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"Comparative Study between Long Pfn And Short Pfn in Treatment of Stable Intertrochanteric Fracture Femur"

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Abstract:
Background: *In elderly population it is most often due to trivial trauma. More than 20000 fractures occur every year and the incidence is expected to double by year 2020.[1]. In 2003 Takigamiet al[2] introduced PFN-A which claimed to have better functional outcome in treating pertrochanteric and subtrochanteric fractures when compared to PFN.Most commonly used intramedullary devices for the management of the proximal femoral fractures are Gamma nail and Short PFN. There are different studies available in literature claiming superiority of Gamma nail [3,4] and Short PFN[5,6,7] individually. Among Short PFN and Gamma nail, Short PFN had shown either equal results[8]or better results[9] biomechanically in the management of unstable intertrochanteric fractures. However both implants have higher rate of complications like anterior thigh pain, femoral shaft fractures distal to or around the distal tip of nail [10,11,12,13] and all these lead to higher rate of revision surgery[14] in the form of exchange with other fixation device, screw removal or implant removal to achieve union and adequate mobility.*
Methodology: *We have done a prospective study on stable intertrochanteric femur fractures operated with proximal femoral nailing at government general hospital / Siddhartha medical college for a period of 24 months.The study includes patients with stable intertrochanteric fractures admitted from January 2016 to July 2017,Based on inclusion and exclusion criteria.*
Results:In our series, total number of long PFN cases n = 15,mean age for men is 75.5 , mean age for women is 72 and mean age for long PFN group in our study is 73.7 years.Total number of short PFN cases n = 15, mean age for men is 77.8, mean age for women is 72.8 and mean age for short PFN group in our study is 75.3 years.In the present study, men were more commonly involved. Majority of the patients were male – 9(60%) cases and 6(40%) were females in long PFN group, 10 (66.66%) male and 5 (33.33%) female cases in short PFN groups.Right side was involved in 19 (63.33%) cases and left in 11(36.66%), right side was more commonly involved than left side. In both groups 14 cases (93.3%) affected were due to trivial fall, 1 case (6.66%) was due to RTA. Trivial fall was the most common mode of injury.Mean weeks for radiological union in long pfn group is 13.3 weeks.Mean weeks for radiological union in short pfn group is 14.4 weeks.
In our study, according to Harris Hip Score[15] (modified), good results are seen in 66.66 % cases of intertrochanteric fractures operated using long PFN and 33.33% cases of intertrochanteric fractures operated using short PFN.
Conclusion: *In our results it was evident that the use of Long PFN has advantages over short PFN in terms of the less postoperative complications, less mean time of union & better lower extremity functional scores.Most of the complications of proximal femoral nailing are surgeon and instruments related which can be cut down by proper patient selection, good preoperative planning and preoperative good reduction before entry and correct length of the screws.*
Keywords: *proximal femoral nail,proximal femoral nail antirotation,Association of osteosynthesis, Association for the Study of Internal Fixation,*Orthopaedic *Trauma Association,Dynamic hip screw.*

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I. Introduction

Intertrochanteric fractures occur commonly in elderly patients. Incidence of these fractures has increased primarily due to increased life span and more sedentary life style brought by urbanization.[16] In elderly population it is most often due to trivial trauma. More than 20000 fractures occur every year and the incidence is expected to double by year 2020.[1]. In 2003 Takigamiet al[2] introduced PFN-A which claimed to have better

functional outcome in treating pertrochanteric and subtrochanteric fractures when compared to PFN. Cummings et al[17] proposed 4 possible factors for prevalence of intertrochanteric fractures in elderly 1) loss of local shock absorbers, muscles and fats are inadequate in elderly patients 2) osteoporosis and reduced bone quality 3) slowing down of protective reflexes in elderly 4) orientation of the fall over the hip. More than 90% of hip fractures in elderly are intertrochanteric fractures with complication rate of 20-30% and mortality rate of about 17%.[18,19] Most intertrochanteric femoral fractures occur in elderly individuals as a result of mild to moderate trauma due to osteoporotic bones while in younger patients these fractures usually result from high-energy trauma.[18] Operative treatment is the bestoption in most of the trochanteric fractures. [20] Conventional implants like dynamic hip screw, angular blade plates or cephalomedullary nails can be used for the successful treatment of stable intertrochanteric femoral fractures.[21]

Biomechanically very large force is required to produce the medial migration of femoral shaft with intramedullary device which is a common complication of extramedullary devices.[22]The use of intramedullary devices may allow a faster restoration of postoperative walking ability, when compared with extramedullary sliding devices.[23]

Most commonly used intramedullary devices for the management of the proximal femoral fractures are Gamma nail and Short PFN. There are different studies available in literature claiming superiority of Gamma nail [3,4] and Short PFN[5,6,7] individually. They had shown better or at least comparable result when compared to extramedullary devices. Presently available studies in literature compare the outcome of intramedullary devices versus extramedullary devices in the management of the proximal femoral fractures where either Gamma nail[24-26] or Short PFN[23]is used. However few studies have warranted the use of Gamma nail[10,11] and Short PFN [14] in day-to-day practice as they failed to produce the same results in hands of every surgeon. Among Short PFN and Gamma nail, Short PFN had shown either equal results[8]or better results[9] biomechanically in the management of unstable intertrochanteric fractures. However both implants have higher rate of complications like anterior thigh pain, femoral shaft fractures distal to or around the distal tip of nail [10,11,12,13] and all these lead to higher rate of revision surgery[9,14] in the form of exchange with other fixation device, screw removal or implant removal to achieve union and adequate mobility. Due to above reasons few studies have shown minimal[27] or no advantage of intramedullary devices over extramedullary devices. Long intramedullary devices may overcome these complications.[28]

II. Methodology

In this study, we compared the results of Long PFN against Short PFN with regard to pain, walking ability and instability using Modified Harris Hip score mean time for radiological union and postoperative complications.We have done a prospective study on stable intertrochanteric femur fractures operated with proximal femoral nailing at government general hospital / Siddhartha medical collegefor a period of 24 months.The study includes patients with stable intertrochanteric fractures admitted from January 2016 to July 2017.

Inclusion criteria:
Age of the patient above 60 years
All closed and stable fractures
Acute fractures
All intertrochanteric fractures of type I Evans classification[29]
Medically fit for operative treatment

Exclusion criteria:
All Open fractures
Subtrochanteric fractures and unstable intertrochanteric fractures
All pathological fractures
Age less than 60 years
Patients not fit for the surgery
The study is conducted at Government General Hospital / Siddhartha Medical College, Vijayawada in the Department of Orthopedic surgery. All the patients were randomly allotted either short or long PFN.
Methods of Collection of Data:By History, follow up at interval of 6 weeks,12 weeks,18 weeks and 6 months, clinical examination, analyzing case papers.

On admission patient was first examined thoroughly in primary survey for vital data and other major associated injuries of head, thorax, abdomen or spine along with local injuries

III. Results

In our series, total number of long PFN cases n = 15,mean age for men is 75.5 , mean age for women is 72 and mean age for long PFN group in our study is 73.7 years.Total number of short PFN cases n = 15, mean age for men is 77.8, mean age for women is 72.8 and mean age for short PFN group in our study is 75.3 years.In the present study, men were more commonly involved. Majority of the patients were male – 9 (60%) cases and 6 (40%) were females in long PFN group, 10 (66.66%) male and 5 (33.33%) female cases in short PFN groups.Right side was involved in 19 (63.33%) cases and left in 11(36.66%), right side was more commonly involved than left side. In both groups 14 cases (93.3%) affected were due to trivial fall, 1 case (6.66%) was due to RTA. Trivial fall was the most common mode of injury.Mean weeks for radiological union in long pfn group is 13.3 weeks.Mean weeks for radiological union in short pfn group is 14.4 weeks.

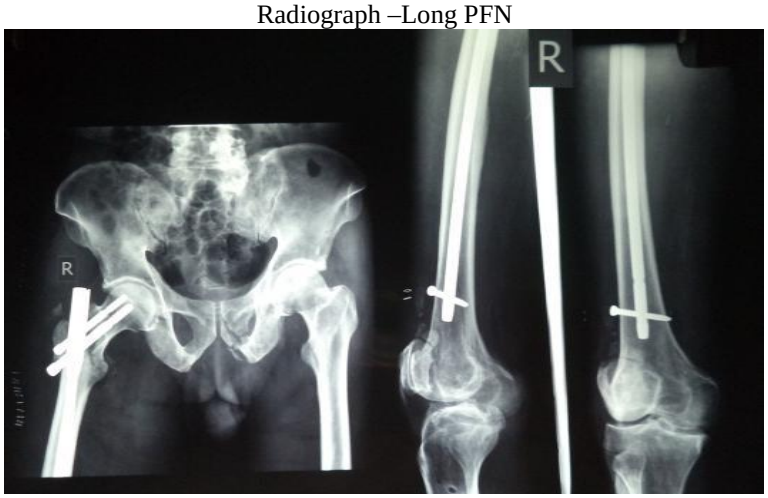
All patients were followed at 6 weeks, 12 weeks,18 weeks, 6 months and some patients up to one year and further if necessary. At each follow up radiograph of operated hip with upper half femur was taken and assessed for fracture union and implant failure and screw cut out. In our study, according to Harris Hip Score (modified), good results are seen in 66.66 % cases of intertrochanteric fractures operated using long PFN and 33.33% cases of intertrochanteric fractures operated using short PFN.

Table -1: Comparitive Study Of Results Of Long Pfn Vs Short Pfn In Our Study

Parameter	Long PFN	Short PFN
Sample Size	15	15
Mean Age(Yrs)	73.7	75.3
Gender (M/F)	9/6	10/5
Side (R/L)	9/6	10/5
Mean Time for Radiological Union(weeks)	13.3	14.4
Mean Harris Hip Score[32] at 6 Months	79.33	77.30
Hip Pain	6.66%	20%
Failure Percentage	0	6.66%

Radiograph –Short PFN

Radiograph –Long PFN



IV. Discussion

Intertrochanteric femur fractures comprise approximately half of all hip fractures caused by low energy mechanism. These hip fractures occur in characteristic population with risk factors including increasing age, female gender, osteoporosis, history of fall and gait abnormality. Inspite of great advances made in the field of trauma in last 50 years management of this fracture has always remained subject of debate. There are several internal fixation options for managing these fractures that generally fall into two categories: some form of intramedullary fixation or some form of plating. Proximal Femoral Nail is a load sharing device with rotational stability and also short lever arm in addition to indirect fracture reduction.

Intertrochanteric fractures are very frequently faced by orthopedic surgeons worldwide. Rapid industrialization &automobile use is increasing their incidence. Usually they are seen from 5th decade of life onwards.[30,31] Osteoporosis, sluggish reflexes, diminishing vision are common associated factors in this age group but now a days following road traffic accidents these fractures are often seen in younger populationalso. Conservative management is poorly tolerated by elderly patients and is associated with complications like decubiuts ulcers, deep venous thrombosis, aspiration pneumonitis, malunion and limb shortening.

To avoid such complications AO/ASIF group in 1997 introduced a third generation intramedullary device called Proximal Femoral Nail. It also works on principal of controlled collapse at fracture site but being intramedullary it has short lever arm, placed closed mechanical axis of femur so it is a load sharing device.[30]

The advantages of this devices are

less soft tissue dissection.

Easy identification of entry portal i.e. tip of greater trochanter.

Addition of 6.4 mm antirotation screw to reduce rotation of cephalocervical fragment.[32]

Longer implant length, small & higher level placed valgus angle.

Small diameter & fluting tip reducing stress riser effect.

Higher placement of distal locking screws avoiding abrupt changes in stiffness of construct thereby reducing stress riser effect.[31]

Facilitates Early Mobilization.

Proximal femoral Nail also has some potential disadvantages like – Reverse Z effect, Z effect[33], high learning curve. In our study, 19 cases were males & 11 were females. In all patients standard 135^0 stainless steel Proximal femoral nail was used. Average operation time was 60 minutes. Non weight bearing mobilization was started in all cases on post operative day 4-5 as per pain tolerance. Average hospital stay was 2 weeks. Fracture healing was assessed clinically and radiologically. Average fracture union was 14.4 weeks. Patients were assessed by Harries Hip Score[32]& Good results were seen in 50% cases. All patients were followed for a minimum period of 6 months.

The proximal femoral nail is an effective load bearing device that incorporates the principles and theoretical advantages of all the intra medullary devices and considered to be the second generation nail.[26]Biomechanically the PFN is more stiff it has a shorter moment arm (i.e. from the tip of the lag screw to the centre of the femoral canal) whereas the DHS has a longer moment arm.The larger proximal diameter of PFN imparts additional stiffness to the nail. It also combines the advantages of closed Intramedullary nailing, a dynamic femoral neck screw, minimal blood loss, shorter operative time and early weight bearing than DHS.[24]

PFN was developed to improve the rotational stability of the proximal fracture fragment and the tip of the nail was re-designed with reduction of the distal diameter of the nail to decrease the risk of intra and post - operative fractures of the femoral shaft by a significant reduction in bone stress. PFN has rotational stability of the proximal fracture fragment and the tip of the nail is of lesser diameter to decrease the risk of intra and post - operative fractures of the femoral shaft by a significant reduction in bone stress. This prospective series demonstrates that there is clinically significant differences in failure rates and hip pain rates in stable inter trochanteric fractures treated by long PFN versus short PFN. The long PFN group had significantly less failure rate and hip pain rate than those with short PFN.Hou Z et al[34] studies had found no differences in using long PFN or short PFN for intertrochanteric fractures and they attribute such no differences to the advance changes in the biomaterials including titanium implants and to give more anatomic fit to the geriatric femur in long nails, similarly short nails were modified in length and incorporated a tapered end and smaller locking screws. All the above changes could achieve the goal of decreasing the incidence of fracture in the diaphyseal region.

In our study we noted that short PFN is not suitable for type A 3 fractures because its distal nail tip is too short to provide effective stabilization, in contrast with long PFN which is suitable for almost all intertrochanteric fractures because it provides stability which has advantages especially in intertrochanteric fractures with severe osteoporosis. In our study hip pain was reported in three cases of short PFN group but only one case in long PFN group. This may be due to the end of long nail is located at distal femur with relatively large medullary cavity thus reducing the pressure on the femoral cortex and less post-operative hip and thigh

pain. In our study, trivial trauma in the form of slip and fall was the most common mode of injury (93%). Results were comparable to that of Pajarinenet al[23] (Trivial fall –89.8%, RTA- 10.2%).

Table 2: Comparison Of Mean Harris Hip Score[15] In Present Study With Other Studies

Study	Year	Mean hip Score
Karni et al [35](n= 60)	2011	92
Present Study (Long PFN)	2017	79.33
Present Study (Short PFN)	2017	77.30

In our study mean hip score with long PFN and short PFN shows fair results when compared to karni et al[35] which shows excellent results. Stable fixation and early mobilization decreases both morbidity and mortality rates and improve functional results when intertrochanteric fractures are treated in elderly patients and those with osteoporosis. Most complications associated with PFN use while treating intertrochanteric fractures are varus collapse of the proximal femur, screw cut-out, shortening of the femur, malunion, secondary fracture of the femur or greater trochanter, thigh pain, screw fracture, heterotopic ossification, and a Z-effect or reverse Z-effect of nails with two lag screws.In this study two different PFNs were compared, which are used in the treatment of stable intertrochanteric fractures and it was found that two different PFN designs yielded comparable results.

In 2005 Pajarinen J et al**[23]** compared post-operative rehabilitation in peritrochanteric fractures treated with a dynamic hip screw versus a proximal femoral nail. They noted that significantly more patients in PFN group have regained their pre injury walking ability and less shortening than in the other group.In our group also they achieved preinjury walking ability and no shortening. Lei-Sheng Jiang et al in his study had no complications such as cutout or breakage of the implants or periimplant fractures. He recommended that the lag screw of PFN should be placed in the lower part of the femoral neck close to the femoral calcar, with screw tip reaching the subchondral bone 5 to 10 mm below the articular cartilage in anteroposterior view. In our study one case of short PFN shows z-effect which accounts for 6.66%.The most recent study evaluating the use of PFN is from Fogagnolo et alwho reported 46 patients with an average rate of intraoperative technical or mechanical complications of 23.4%. They also reported 2 implant failures and 1 fracture below the tip of the nail . No fracture below the tip of the nail is seen in our study.

Simmermacheret al**[36]** in a clinical multicenter study, reported technical failures of the 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% of cases. In our study we did not encounter any such complication as poor reduction, mal rotation or cut out of screws.

Table 3: comparison with other studies.

Parameter	C Boldin et al[6]	Dominigo et al [37]	Fogagnolo et al[38]	Simmermacher et al[39]	Present study with PFN
No.of Patients	55	105	155	49	30
Duration of surgery	68 min	77 in	76 min	46 min	75 min
Bonu union(months)	100% 4 months	100% 9 months	99% 6 months	98% 6 months	85% 6months
Failure of Fixation	0%	11%	2%	0%	1%
Delayed union	_	_	0.7%	2%	0%
Open Reduction	10%	_	1.3%	34.6%	0%
Reoperation Rate	10%	9%	12%	0	0
Duration of hospital stay	12 days		17 days		12 days

Successful treatment of intertrochanteric fractures depends on bone quality, patient age, general health, interval from fracture to treatment, treatment adequacy, comorbidities, and fixation stability.Surgical management is preferred because it facilitates early rehabilitation. The short proximal femoral nail reduces stress concentration at the tip and the smaller distal shaft diameter may prevent femoral shaft fractures. It also acts as a buttress to prevent medialisation of the shaft and provides more efficient load transfer than does a sliding hip screw. It is a superior implant for stable and unstable intertrochanteric fractures in terms of operating time, surgical exposure, blood loss, and complication rates.

Werner et al was the first who introduced the term Z-effect, detected in five (7.1%) of 70 cases. The incidence of cut-out of the neck screw in this study was 8.6%. The Z-effect phenomenon is referred as a characteristic sliding of the proximal screws to opposite directions during the postoperative weightbearing period. In this study one case of short PFN shows z-effect which accounts for 6.66%.

Reverse Z-effect described by Boldin et al[16] occurred with movement of the hip pin towards the lateral side, which required early removal. In their prospective study of 55 patients with unstable intertrochanteric or subtrochanteric fractures, they had three cases with Z-effect[33] and two with reverse Z-effect . In our study one case of short PFN shows z-effect which accounts for 6.66%.

V. Conclusion

In our results it was evident that the use of Long PFN has advantages over short PFN in terms of the less postoperative complications, less mean time of union & better lower extremity functional scores. Most of the complications of proximal femoral nailing are surgeon and instruments related which can be cut down by proper patient selection, good preoperative planning and preoperative good reduction before entry and correct length of the screws.Our sample size reflects the routine patient inflow in our hospital. A study with a larger sample size would have made a better assessment of this surgical intervention. As our study was time bound the patients were followed up for a minimum of 6 months and a maximum of 1 year. Therefore the long-term effects of this intervention remains unknown in our study. A longer follow up would have made a complete assessment of this surgical intervention.

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