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Prospective Study of the Effectiveness of Intramedullary Fixation of Unstable Peritrochanteric Fractures with Interlocking Proximal Femoral Nail

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Abstract
Background: *Femur is the longest and strongest bone in the body and one of the principal load bearing in the lower extremity. Fracture of this bone may result in prolonged morbidity and extensive disability unless the treatment is appropriate. Among fractures of femur, Trochanteric fractures are associated with substantial morbidity and mortality. Aim of this study to assess the effectiveness of Intramedullary fixation of unstable peritrochanteric fractures with interlocking proximal femoral nail.*
Methods: *It is a prospective study involving 21cases.All the cases enrolled in this study were from the Department of Orthopaedics, kanyakumari Govt medical college. Boyd and Griffin classification and Harris hip scoring is used.*
Results: *Among 21 cases, 20 patients came for regular followup. Out of 20 cases 14 were males 6 were females. After the follow up period of 10.75 months it was observed that 1 case developed superior cut out of lag screw with severe varus deformity and another two cases developed varus deformity which is less than 10% and another 3 cases developed abductor lurch. All the other patients were back to their pre injury occupation.*
Conclusion: *PFN proved as a better implant with adequate surgical technique. The requirement and followup based changes in design of PFN decrease the complication rates and increases all the postulated advantages of Intramedullary devices used in the treatment of trochanteric fractutres.*

Introduction

Fractures around the trochanter region of femur are one of the commonest fracturesencountered in orthopaedics and also the most devastating injuries of the elderly. The incidence of this fracture increase with advancing age. In younger patients the fractures usually result from high energytrauma like RTA and fall from height and accounts for only ten percent .older patients suffering from a minor fall can sustain fracture in this area because of weakened bone due toosteoporosis or pathological fracture and this accounts for 90%.

Until 1960's non operative treatment was the option available for these type of fractures in the form of traction with prolonged bed rest with fracture healing occurring in tento twelve weeks (usually) followed by a lengthy programme of

ambulation training. These are associated with complications of prolonged recumbence like decubitus ulcer, UTI, joint contractures, pneumonia and thrombo- embolic complications resulting in high mortality rate.

During this century a better understanding of the biomechanics of the fracture and thedevelopment of better implants have lead to radical changes in treatment modalities. While the development in biomedical research have yielded implants of greater strength and longer fatigue life. With thethorough understanding of fracture geometry and biomechanics optimal treatment can be selected for individual cases.

In unstable trochanteric fractures where there is loss of postero-medial cortexcontinuity, when load is applied increased bending force on the implant 'lead to implant breakage, screw cutout or separation of plate from shaft. This lead to the introduction of Intramedullary devices which theoretically due to its position provides more efficient loadtransfer and shorter lever arm can decrease tensile strain thereby decreasing the risk ofimplant failure.

In 1996, PFN (Proximal femoral nail) was introduced by AO/ASIF which has the biomechanical advantage of all IM devices and considered to be as a second generation nail.[1] PFN is 240 mm in length is made of 316 LVlMstainless steel or titanium. 2 proximal screwscan be inserted into the femoral neck through the proximal part of the nail. Theload bearingneck screw is 11 mm and the tip of it should be placed subchondrallyintothe distal half offemoral head. The other screw is a 6 mm derotation- proximal pin and should be placedthrough the upper part of the nail into the proximal half of the femoral neck to prevent rotationof the head and neck fragment. 2 distal interlocking bolts of 4.9 mm size is inserted through thedistal part of the nail connecting the lateral and the medial cortex of the shaft. It has bothdynamic and static locking. The proximal end of PFN is 17.5 mm in diameter.

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Materials and Methods

At our institution we selected 21 cases of peritrochanteric fractures for this prospective study. All 21 cases were treated with proximal femoral nail (indigenous) of which 20 patients came for regular follow up and they were included in the study. The age group varied from a minimum of 32 years to a maximum of 72 years and average age was 52.7 years. The duration of the study was from June ' 2015 to June ' 2016The mean follow up was 10.75 months. Of the 20 patients 14 were males and 6 were females. Right side was involved in 7 patients and in 13 patients the left side was involved. 13 patients were sedentary workers and 7 patients were manual laborers.

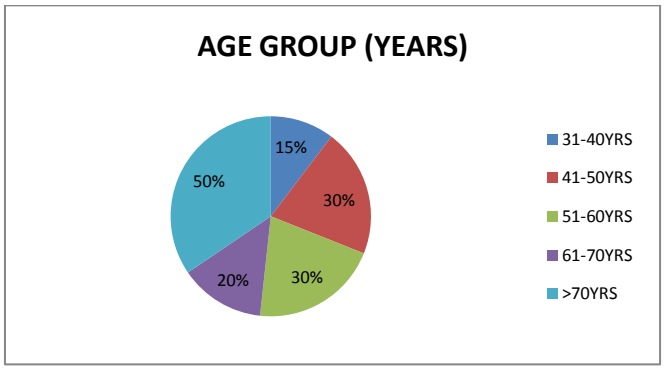
All the fractures were classified according to the Boyd and Griffin classification for peritrocha-nteric fractures.

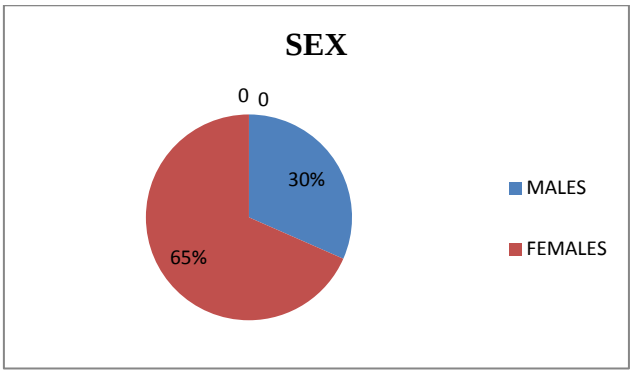
11 patients were classified as type II

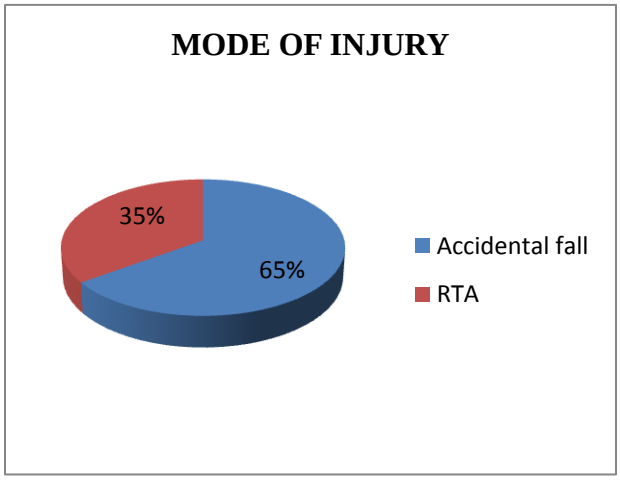
4 patients were classified as type III

5 patients were classified as type IV

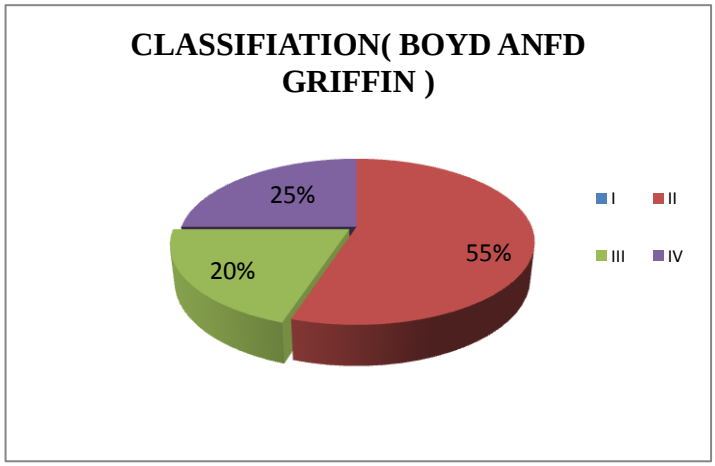
All of them are unstable trochanteric fractures







Accidental fall was the most common followed by RTA



Associated Injuries

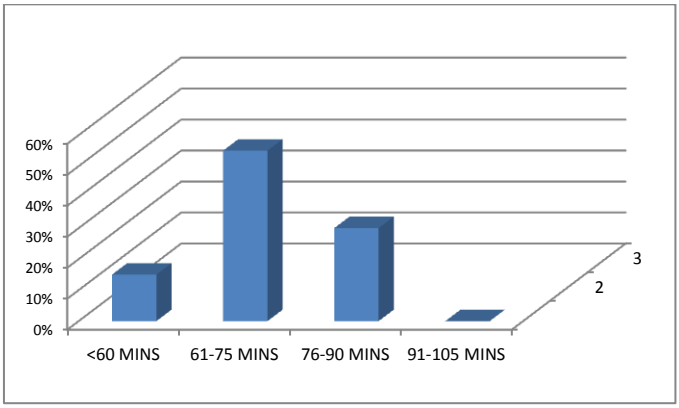
Colle's fracture - 1case

Fracture shaft of humerus - 1case

The average interval from injury to the time of surgery was 5 days. All the patients were managed initially with skin traction before taking up for surgery. Patient with Colle's fractureand fracture shaft of humerus were treated with CMR with POP immobilization for Colle'sfracture on the day of admission and ORIF of fracture shaft of humerus after internal fixation ofthe trochanteric fracture.

Implant

- Length of indigenous PFN - 240mm
- Proximal diameter - 15.omm
- Distal diameters - 9,10,11 &12mrn
- Self tapping derotation- hip pin - 6.0 mm (50,55 ,60 to 110 mm size)
- Self tapping load bearing femoral- 8.0 mm Neck screw (lag) (50,55,60 to 110 mm size)
- Distal locking bolts (2 nos.) - 4.9mm
- 135 angled proximal holes for cervical screws



Operating Time

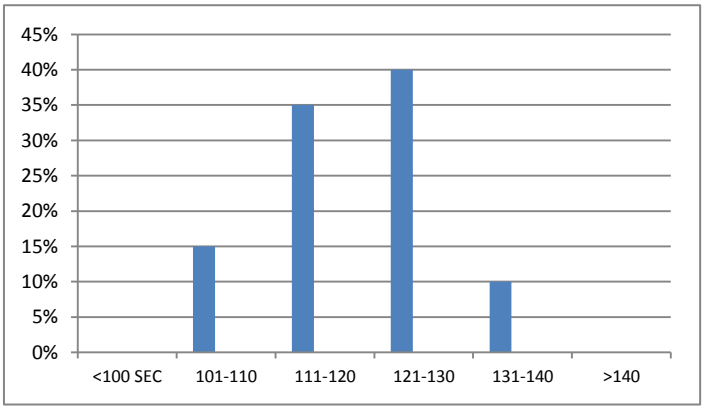
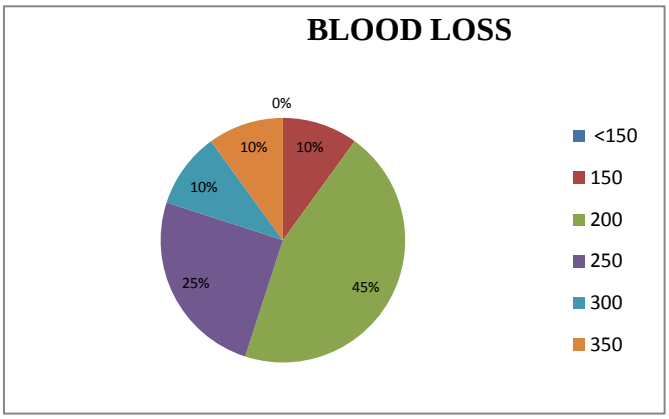
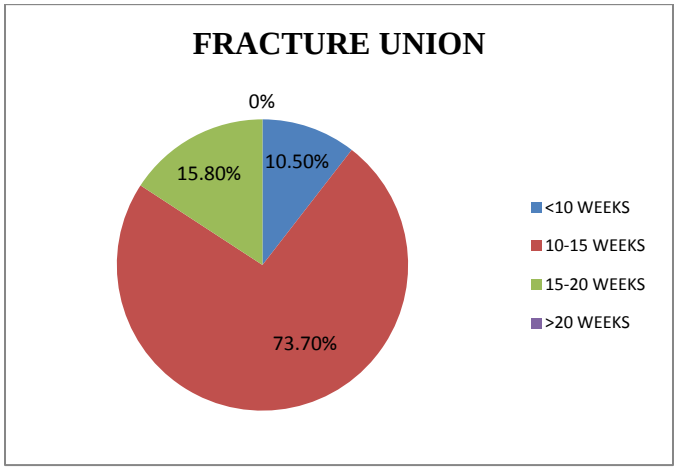


Image Intensifier Exposure (Sec)



Fracture Union



All the patients were ambulated as early as 3 weeks with aids and at the end of 6 weeks allpatients were allowed full weight bearing. The mean Harris hip score at the end of 3 months was 78.65 and at end of 6 months was 85.05.

One patient had cutout of the cervical screws leading to collapse and severe varusdeformity. He was re-operated at 6 weeks with calm replacing cemented bipolarhemiarthroplasty.

Another patient with a single load bearing cervical lag screw developed varus deformityof 8^0. The fracture united and patient was comfortable wit deformity, so left alone. All the otherpatients went back to their pre injury occupation. 3 patients developed abductor lurch whichimproved with time,Superficial wound infection occurred in 1case and it settled down withantibiotics. There was no case of deep infection.

Preoperative Radiograph of Type II Trochanteric Fractrure (Boyd And Griffin Classification)

Trochanteric Fracture Type II Postoperative Radiograph

Type III Trochanteric Fracture Preoperative Radiograph

Postoperative Radiograph Type III Trochanteric Fracture

Results and Discussion

Several fixation devices have been developed to overcome the difficulties encountered inthe treatment of unstable trochanteric fractures. Until recently most of these fractures were treated by sliding hip screw. Since these devices performed less well in unstable trochantericfractures with high rates of failure, intra medullary devices have become increasingly popular. The proximal femoral nail is an effective load bearing device that incorporates the principles andtheoretical advantages of all the intra medullary devices and considered to be the second generation nail (Schipper I.B. et al 2004). Biomechanically the PFN is more stiff, it has a shorter movement arm (i.e. from the tip of the lag screw to the centre of the femoral canal)[7]

The larger proximal diameter of PFN imparts additional stiffness to the nail. It alsocombines the advantages of closed Intramedullary nailing, a dynamic femoral neck screw,minimal blood loss, shorter operative time and early weight bearing than DHS (Leung et al1992)[11]

The gamma nail and IMHS was the first intra medullary devices available from 1988 specifically designed for the treatment of these fractures. Follow up studies showed serious implant related complications like fracture of femoral shaft upto17 % , failure of fixation upto7 % and complications of distal locking in 10 % (Schipper I.B. et al 2004), because of these welldescribed and persistent problems the PFN was developed to improve the rotational stability ofthe proximal fracture fragment and the tip of the nail was redesigned with reduction of thedistal diameter of the nail to decrease the risk of intra and post - operative fractures of thefemoral shaft by a significant reduction in bone stress. Since its introduction in 1997 several clinical studies have shown good results with few intra operative problems and a low rate of complications. In this current study the union rate was 95.0 % with one case of varusmalunion(5.0 %). 1 *case* of re-surgery with calcar replacing cemented bipolar hemiarthroplasty(5.0%).There was no case of perioperative and post operative femoral shaft fractures.

The average blood loss in patients treated with PFN was 232.5 ml. The results were comparable with Schipper I.B. et al2004, Wilhelmina[14]H.G. Ekstrom et a1 2003, Pajarinen J. et a1 2005.

Average Blood Loss	Wilhelmia. H.G. Ekstrom et al – 2003	Schipper.I.B et al -2004	Pajarinen.J et al -2005	Our series
	200ml	220 ml	330 ml	230 ml

Average operating time in our series was 71.5 minutes. In our initial cases operating timewas in a higher range (go mts.). With experience the operating time reduced (58mts.). Resultswere comparable to the series of Dousa et a1 2002, Pavelka t. Et a1 2003,[4]Pajarinen j. Et a1 2005.

Average Operating Time	Dousa et al – 2002	Pavelka. T et al – 2003	Pajarinen.J et al -2005	Our series
	61 min	56 min	55 min	71.5 min

The usage time for image intensifier was 120.10 seconds. Results were comparable to theseries of Dousa et al 2002, Kostal .R et a1 2003 ,Pavelka.T et al2003.

Image Intensifier Exposure	Dousa et al – 2002	Kostal. R et al – 2003	Pavelka. T et al -2003	Our series
	170 sec	80 sce	60 sec	120 sec

In comparison mechanical failure of DHS occurs in lo to 20 % cases primarily due tocutting out of the lag screw superiorly (Wolfgang, Bryant & O'Neill *et* all982). The operativeblood loss in patients treated with DHS using Medoff plate is higher - 350 ml compared to PFhT- 200 ml (Wilhelmina H.G. Ekstrom et al 2003). N l weight bearing is delayed in patients treated with DHS (Leunget all992)[2] · Restoration of walking ability is gained more significantlyfaster in patients treated with PFN than DHS (Pajarinen J. et a1 2005). Despite the short leverarm screw cutout and shaft fractures have been more commonly reported in patients treatedwith Gamma nail (Herrera .A et al2002) [10] than PFN. Pilot studies has shown good outcome withfew complications after treatment with PFN when compared to Gamma nail (Schipper I.B. et al2004) [8]

Multiple factors have been implicated like implant design, fracture stability, operativetechnique, surgeon skills & learning curve in the outcome of good results. Optimal reduction ofthe fracture, conformation of reduction in both AP and lateral views and accurate positioning ofthe nail and screws remain of crucial importance and should be obtained at all times to preventthe important complication of screw cutout. Reduction in distal nail diameter, pre-reaming of femoral canal one size bigger than the implant and meticulous placement of the distal locking screws without creating additional stress risers decrease the complication rate of femoral shaft fractures.

Patients with narrow femoral canal and abnormal curvature of the proximal femur are therelative contra indications to intra medullary fixation with PFN. We have followed theserecommendations in this series. We have not encountered any per operative or post operativefemoral shaft fractures. A larger cohort of patients is necessary to document the incidence ofshaft fractures which is a limitation to our study.

Results	Proximal Femoral Nail	
	Mean	
Operating Time	71.5 min	
Blood Loss	230 ml	
Image intensifier Exposure	120 sec	
Fracture Union	12.6 weeks	
Harris Hip Score at 6 months	85.05	
Superior cut out of lag screw With re-operation	No	%
	1	5.0
Varus Deformity	2	10.0
Abductor Lurch	3	25.0

In our series we had 1 case of superior cut out of lag screw with severe varus deformity that lead to re-operation (5.8 %). Varus deformity in another 2 cases (11.8%) which is lessthan 10 % and they were comfortable, so no intervention was done. Gluteus medius tendoninjury has been reported in 27 % patients treated with IM devices (McConnell et a1 2003). Theabductor lurch may improve in many number of these patients and may also remain static insome patients we had 3 cases of abductor lurch in the post operative period (17.6%) whichimproved with progression of time.

Conclusion

Intra medullary nailing with PFN as claimed has distinct advantages over other intramedullary devices likereduced operating time, less blood loss, rigid fixation and positive effect on the speed ofrestoration of walking. It also has advantage over gamma nail in rotational stability of proximal fragment and reduction in the complication rate of femoral shaft fractures.[(12)]

By decreasing the proximal diameter of the original PFN (17.5mm) to 15 mm and the diameter of load bearing cervical lag screw (11.0 mm) to 8.0 mm, it becomes a suitablealternative for DHS in Indian patients. Early mobilization and weight bearing is obtained inpatients with PFN thereby decreasing the incidence of decubitus ulcer, UTI, hypostaticpneumonia, firombo -

embolic complications related to prolonged recumbency.

The incidence of per operative and post operative femoral shaft fractures can be reducedby pre-reaming the shaft one size more than the diameter of the nail and by distal lockingmeticulously without creating additional stress risers. The incidence of cutout of cervical lagscrew can be reduced by optimal reduction of the fracture and accurate positioning of cervicallag screws and nail.

Finally, we conclude that the PFN is a significant advancement in the treatment ofunstable peritrochanteric fractures which has the unique advantages of closed reduction -preservation of fracture hematoma, less tissue damage, early rehabilitation and early return towork.,However a skilled surgeon may treat the demanding unstable trochanteric fractures withany type of fixation device as long as he or she remembers that the fixation device will nevermake up for surgical failures. Therefore improvement in treatment will predominantly be in thehands of surgeons rather than in those of the implant industry.

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