole is drilled both in the medial fragment and the lateral part of the femur.
- Medullary reaming was achieved with the 8.5 mm Reamer Head (352.085) at highest speed and slight but uniform force to advance the reamer head in the medullary canal. Flexible shaft was moved forwards and backwards to remove the bone chips from the reamer head. The nail was inserted manually into the femoral opening. Alternative Insertion can be supported by light hammer blows. 125° or 130° Aiming Arm (357.015 or 357.016) was chosen for the corresponding CCD-angle of the chosen nail.
- Distal locking was performed with two caudal locking bolts at the proximal end. By using image intensification, 4.0 mm Drill Bit (511.417) was inserted into the incision obliquely. End Cap was inserted on nail.

Regular follow-up of all cases was done at 2 weeks, 4 weeks and 2 months. At each follow-up, patients were evaluated clinically using the Harris hip score and radiologically with appropriate X-rays. Harris hip score was used to evaluate the functional outcome in the present study. Results were rated as– excellent: 90-100; good: 80-89; fair: 70-79; and poor: < 70. Data was analyzed at the end of study.

All the data were analyzed using descriptive statistics. The statistical software used was SPSS 20.0. The results were considered significant at a two-tailed level of 0.05.

RESULTS

This was a prospective clinical trial analytical performed on 300 patients of femoral shaft fracture. In this context age range was 40-90 years and the average age of the patients was 60.96 years. Majority of the patients were between 60-75 years. Male preponderance was found to be higher i.e. 61% in our study as shown in Table 1. The elderly females are more prone to fracture of femur due to osteoporosis.

According to Table 2, the left sided hip was fractured in 174(58%) patients of our series. Depending on the anteroposterior and lateral oblique radiographic view available they were grouped into Type I, II, III and IV based on Boyd and Griffin classification of Subtrochanteric femoral fracture. In our series 5% patients had Type I fracture, 22% patient had Type II fracture, 25% patients had Type III and 48% patients had Type IV subtrochanteric femoral fracture.

Left side femoral fracture was most prevalent i.e. 174(58%) and right side fracture was seen in 126(42%) patients. Most of the femoral fracture were caused by trivial fall 96 (32%), road traffic accident 132(44%) and 72 (24%) patients had fall from height.

Associated injuries were observed with the femoral fracture. 20 (6.67%) patients had colle's fracture, 26(8.66%) patients had abrasion, 19(6.33%) patients had lacerated wound and 10 (3.35%) patients were having old fracture on opposite hip. Some surgical or medical conditions were associated with some patients. Hypertension in 74(24.67%) patients and diabetes mellitus in 67(22.33%) patients were found to be most prevalent systemic disease associated with the femoral fracture patients. Anemia in 18 female patients, ischemic heart disease in 12 patients and benign prostate enlargement was observed in 5 patients. Inguinal hernia was observed in 19 patients. All above findings were described in Table 3.

In our study hospital stay ranges from 1-20 days with a mean average of 10.2 days. We operated 98% of patients within first week. Those patients who had no operative or post operative complications were discharged after reduction of pain and swelling within 15 days. 15 patients were discharged on post operative third week. On average total hospital stay 90 patients had less than 10 days and 195 patients had 11-15 days total hospital stay. All these findings were described in Table 4.

According to Table 5, Five patients were died by other complications, 6 patients had peri prosthetic fracture, 12 patients had malunion, 30 patients had nonunion of fracture, 15 patients had superficial wound infection in first week, 21 patients had shortening of leg, 30 patients had stiffness of hip, 45 patients were suffering from bed sores. Out of 300 patients 136 patients were not having any complications after a month.

Table 6 describes functional outcome. 85% patients had varying degree of pain. Limping was absent in 100 patients and mild to moderate in 200 i.e. 66.67 % patients. Use of support was not needed in 104 patients, canes for long walk were used by 117 patient, 55 patients were used cane most of the time. One crutch was used by 9 patients and two canes were used by 5 patients.

106 patients could walk unlimitedly, 117 patients could walk upto 6 blocks, 37 patients could walk 2-3 blocks, 38 patients could walk only in their residence. 244 (81.33%) patients could sit comfortably in ordinary chair for 1 hour, 50 patients comfortable on a high chair for 1/2 hour, 7 patients were unable to sit on chair.

100 patients could climb stairs without use of railing. 141 patients were able to climb stairs with the use of railing. 26 patients were able to climb by any manner and 10 patients could not climb the stairs.

Harris hip score was used to evaluate the functional outcome in the present study. Results were rated as – excellent: 90-100 in 81 (27%); good: 80-89 in135 (45%); fair: 70-79 in 50 (16.67%) and poor: <70 in 16 (5.4%) patients. All above findings were described in Table 7. All the results showed statistically significant.

Table 1: Demographic characteristics.

Age group in years	Gender		Total n(%)
	Male (n)	Female (n)	
40-50	57	36	93(31)
51-60	42	27	69(23)
61<	84	54	138(46)
Total	183	117	300(100)

Table 2: details of fracture

Variable	Group	Frequency	%
Side of fracture	Right	126	42
	Left	174	58
Mode of injury	Trivial fall	96	32
	RTA	132	44
	Fall from height	72	24
Type of Fracture (Boyd And Griffin)	Type I	15	5
	Type II	66	22
	Type III	75	25
	Type IV	144	48

Table 3: associated injuries and other medical problems

Problem		Frequency	%
Associated injuries	NIL	168	56
	Colle's fracture	20	6.67
	Abrasion	26	8.66
	Lacerated wound	19	6.33
	Old fracture on opposite hip	10	3.35
Associated medical/ surgical problems	HTN	74	24.67
	DM	67	22.33
	COPD	30	10
	CVA	18	6
	Anaemia	9	3
	IHD	12	4
	BPH	15	5
	Inguinal hernia	19	6.33

Table 4: hospital stay

Hospital stay	Days	Frequency	%
Pre operative	1-5	294	98
	6-10	6	2
Post operative	1- 5	90	30
	6-10	204	68
	11-15	6	2
Total	<10	90	30
	11-15	195	65
	16-20	15	5

Table 5: post operative complications

Complications	Frequency	%
Death	5	1.66
Peri prosthetic fracture	6	2
Malunion	12	4
Nonunion	30	10
Superficial infection	15	5
Shortening	21	7
Stiffness of hip	30	10
Bed sore	45	15
Nil	136	45.4

Table 6: functional outcome

Function	Criteria	Frequency	%
Pain	None	45	15
	Slight	67	22.3
	Mild	56	18.6
	Moderate	52	17.3
	Marked	26	8.67
Limping	None	100	33.33
	Slight	125	41.67
	Moderate	68	22.62
Use of support	None	104	34.67
	Cane for long walks	117	39.00
	Cane most of the time	55	18.3
	One crutch	9	3
	Two canes	5	0
Walking distance	Unlimited	106	35.33
	6 blocks	117	39
	2-3 blocks	37	12.35
	Indoor only	38	12.66
Sitting	Comfortable in ordinary chair for 1 hour	244	81.33
	Comfortable on a high chair for 1/2 hour	50	16.67
	Unable to sit	7	2.33
Staire climbing	Without using railing	100	33.33
	Use of railing	141	47
	Any manner	26	8.33
	Unable	10	3.3

Table 7: Functional results

Functional result	Frequency	%
Excellent	81	27
Good	135	45
Fair	50	16.6
Poor	18	6
Unknown	16	5.4

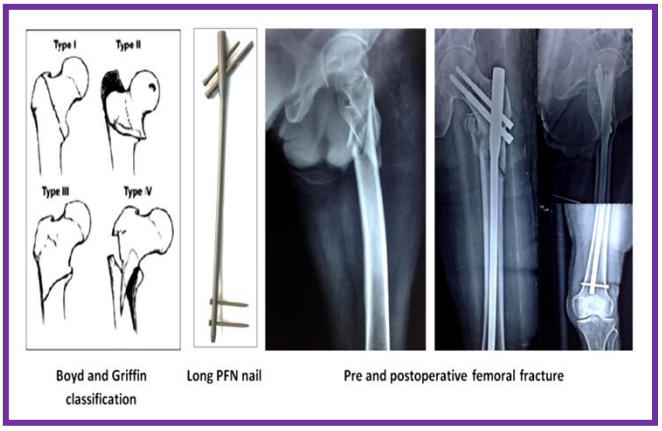

Figure 1:

DISCUSSION

This was a prospective clinical trial performed on 300 patients of femoral shaft fracture. The study was

carried out to evaluate the immediate and early results of long PFN for femoral fractures in elderly patients.

In this context of our study, age range was 40-90 years and the average age of the patients was 60.96 years. Majority of the patients were between 60-75 years. Male preponderance was also found to be higher. Korhan O et al[32] in 2011 use of proximal femoral nail in the treatment of subtrochanteric fracture found that 63% occurred in patients from 51 to more than 70 years old and 24% of patients between 17 to 50 years old.

Male preponderance was found to be higher i.e. 61%. The left sided hip fracture was found to be predominant in our series. Depending on the anteroposterior and lateral oblique radiographic view available they were grouped into Type I, II, III and IV based on Boyd and Griffin classification of Subtrochanteric femoral fracture. In our series 5% patients had Type I fracture, 22% patient had Type II fracture, 25% patients had Type III and 48% patients had Type IV subtrochanteric femoral fracture.

Left side femoral fracture was most prevalent i.e. 174(58%) and right side fracture was seen in 126(42%) patients. Most of the femoral fracture were caused by trivial fall 96 (32%), road traffic accident 132(44%) and 72 (24%) patients had fall from height.

Associated injuries like Colle's fracture, abrasion, lacerated wound and fracture on opposite hip were observed with the femoral fracture. Some surgical or medical conditions like Hypertension, diabetes, Anemia mellitus, ischemic heart disease, benign prostate enlargement and inguinal hernia were associated with some patients. All the patients' intraoperative details were noted in terms of the duration of surgery, ease of reduction, complications, radiation exposure and amount of blood loss. In our series, we had 2 cases of superficial wound infection, which required intravenous antibiotics for 3 weeks' period. Soucanye de LE et al[1] in 2012, Tyllianakis M et al[6] in 2004, extracapsular proximal femoral fractures also depicted similar results.

In our study hospital stay ranges from 1-20 days with a mean average of 10.2 days. We operated 98% of patients within first week. Those patients who had no operative or post operative complications were discharged after reduction of pain and swelling within 15 days. 15 patients were discharged on post operative third week. On average total hospital stay 90 patients had less than 10 days and 195 patients had 11-15 days total hospital stay. Ranjeetesh K et al[14] in 2012, Pan X et al[15] in 2004, Muzaffar N et al[20] in 2013, Liu XW et al[21] in 2009 dynamic hip screw and proximal femoral nail, showed similar results of hospital stay maximum patients were total stayed for 2-3 weeks.

Simmermacher et al[29] in 1999, stated that the mean duration of surgery (skin to skin) was 68.7 min (range 25-240 min). Pajarinan et al[16] in their comparative study of DHS and PFN in proximal femoral fracture, the average time of surgery in DHS was 45 min (range 20-105 min) and in PFN was 55 min (35-200 min). In our study the average time for long PFN arthroplasty operation required was 45-60 minutes. An average intraoperative total blood loss was 1.2 litre, these findings were similar to previous studies.

In the comparitive study by Ranjeetesh et al[14] in 2012, revealed that total operation time for PFN was average 55 min and for DHS was average 87 min, total intraoperative blood loss was average 100 ml in PFN and 250 ml in DHS. Pan et al[15] in 2004, revealed that total operation time for PFN was average 59.16 min and for DHS was average 87.35min, total intraoperative blood loss was average 273 ml and 480 ml in DHS. Pajarinen et al[16] in 2005, revealed that total operation time for PFN was average 55 min and for DHS was average 45 min, total intraoperative blood loss was average 320 ml and 357 ml in DHS. Giraud et al[17] in 2005, revealed that total operation time for PFN was average 35 min and for DHS was average 42 min, total intraoperative blood loss was average 410 ml and 325 ml in DHS.

Five patients were died by other complications, 6 patients had peri prosthetic fracture, 12 patients had malunion, 30 patients had nonunion of fracture, 15 patients had superficial wound infection in first week, 21 patients had shortening of leg, 30 patients had stiffness of hip, 45 patients were suffering from bed sores. Out of 300 patients 136 patients were not having any complications after a month. Soucanye de LE et al[1] in 2012, Tyllianakis M et al[6] in 2004, extracapsular proximal femoral fractures also found similar results like our study.

Limping was absent in 100 patients and mild to moderate in 200 i.e. 66.67 % patients. Use of support was not needed in 104 patients, canes for long walk were used by 117 patient, 55 patients were used cane most of the time. One crutch was used by 9 patients and two canes were used by 5 patients. Keon OJ et al[4] in 2010, Hak DJ et al[5] in 2011 study on

Intertrochanteric Fractures in their study found same results as our study.

106 patients could walk unlimitedly, 117 patients could walk upto 6 blocks, 37 patients could walk 2-3 blocks, 38 patients could walk only in their residence. 244 (81.33%) patients could sit comfortably in ordinary chair for 1 hour, 50 patients comfortable on a high chair for 1/2 hour, 7 patients were unable to sit on chair. Dousa P et al[13] in 2002, Windoff J et al[26] in 2005, Schipper IB et al[27] in 2002, Menezes DF et al[28] in 2005 also have similar results in their studies. Tyllianakis M et al[6] in 2004, extracapsular proximal femoral fractures found similar results.

Menzes et al[28] (2005) in a clinical study of 155 consecutive patients treated with long proximal femoral nail, reported failure of fixation in 2%, femoral shaft in 0.7%, fixation failures included one cut out, one delayed fracture healing and one lateral displacement of the antirotation screw. In our study, no failure of fixation occured, we have reported 10 % nonunion and 4% malunion cases because of associated systemic condition and additional injuries which interfered with the healing.

Simmermacher et al[29] (1999) in a clinical multicenter study, reported technical failures of the long PFN after poor reduction, malrotation or wrong choice of screws in 5% of the cases. A cut-out of the neck screw occurred in 0.6%. In our study, we had no failure rate with 10 % nonunion and 4% malunion.

100 patients could climb stairs without use of railing. 141 patients were able to climb stairs with the use of railing. 26 patients were able to climb by any manner and 10 patients could not climb the stairs. Giraud et al[17] in 2005, revealed that much of the patients could not climb stairs at 2 month follow up. Harris hip score was used to evaluate the functional outcome in the present study. Results were rated as – excellent: 90-100 in 81 (27%); good: 80-89 in135 (45%); fair: 70-79 in 50 (16.67%) and poor: <70 in 16 (5.4%) patients. All the results showed statistically significant.)Soucanye de LE et al[1] in 2012 and Simmermacher et al[29] (1999) in a clinical multicenter study, reported similar results. Our study showed statistically significant results in terms of functional outcome.

CONCLUSION

In the last decade, extra medullary methods of fixation with various angular plates or with a compression hip screw with a plate are more and more replaced by newer intramedullary techniques because of their advantages: The surgical procedure is faster, the blood loss is smaller, the bone healing mainly remains in the reduced position with biomechanically strong fixation, what allows earlier weight bearing on the bone with less local and general complications. From our study, we conclude that long PFN is a reliable implant for subtrochanteric fractures leading to high rate of bone union and minimal soft tissue damage. Intramedullary fixation has biological and biomechanical advantages, but the operation is technically demanding. This study was found to be statistically significant with very few and manageable complications.

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