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Original Research Article

Functional outcome of proximal femoral nail and proximal femur locking compression plate in the treatment of complex proximal femoral fractures

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Abstract

Purpose: To assess functional outcome of proximal femoral nail and proximal femur locking compression plate in the treatment of complex proximal femoral fractures based on harris hip scoring.
Methods: Patients having history of Trauma or RTA who complains of Hip pain and Unable to walk or Swelling around hip aged above 18 years and below 80 years who are admitted in a Tertiary hospital, will be taken for study after obtaining their written informed consent. Totally 30 cases will be taken for the study.15 cases of Proximal femur nail And 15 cases of Proximal femur locking compression plate.
Research design: A prospective type of study.
Methods of data collection:
Collecting of data are as follows-
1. History by verbal communication.
2. Clinical examination.
3. Routine blood investigations and serology.
4. X-Ray Hip AP and Lateral view.
5. Written and informed consent will be taken for surgical procedure.

Results: We observed that PFN has more advantages as compare to PFLCP, PFN has shorter bending lever arm and it can bear more compressive stresses on medial cortex of proximal femur. PFN also prevents varus collapse of the medial cortex of subtrochanteric region thus reducing the incidence of failure rate. In our study we observed that even though there were no major differences in the functional outcomes and union, implant failure was more associated with PFN and there is significant decrease in the amount of blood loss and operating time in patients treated with PFN when compared to patients managed by PFLCP. Our observation was similar to study by V. Srivastava *et al*. where they observed that the blood loss, operating time and incision length was significantly lower in PFN when compared

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to PFLCP.

Conclusion

Both PFN and PFLCP are effective in the management of proximal femoral fractures. Intertrochanteric fractures takes usual time for union whereas Subtrochanteric fractures are fractures which take a longer time for union. No major differences were noted in the functional outcomes and complication between the PFN and PFLCP. Advantages of PFN over PFLCP are decreased blood loss, decreased duration of surgery and less devascularization of the fracture fragments, with less disturbance of fracture haematoma.

Keywords: Intertrochanteric fractures, subtrochantric fractures, PFN, PFLCP

Introduction

Most frequent fractures of proximal femur are intertrochanteric fractures which involve upper end of femur between both trochanters with or without extending into the upper femoral shaft [1] occurring commonly in geriatric patients.

Sub-trochanteric fractures have evolved as one of the most important causes of morbidity and mortality in elderly patients. They account for approximately 10-30% [1] of peritrochanteric fractures. Subtrochanteric region is area below the inferior border of lesser trochanter extending distally 5 cm^2 to the junction of proximal and middle third of femur. These fractures have a bimodal distribution [2] and are seen in two main populations, older osteopenic patients following low energy falls and younger patients with high energy trauma.

Since general life expectancy of population has increased in the past two decades incidence of fractures of proximal femur are also increasing.

In 1990 of overall hip fractures 26% occurred in Asia. This is expected to rise up to 37% in 2025 and 45% in 2050 [2, 3].

Only moderate or minimal trauma is enough to cause proximal femur fractures in geriatric patients. Simple self-fall causes intertrochanteric fractures in elderly people due to osteoporosis and increased incidence of self-fall with increasing age is due to decreased muscle power, decreased reflexes, poor vision and labile blood pressure.

In younger patients it requires high energy trauma.

Intertrochanteric fracture line involves along extra capsular basilar neck region to region along the lesser trochanter, un-displaced fractures and fractures with intact posteromedial cortex are said to be stable [4].

Unstable contribute to about 50%-60% of all intertrochanteric fractures [5, 6, 7]. Early surgical intervention is needed in majority of the patients to avoid the major complications that can occur due to long term immobilization which include deep vein thrombosis, thrombophlebitis, urinary and lung infections and ulcers. This pattern of fracture is associated with higher rates of malunion and non-union than any other femoral fractures because of the anatomical peculiarity of this area.

Traditionally the medial and posteromedial fracture fragments were considered to be important elements in determining severity of peritrochanteric hip fractures [8]. Later GOTFRIED emphasized the importance of lateral trochanteric wall in stabilizing subtrochanteric fractures. Locking plates for stabilising subtrochanteric fractures were developed in 21st century as it can act as a buttress for the lateral trochanteric wall and helps in the stabilisation of lateral trochanteric wall.

Results

In our study the average age of patients where PFN was used was found to be 57 and average age of patients where PFLCP used was 53.

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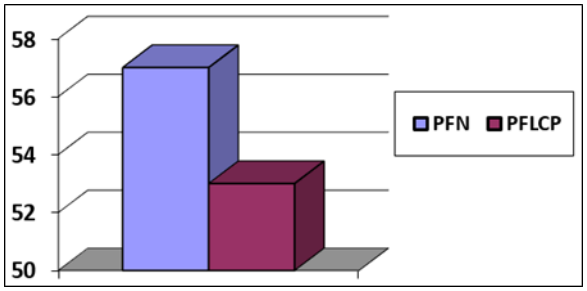
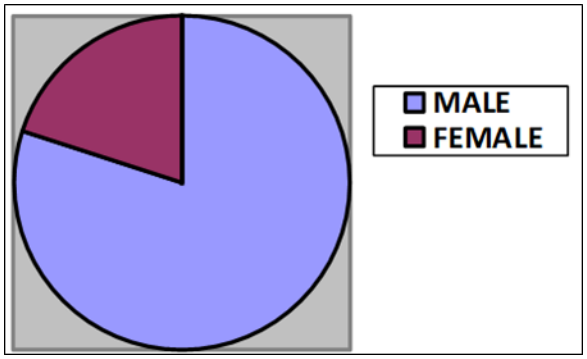


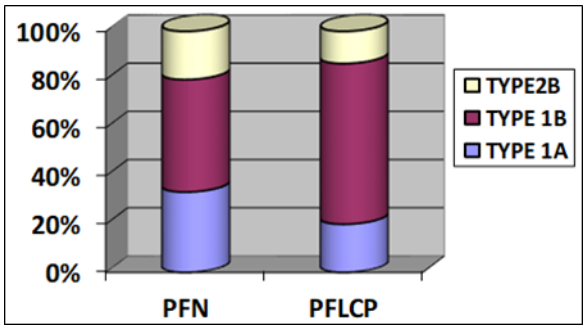
Among our 30 patients in the study 24 patients were males and 6 patients were females.



Out of the 15 cases of PFN all patients 11 were males and 4 were females and among the 15 cases of PFLCP only 2 were females.

In our study we found that among 30 cases 18 cases were following accidental fall and 12 cases were due to RTA.

In our study most of the cases were Russel Taylor Type IB. 3 cases each were classified under Russel Taylor type IIB and 4 cases were classified under type IA.



P value: 0.033, we observed that when the method of reduction was compared in PFN and PFLCP groups, 67% of cases managed by PFN, reduction could be achieved by closed method and this is a significant difference in the method of reduction as compared to PFN and PFLCP group.

In our study bone grafting was done in a total of 4 cases out of which 3 cases primary bone grafting was done and for one case secondary bone grafting was done. Out of the 3 cases of primary bone grafting, 2 were done for PFN patients and one for a case treated by PFLCP. Secondary bone grafting was done for a case of PFLCP which had implant failure and later revision surgery was done with PFN and secondary bone grafting.

The average operating time in PFN patients was found to be 80 min and average operating time in PFLCP patients was found to be 104 minutes.

The average blood loss in PFN patients was found to be 75ml and in PFLCP patients was found to be 150 ml.

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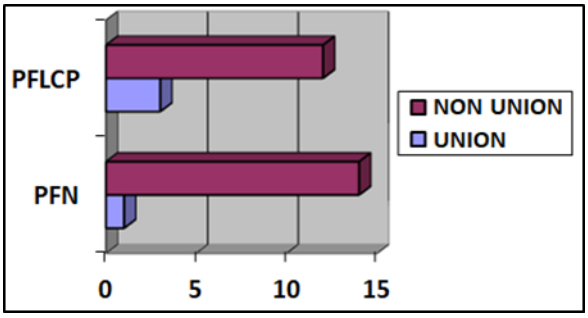
Out of the 30 cases 4 cases went for non-union, Among the 4 cases, 3 were treated with PFLCP. Among the three cases for one of the case revision surgery was done with PFN, One case which was managed by PFN went for hypertrophic non-union.



P value on comparing the union rate of both groups was found to be 0.453 and it means there is not much statically difference in union rates between 2 implants.
The average time for union in weeks for cases managed with PFN was found to be 16 weeks and those managed with PFLCP was found to be 18 weeks.
The average follow up of patients with PFN was 10 months for PFN and 12 months for PFLCP.

Harris hip score

In our study of 30 patients, 27% that is 9 patients had an excellent Harris Hip Score. Out of this 5 cases with excellent Harris hip score, 6 cases were managed by PFN and 3 case managed by PFLCP.3 cases that is 10% of cases had a poor outcome. Patients with Harris Hip Score was categorized as follows:
Excellent: 90-100.
Good: 80-90.
Fair: 70-80.
Poor: less than 70.

In our study of 30 patients varus collapse was seen and in 3 cases managed by PFLCP. In our study screw breakage of proximal locking screws were seen in 2 cases managed by PFLCP and in one case of PFN there was breakage of denotation screw.
Among the 30 cases in our study, shortening was observed in 15 cases, out of which 5 cases was seen in PFN group and 10 cases belong to PFLCP group.3cm shortening was seen in 2 cases, all other cases had shortening of less than 3cM.

Groups		Mean	Std. Deviation	P Value
Age	PFN	57.20	16.390	0.154
	PFLCP	53.50	14.524	
Union	PFN	15.56	2.404	0.069
	PFLCP	18.00	3.024	
Operating Time	PFN	80.00	13.944	.001
	PFLCP	104.00	13.499	
Blood loss	PFN	78.00	13.375	.000
	PFLCP	152.50	32.167	
Follow Up (months)	PFN	9.80	2.440	.301
	PFLCP	11.80	5.412	

Interpretation of P value: P value > 0.05 no significance, < 0.05 is significant and <0.01 highly significant.

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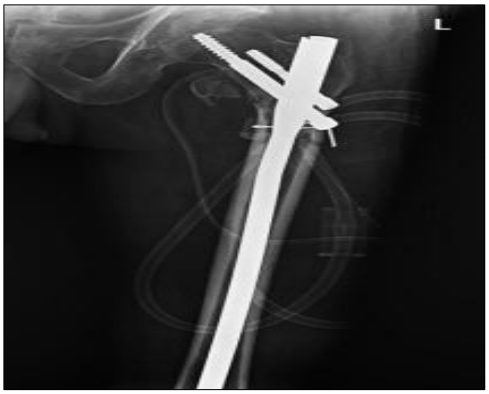
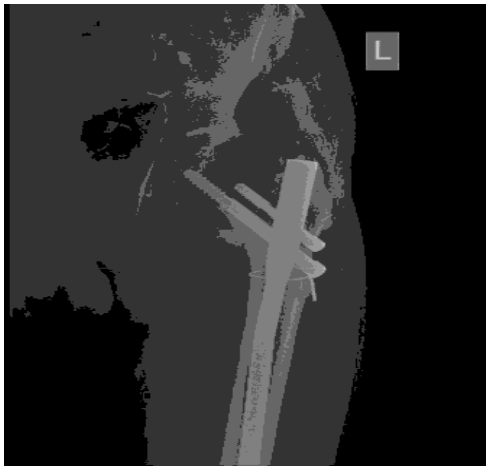
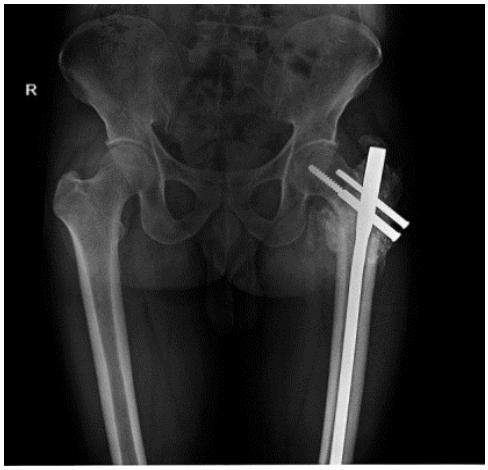
In our study on comparing the operating time and blood loss in PFN and PFLCP groups we observed that the differences were highly significant and the method of reduction when compared to PFN and PLCP group is also of significance. This indicates that there is a highly significant decrease in the average blood loss and operating time in cases treated by PFN when compared to PFLCP group and also closed reduction is seen more with cases managed by PFN when compared to PFLCP.

Left subtrochanteric fracture



Pre OP **Post OP**





16 Weeks **6 Months**

1 Year

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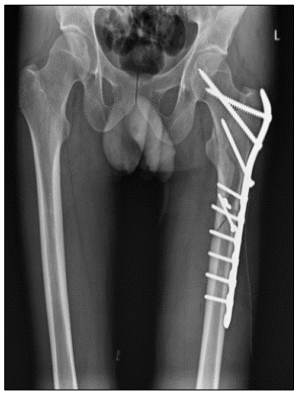
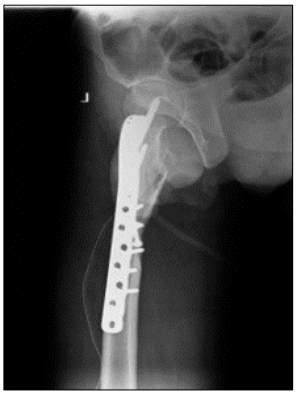
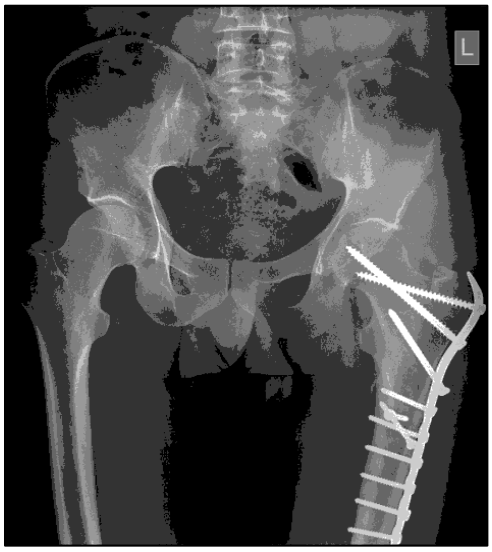
A Case of PFLCP





Pre OP **Post OP**

8 Weeks **12 Weeks** **16 Weeks**



6 Months **1 Year**

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Discussion

In subtrochanteric fractures deforming forces are difficult to curtail and these fractures take a longer time to unite. Hence it is a great challenge for treating orthopedician. It still remains a controversial topic as to which is the best implant. The main system of implants widely used now are the intramedullary hip screw system, intramedullary interlocking nails and the plate screw systems each with its own advantages and disadvantages.

Intertrochanteric femoral fractures contribute to more than half of total hip fractures in elderly osteoporotic patients ageing over 60 years. With increasing life expectancy due to advancements in medical care, the incidence of intertrochanteric fractures are also increasing.

Fall from standing height is the most common mode of injury in these patients. Diminished vision, reduced reflexes, poor muscle tone and balance also contribute to the increased incidence in elderly [9].

Various modalities of treatments are available which include dynamic hip screw, cephalomedullary nail, dynamic condylar screw, cemented hemiarthroplasty with or without augmented calcar reconstruction, proximal femoral locking plate and trochanteric stabilization plate.

The ultimate goal of the treatment being early mobilization of the patients preventing the complications of fracture disease.

Intramedullary fixation has advantages over extramedullary implants as it is more of a biological fixation with less devascularization, less bleeding less surgical duration and early functional recovery [10]. Herscovici *et al.*, in a retrospective study compared the functional outcomes of intramedullary and extramedullary implants and observed that functional results and complications rates were almost similar, but the advantages of intramedullary implants over extramedullary devices were in terms of less bleeding and faster surgical duration.

We observed in our study that the mechanism of injury in majority our patients was following road traffic accidents with 60% of cases sustained fractures following RTA and 40% of cases following accidental fall, a study conducted by [9]Subramanyam Yadlapalli *et al*. also showed similar results. In our study 25% of cases was reduced by closed reduction. A study by Wiss

Donald *et al*. showed 69 cases treated by closed reduction. In a study by [11] Wen Yue Wang *et al*. 80% of cases were reduced by closed reduction. In a study by N Tzachev *et al*. out of 100 cases 60 cases were reduced by closed reduction and 40 cases by open reduction. All cases treated by PFLCP we had to do an open reduction in order to achieve good anatomical fracture reduction, whereas 50% of cases managed by PFN we could achieve open reduction without disturbing the fracture haematoma. The average blood loss in PFLCP group was 152.50 ml. The results of other similar studies are as follows:

The average blood loss in PFN was 78.00ml, there is a significant difference in the amount of blood loss in PFN groups when compared to the PFLCP group (p value 0.00) Studies by [12] V. Srivastava *et al*. where PFN was compared to PFLCP also had a p value less than 0.001. Other studies which showed blood loss in PFN comparative to our studies are:

The average operating time also was significantly lower for PFN group when compared to the PFLCP group. We had a very good union rate in our cases with 90% union rate for cases treated with PFN, with only a single case that went for hypertrophic non-union. Other studies also showed almost similar union rates.

Studies	Union rates
H Bannan *et al*.	85%
Jiang *et al*.	97%
Wang Wen Yue *et al*.	96%
Gunninder Gosal *et al*.	93.4%
Our study	90%

Union rates in PFLCP was 70%, with 3 cases of non-union and. Out of the 3 cases, for one case revision surgery was done with PFN and secondary bone grafting. Our study results were comparable with other study results.

Studies	Union rates
Mark W Floyd *et al*.	78%
Saini *et al*.	90.6%
Owais Ahmed *et al*.	80%
Raghavendra *et al*. N	78%
Nishanth Kumar *et al*.	80%
Our study	70%

In our study we observed that cases treated with PFN union was achieved in a mean of 16 weeks. Other studies where union time for PFN was analyzed and similar to our study were:

Study	Union time
S.V. Yadikar *et al*.	16 weeks
Gurinder GOSAL *et al*.	14 weeks
Thapa *et al*.	3-3.5 months
Korhan Ozkan *et al*.	16.5 weeks
Prasad M Gowda *et al*.	4.6 months
Our study	16 weeks

Weight bearing was delayed in cases treated with PFLCP and full weight bearing was started only after complete radiological evidence of callus formation.

In our study we observed that 80% of cases in PFN group had good to excellent Harris Hip Score [13], S.V. Yadikar *et al*. in their study had 92% of cases with good to excellent results. In PFLCP group 60% of cases had good to excellent Harris Hip Score, study by PK Chalise it was observed that 88% of cases had a good to excellent Harris Hip Score whereas in a study

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by [2, 6] Nishanth kumar *et al*. a good to excellent Harris Hip Score was seen in 77.5% of patients.

Another PFN case that had implant failure, had breakage of distal locking bolts, breakage of the nail distal to the lag screw. The nail broke at 6 months of follow up but eventually the fracture united with varus collapse of the proximal fragment. Reason for break age of the nail could be due to the failure to achieve posteromedial continuity and inadequate reduction.

Among the patients operated with PFLCP, we had 3 cases of implant failure. Revision surgery using PFN was done for one of the cases, 2 other cases no revision procedure was done. One of the patients had plate breakage after 6 months with varus collapse.

Another case where PFLCP fixation was done, had implant failure at 6 months.

Another patient had implant failure at 8 weeks follow up. Patient was not compliant and started weight bearing early in spite of strict advice. In this case the caise of failure was due to early weight bearing of the patient. In a study by [14] Mark. W. Floyd *et al.*, 23% of patients had catastrophic failure of the implant and revision rate was 46% [15]. Glassner and Tejwani reported a 70% failure rate in their studies, 30% of cases developed varus collapse, 20% of cases had breakage of plates. In a study by Naiyer Asif *et al*. union rate was found to be 92%, 3(12%) patients developed bending or breakage of proximal screws and 3 (12%) cases varus collapse was observed. They observed that the failure was due to early weigh bearing before callus formation, and they observed that in all the failure cases there was a lack of posteromedial continuity and patients were unreliable and non-compliant with weight bearing. Wirtz *et al*. recently in their study reported 37% complications in their study included important complications such as infection, cut out and varus collapse which required revision surgeries. In a study by Karl Wieser *et al*. it was observed seen that 4 among total of 14 cases showed failure.

We observed that the cause of failure in our study among PFLCP patients was due to mechanical stress at the plate screw interface caused due to early weight bearing on the affected leg, before bone healing has been completed. This was observed by Haidukewych *et al.* in their study the cause of plate breakage was due to the inability to win the race between fracture healing and implant failure among the patients.

In a study by [16] Jie Wang *et al*. where biomechanical evaluation of different implants like PFN and PFLCP was compared it was observed that PFN was superior biomechanically to other implants in terms of its construct. We observed that PFN has more advantages as compare to PFLCP, PFN has shorter bending lever arm and it can bear more compressive stresses on medial cortex of proximal femur. PFN also prevents varus collapse of the medial cortex of subtrochanteric region thus reducing the incidence of failure rate. In our study we observed that even though there were no major differences in the functional outcomes and union, implant failure was more associated with PFN and there is significant decrease in the amount of blood loss and operating time in patients treated with PFN when compared to patients managed by PFLCP. Our observation was similar to study by [12] V. Srivastava *et al*. where they observed that the blood loss, operating time and incision length was significantly lower in PFN when compared to PFLCP.

Conclusion

Both PFN and PFLCP are effective in the management of proximal femoral fractures. Intertrochanteric fractures takes usual time for union whereas Subtrochanteric fractures are fractures which take a longer time for union. No major differences were noted in the functional outcomes and complication between the PFN and PFLCP. Advantages of PFN over PFLCP are decreased blood loss, decreased duration of surgery and less devascularization of the fracture fragments, with less disturbance of fracture haematoma.

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