A COMPARATIVE STUDY OF PROXIMAL FEMUR LOCKING COMPRESSION PLATE VERSUS PROXIMAL FEMORAL NAILING IN THE MANAGEMENT OF COMMINUTED TROCHANTERIC AND SUBTROCHANTERIC FRACTURE

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ABSTRACT

BACKGROUND

Fractures of proximal femur and hip are relatively common injuries in elderly individuals constituting 11.6% of total fractures. The latest implant for management of intertrochanteric fracture is Proximal Femoral Locking Compression Plate (PF-LCP). In this study, we compare the clinical outcome of fractures treated by proximal femoral nail with that of proximal femur locking compression plate.

MATERIALS AND METHODS

The present study consists of 24 elderly patients of peritrochanteric factures of femur satisfying the inclusion criteria who were treated with PF-LCP or PFN in Department of Orthopaedics, S.V.R.R.G.G.H, Tirupati, during a period between December 2013 to October 2015.

RESULTS

24 cases were treated with PF-LCP or PFN in a randomised pattern who satisfied inclusion criteria. Intraoperative complication were found to be more with PF-LCP in contrast to PFN. Postoperative rehabilitation was easier with PFN though not statistically significant functional and anatomical outcomes were found to be better with PFN.

CONCLUSION

Both PFN and PF-LCP have good effectiveness in the treatment of intertrochanteric fractures with the lateral unsubstantial femoral wall in the elderly patients. Each has its own advantages and disadvantages. Further studies with large number of patients and long-term follow up is needed to determine the optimal implant for the internal fixation of comminuted pertrochanteric femoral fractures.

KEYWORDS

PFN, PF-LCP, Comminuted Trochanteric.

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BACKGROUND

Fractures of proximal femur and hip are relatively common injuries in elderly individuals constituting 11.6% of total fractures.[1] Trochanteric fractures present a huge threat to life. If they are not treated, they may cause a considerable change in quality of life, which results in greater percentage of deaths.[2,3] From the 1980 to 2000, sliding compression hip screw became the gold standard for hip fracture fixation.[4,5,6]

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The complication rate for unstable fractures treated with a dynamic hip screw has shown to be as high as 3% to 15%.[7,8] In 1996, the AO/ASIF developed the Proximal Femoral Nail (PFN) as an intramedullary device for the treatment of unstable per-, intra- and subtrochanteric femoral fractures in order to overcome the deficiencies of the extramedullary fixation of these fractures.[9,10]

The latest implant for management of intertrochanteric fracture is Proximal Femoral Locking Compression Plate (PF-LCP).

In this study, we compare the clinical outcome of fractures treated by proximal femoral nail with that of proximal femur locking compression plate utilising various parameters, very few such studies were done earlier. This study would help in assessing implant choice in comminuted trochanteric and subtrochanteric fractures.

MATERIALS AND METHODS

The present study consists of 24 elderly patients of peritrochanteric factures of femur satisfying the inclusion criteria who were treated with PF-LCP or PFN in Department of Orthopaedics S.V.R.R.G.G.H, Tirupati, during a period between December 2013 to October 2015. This study was carried out to study the results of peritrochanteric fractures treated with PF-LCP or PFN. All the 24 patients were followed up at regular interval.

CRITERIA FOR SELECTION OF PATIENTS

Inclusion Criteria

Age >18 years, unstable intertrochanteric fractures {reverse oblique fractures and intertrochanteric fractures with loss of posteromedial cortex}, signed written informed consent (by the subject or legal guardian) and agreement to attend the planned follow ups.

Exclusion Criteria

Open hip fractures, pathological fractures, any displacement of a femoral neck fracture, active malignancy.

OBSERVATIONS AND RESULTS

Age

In our study, maximum age was 80 years and minimum age was 32 years. Most of the patients were between 50-80 years. Mean age was 59.17 years.

Sex

There were 15 male and 9 female patients.

Cause and Side

Most of cases were due to slip and fall. Right hip was involved in 14 cases, left involved in 10 cases.

TIMING OF INTERVENTION

All the cases included in our study group were fresh fractures who underwent surgery at the earliest possible in our setup. The delay was due to associated injuries and medical condition of the patient. All the patients were operated at an average interval of 10.78 days from the day of trauma.

INTRAOPERATIVE PARAMETERS

In our study, we considered various intraoperative parameters like radiographic exposures, duration of surgery and amount of blood loss. Radiographic exposure was more for PF-LCP in initial few cases. Exposure and duration of surgery was more for initial few cases as we got experienced radiation exposure and duration of surgery was reduced.

Blood loss was measured by mop count (each fully soaked mop contain 50 mL of blood) and collection in suction. External blood loss was more for PF-LCP compared to PFN and in PFN, there was more blood loss where open reduction was performed in which closed reduction could not be achieved.

Reduction though was comparatively easy with PF-LCP as it involved open reduction when compared to closed reduction in PFN stabilising the fracture with PF-LCP was an uphill task. Seating the plate to the contour of proximal femur did not always allow for optimum placement of screws across the neck into the femoral. In contrast optimum, placement of screws in head would lead to prominent plate proximally, which can hinder the abduction. In our study, there was difficulty in achieving closed reduction in one case of displaced and reverse oblique fracture where open reduction was done.

We had no difficulties in distal locking. All the cases were locked distally with at least one locking bolt. There were no instances of drill bit breakage or jamming of nail.

There was one superficial infection among the PF-LCP patients. No deep infection in either group. Varus malunion was seen with 3 cases. Shortening of more than 1 cm was seen in 3 cases. Persistent hip pain is seen in 3 cases due to prominent proximal end plate impinging onto the acetabular edge and adjacent soft tissue. There were no cases of nonunion. There were no cases of hip and knee joint stiffness. There is one case of varus malunion and shortening in patient where the fracture was reverse oblique type and we were forced to open the fracture site to achieve reduction. In turn, open reduction has led to delay in radiological healing. There were no cases of screw cutout and nail breakage. There was no case of femoral shaft fracture or nonunion or implant failure. Hip stiffness developed in one case due to poor postoperative rehabilitation as the patient was not compliant with postoperative advises.

DURATION OF HOSPITAL STAY

In our study, the average duration of hospital stay was 20.08 days for PFN patients and 21.75 days for PF-LCP patients. The mean time of full weight bearing was 10.91 weeks for PFN and 13.17 weeks for PF-LCP. All patients enjoyed good, hip and knee range of motion except for 1 patient of PFN due to prolonged immobilisation resulting in hip stiffness as the patient was poorly compliant with postoperative rehabilitation.

FRACTURE UNION

Time to healing defined as the time of the formation or circumferential bridging callus across the fractures. The average time of healing was in PFN-12.25 week, in PF-LCP-14.31 weeks.

ANATOMICAL RESULTS

Anatomical results were assessed by shortening, hip and knee range of movements and varus deformity.

Anatomical Result	Number of Cases	
	PFN	PF-LCP
Shortening more than 1 cm	1	3
Varus deformity	1	3
Restriction of hip movement	1	0
Restriction of knee movement	0	0

Table 1. Anatomical Results

'p' value 0.4 (not significant).

FUNCTIONAL RESULTS

Interpretation of functional results of PF-LCP and PFN based on Salvati-Wilson's hip scoring system.

Functional Results	Number of Cases		Percentage	
	PF-LCP	PFN	PF-LCP	PFN
Excellent	4	6	58.3%	75%
Good	2	1	16.7%	112.5%
Fair	3	1	25%	12.5%
Poor	0	0	0%	0%

Table 2. Functional Results of Intertrochanteric Fractures

'p' value 0.5 (not significant)

Functional Results	Number of Cases		Percentage	
	PF-LCP	PFN	PF-LCP	PFN
Excellent	2	2	66.67	50
Good	1	1	33.3	12.5
Fair	0	1	0	12.5
Poor	0	0	0	0

Table 3. Functional Results of Subtrochanteric Fractures

'p'value 0.5(not significant)

Case 1

Preoperative

Postoperative

After 6 Weeks

After 6 Months

Sitting Cross Leg

Flexion

Case 2

Preoperative

Postoperative

After 6 Weeks

After 6 Months

Sitting Cross Leg

Flexion

Case 3

Preoperative

Postoperative

After 6 Months

Sitting Cross Leg

Flexion

Squatting

CASE 4

Preoperative

Postoperative

After 6 Weeks

After 6 Months

Sitting Cross Leg

Flexion

Case 5

Preoperative

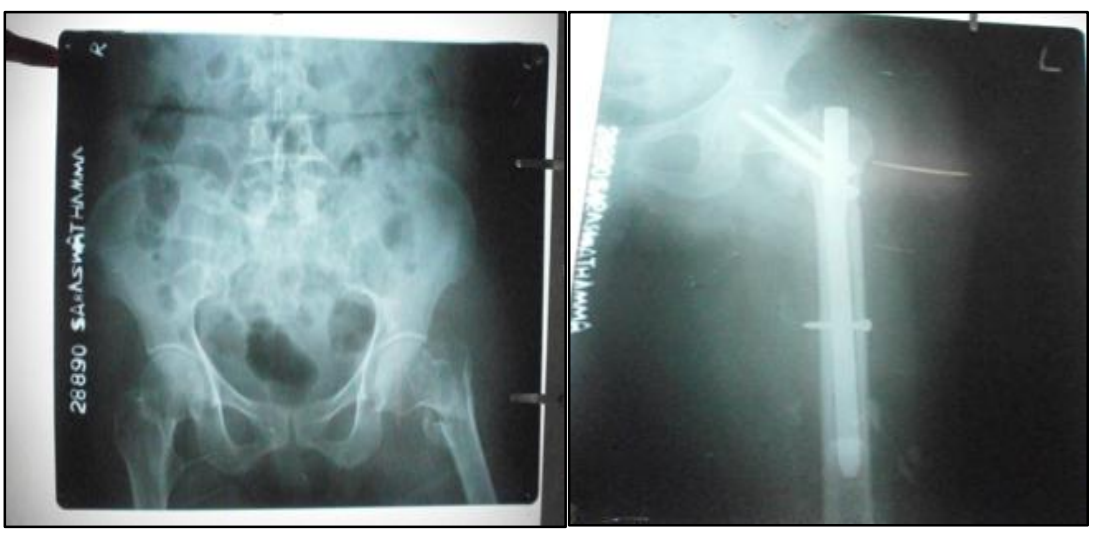
Postoperative

After 6 Weeks

After 6 Months

Flexion ***Standing***

Case 6



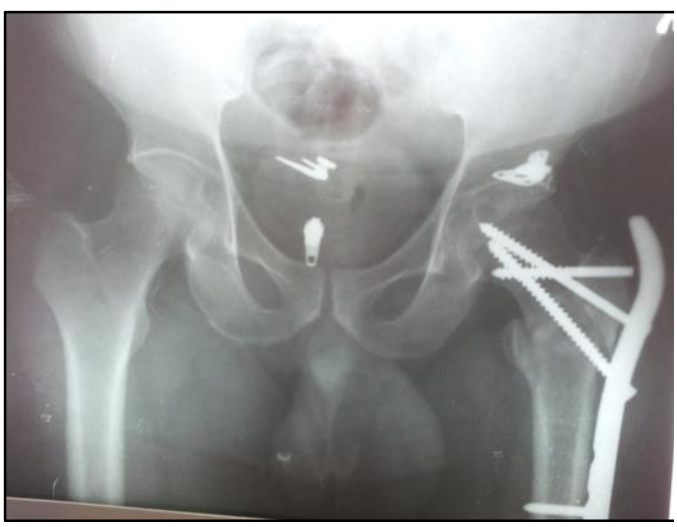
Preoperative ***Postoperative***

After 6 Weeks ***After 6 Months***

Sitting Cross Leg

Flexion

COMPLICATIONS



Broken Proximal Screw

Varus Malreduction with Only 2 Screws Into Head of Femur

Union in Valgus Malreduction

Varus Malunion

DISCUSSION

The treatment of intertrochanteric facture is still associated with some failures.[11,12] The high incidence of complications reported after surgical treatment compels the surgeon to give a second thought regarding selection of proper implant. In our study, 24 cases of intertrochanteric and subtrochanteric fractures were treated by PF-LCP and PFN, 12 cases in each. No definitive criteria was selected for using PF-LCP or PFN for particular patient. They were applied randomly. Fractures common in age group between 50-80 years.

Majority of Cases Occurred in Older Individuals[13]

1. The average life expectancy of an Indian is 10 years less than western standards.
2. Malnutrition and osteoporosis go hand in hand.

SEX DISTRIBUTION

There was a male sex preponderance seen in our study. This is in contrast to female preponderance as observed by various other authors.[14,15]

a. Lower sex ratio with predominant male population.
b. Indian males being more active and mobile than females.

Indian females are mainly confined to household activities and are less prone to sustain an extracapsular fracture of hip.

NATURE OF VIOLENCE

Majority of cases sustained fractures due to slip and fall. In younger individuals due to road traffic accidents.[6]

TYPE OF FRACTURES

In this series, there were 17 intertrochanteric fractures and 7 subtrochanteric fractures.

Most of the fractures Boyd and Griffin type II fractures (11). There were 1 case of type III and 5 cases of type IV fractures.

Among the subtrochanteric fractures, there are 2 cases each of type IIa and IIb and one case each of IIIa and IIIb.

INTRAOPERATIVE DETAILS

We found size of incision was smaller in proximal femoral nail group as compared to PF-LCP group.

This is because learning curve of PF-LCP procedure is steep. Radiation exposure is more for PF-LCP group in initial few cases. We could reduce the radiation exposure from 80 shots to 45 as we became familiar with the operative procedure. Often the placement of the plate was time consuming and required more number of radiographic exposure as most often with adequate positioning of the screws in femoral neck and head, proximal end of the plate would be prominent.

The average exposure in PFN study group was also more, though marginally when compared with other studies. This was due to inability to achieve true lateral view to confirm the position of screws in the head and neck. Most of the shots were consumed for confirmation of screw position in lateral position, most of the patients being from geriatric age group achieving wide abduction of contralateral hip to enable adequate positioning of fluoroscope was compromised. Radiopaque jig was also an hurdle in this regard. Less-trained radiographers was also at times a reason for increase in number of radiation exposure.

Duration of surgery in PF-LCP group was definitely prolonged against that of PFN. Placement of plate to the contour of proximal femur and positioning of the screws in the neck and head of femur was critical and most time consuming. Blood loss is less in PFN patients when compared to PF-LCP group (statistically significant p value <0.001).

INTRAOPERATIVE COMPLICATIONS

Among the PF-LCP group, most of the complications were in relation to the placement of the plate to the contour of proximal femur.

Seating the plate to the contour of proximal femur did not always allow for the optimum placement of screws through femoral head and neck. Any attempt for optimal placement of screw neglecting the seating of plate to the femoral contour would leave behind with a prominent plate proximally above the greater trochanter impinging on the pelvis and limiting the abduction, which may be painful later on.

As most of the cases in our study group were highly comminuted and grossly osteoporotic lacking enough strength in order to achieve sound posteromedial contact often requires to position the head in varus in a position, which also negotiated all the three screws across the neck into the head of the femur.

However, in one case, all three screws could not be placed into the head. Hence, the most proximal screw at 95° was avoided accommodating the other two screws.

We feel that this difficulty is probably due to the very design of the PF-LCP. The design of PF-LCP seems to be anatomically contoured to that of western population. However, it is a known fact that anatomy of proximal femur of Indian population considerably varies from that of western counter parts with shorter, narrow neck and smaller head. Hence, standardising the PF-LCP designed based on western population femoral anatomy could be one of the probable reasons for such difficulties intraoperatively. However, technical errors cannot be ruled out as this is one of the newer mode of treatment involving steep learning curve.

Among the PFN group, there were no major operative difficulties except in one case in reverse oblique fracture where we could not achieve closed reduction and hence required open reduction.

POSTOPERATIVE COMPLICATIONS

One case of superficial infection noted in PF-LCP group, which was treated with appropriate intravenous antibiotics.

There were three cases of varus malunion among PF-LCP group as a consequence of varus malreduction

intraoperatively. However, none of them progressed due to further collapse.

In one case, the proximal most screw broke at the junction of plate and screw, however, union and functional outcome was unaffected. There were no case of screw cutout or backing out.

One case of hip stiffness noted in PFN group due to prolonged immobilisation as patient was poorly compliant with postoperative rehabilitation programme.

In the present study- shortening and varus deformity noted in 3 cases of PF-LCP and 1 case of PFN.

MEAN TIME FOR FULL WEIGHT BEARING

Present study shows mean time for full weight bearing was less in PFN group when compared to PF-LCP group (14.25 vs. 10.45 weeks).

RADIOLOGICAL UNION

Present study shows time for radiological union was less in PFN group were compared to PF-LCP group (P value in <0.01).

Closed reduction preserves the fracture haematoma, an essential element in consolidation process. One cases of PFN where open reduction was done for reverse oblique displaced type of facture in which fracture haematoma disturbed and radiological union was delayed.

FUNCTIONAL OUTCOME

We have applied Salvati-Wilson scoring system to assess the functional outcome in our study population. Hence, it is not possible to have an accurate comparison of the functional outcome of our study with those of previous studies.

In our study, those treated with PF-LCP, outcome had been excellent in 4 patients (58.3%), good in 2 (16.7%), fair in 3 (25%) among the patients with trochanteric fractures. The outcome was excellent in 2 patients (28.57%), good in 1 (14.23%) in the patients with subtrochanteric fractures.

Among those treated with PFN, outcome has been excellent in 6 patients (66.7%), good in 1 (33.3%), among the patients with trochanteric fractures. The outcome was excellent in 1 patient (33.3%), good in 1 (33.3%) and fair in 1 (33.3%) in the patients with subtrochanteric fractures.

CONCLUSIONS

In the present study of 24 patients of intertrochanteric fractures, 12 cases were treated with PFN and 12 cases with PF-LCP. The data was analysed, evaluated and following conclusions were drawn.

- Our study showed that PF-LCP is a complex system, which needs careful consideration of various factors like understanding of the biomechanical principle of the plate, patient factor and definite selection of the patients for the treatment as there were high complication rates with respect to the implant.
- Three failures in our PF-LCP group were mainly due to varus malreduction and shortening. These were due to the result of patient factors as well as technical factors; however, there appears to be a high rate of failure even when surgery is performed by experienced and fellowship-trained traumatologists. The overall results were good in this study group.
- In PFN entry point determination is crucial particularly in elderly with osteoporotic bones as wrong entry point may result in iatrogenic comminution of lateral cortex.
- The length of incision was less in PFN.
- The blood loss was less in PFN.
- Postoperatively- Early mobilisation and can be begun in case of PFN as it is a load sharing device and because of its design.
- Mean time for full weight bearing was less in PFN.
- Radiological union was quicker in PFN.
- Results- Functional results (as per Salvati-Wilson hip score) were better with PFN.
- Complications- Can be avoided in both PFN and PF-LCP with proper patient selection and good preoperative planning.
- With experience gained from each case, operative time, radiation exposure and intraoperative complications can be reduced substantially in case of PFN and PF-LCP.

Hence, our study concludes though the learning curve of open reduction and internal fixation with PF-LCP procedure is steep with proper patient selection, good instrumentation, image intensifier and surgical technique, PF-LCP maybe adopted in patient with comminuted fractures where conventional dynamic hip screw fixation is difficult and not advised and there is need for adequate postoperative immobilisation to prevent implant failure complications.

Both PFN and PF-LCP have good effectiveness in the treatment of intertrochanteric fractures with the lateral unsubstantial femoral wall in the elderly patients. Each has its own advantages and disadvantages.

Further studies with large number of patients and long-term follow up is needed to determine the optimal implant for the internal fixation of comminuted pertrochanteric femoral fractures.

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