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Original article

A retrospective analysis of surgically-treated complex proximal femur fractures with proximal femoral locking compression plate☆

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ABSTRACT

Objective: Analyze the outcomes of proximal femoral locking compression plate (PF-LCP) in these complex fractures.

Methods: This study retrospectively analyzed 21 proximal femoral fractures treated with PF-LCP from June 2013 to February 2015. There were 15 females (71%) and six males (29%) with an average age of 61.4 years (range: 34–80 years). The peritrochanteric fractures constituted by intertrochanteric and subtrochanteric fractures were classified by the Boyd and Griffin classification and Seinshemier's classification, respectively. Among them, 16 cases (76%) were of intertrochanteric and five cases (24%) were of subtrochanteric fracture pattern. The functional outcome was assessed by Harris Hip Score and the Parker Palmer mobility score one year post-surgery.

Results: Among 21 patients, 19 patients obtained fracture union without further intervention; two patients required additional bone grafting. No cases of the hip screw cutting the femoral head were noted. There was no post-operative mortality in this study. The average Harris Hip Score was 84.5 (range: 83–94). The assessment by Parker and Palmar mobility score was 7.5 (range: 4–9).

Conclusion: The PF-LCP is a good, stable alternative in the treatment of peritrochanteric femoral fractures. It provides good-to-excellent bone healing with reduced complications.

☆ Work performed in the Vinayaka Missions Medical College and Hospital, Department of Orthopedics, Karaikal, India.

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Uma análise retrospectiva de fraturas complexas do fêmur proximal tratadas cirurgicamente com placa de compressão bloqueada do fêmur proximal

Palavras-chave:
Fraturas do fêmur
Placas ósseas
Fixação de fratura
Interna

RESUMO

Objetivo: Analisar os resultados da placa de compressão bloqueada do fêmur proximal (PF-LCP) nestas fraturas complexas.

Métodos: Este estudo retrospectivamente analisou 21 fraturas proximais do fêmur tratadas com PF-LCP entre junho de 2013 e fevereiro de 2015. Foram incluídas 15 mulheres (71%) e seis homens (29%) com idade média de 61,4 anos (intervalo: 34 a 80 anos). As fraturas peritrocantéricas constituídas por fraturas intertrocantéricas e subtrocantéricas foram classificadas pela classificação de Boyd e Griffin e pela classificação de Seinshemier, respectivamente. Entre elas, 16 casos (76%) foram classificadas como padrão intertrocantérico e cinco casos (24%) como padrão subtrocantérico. O resultado funcional foi avaliado pelo escore de quadril de Harris e pelo escore de mobilidade de Parker Palmer um ano após a cirurgia.

Resultados: Dentre os 21 pacientes, 19 obtiveram união de fratura sem intervenção adicional e dois pacientes necessitaram enxerto ósseo adicional. Nenhum caso de corte da cabeça femoral pelo parafuso do quadril foi observado. Não houve mortalidade pós-operatória neste estudo. A média do escore de quadril de Harris foi de 84,5 (intervalo: 83 a 94). A média do escore de mobilidade de Parker Palmer foi de 7,5 (intervalo: 4 a 9).

Conclusão: A PF-LCP é uma alternativa adequada e estável no tratamento de fraturas femorais peritrocantéricas, propiciando uma osteossíntese classificada como boa ou excelente, com poucas complicações.

Introduction

Proximal femoral fractures are common injuries that mainly affect the geriatric population.[1] In young and healthy individuals, the injury owes due to high energy trauma, road traffic accidents where as in the elder age group, most of the fractures are osteoporotic, resulting from a trivial fall. Proximal femur fractures comprise, fractures of intertrochanteric and subtrochanteric region or both in combination.

Inter trochanteric fractures are most common in female of elderly age group due to osteoporosis and 90% of these fractures result from a simple fall.[1] As conservative methods prognosed to have higher mortality rates ranging from 4.5 to 22% they are now reserved only for very elderly person with high medical risk for anesthesia and surgery.[2] Thus, surgery by open reduction and internal fixation is the ideal choice of management. The objective of the surgery is to attain initial stability and early mobilization of the patients in order to avoid complications such as deep vein thrombosis, pulmonary embolism, urinary tract and lung infections and ulcers.[2] Dynamic hip screw (DHS) is the gold standard treatment for stable intertrochanteric fractures.[3]

In case of unstable intertrochanteric fractures, the incidence of medialization of distal fracture fragment, implant cutouts and limb shortening are high. In those cases, proximal femur nail (PFN) is the implant of choice.[4,5] PFN has an additional anti rotation pin or set pin which is used to prevent the rotational strain at the fracture site. Due to the better understanding of bio-mechanics of hip fracture and its geometry, this technique could provide promising results.[6,7]

In certain cases, like great trochanter or lateral wall fracture variety in proximal femoral fractures, PFN cannot be performed.[8,9] In those cases, Dynamic Condylar Screw (DCS) is the treatment of choice, but, in case if there is more communition in the lateral wall, DCS is difficult to employ.[10] The lateral trochanteric wall is believed to be an important factor in stabilizing pertrochanteric fractures, keeping the lateral wall intact minimizes the rates of malunion and nonunion as well as can promote in quick fracture healing. This led way to the development of newer methods like Proximal Femur Locking Compression Plate (PF-LCP). It is the feasible alternative for the treatment of these kinds of fractures.[11,12]

PF-LCP provides the surgeon with the easy accessibility to achieve plate to bone apposition as well as axial load compression or angular stability because of three screw fixation pattern at the fracture site. Unlike conventional compression plates, the screw head locks into the PF-LCP, thereby creating an angular stable construct. PF-LCP can provide a stress shield for the lateral trochanteric wall and prevent lateral migration of proximal fracture fragments. Thus, PF-LCP does not fail at the screw bone interface as well as provide a strong anchor in osteoporotic bone. The multiple locking screw holes of the PF-LCP provide various options to overcome any complex fracture pattern. It functions as an internalized external fixator and minimizes the pressure on the periosteum and thereby encourages quick biological healing.[13]

The objective of our study is to analyze the outcomes of PF-LCP in fixation of proximal complex femoral fractures in terms

of union, functional outcome, post-operative complications and failure rate.

Materials and methods

In our study, 21 adult patients with complex proximal femur fractures following the inclusion criteria treated with PF-LCP from June 2013 to February 2015 were retrospectively analyzed from the hospital records. There were 15 females (71%) and six males (29%) with an average age of 61.4 years (range: 34–80 years). Most of the fractures were caused by trivial fall ($n = 14$) followed by road traffic accidents ($n = 7$). The right side was included in eight cases (38%) and the left side in 13 cases (62%). The peritrochanteric fractures constituted by intertrochanteric and subtrochanteric fractures were classified by Boyd and Griffin classification along with Seinshemier's classification, respectively.[14] Among that, 16 cases (76%) were of intertrochanteric and five cases (24%) were of subtrochanteric fracture variety. All cases were followed up routinely.

Inclusion criteria

- Patients with complex proximal femur fractures
- Patients with lateral wall fractures comminution
- Patients with fractures due to severe osteoporosis.

Exclusion criteria

- Simple trochanteric fracture
- Associated Femoral neck fracture
- Pathological fractures
- Reverse oblique and Noncommunited fractures

Surgical technique

As soon as the patient with suspected subtrochanteric or trochanteric fracture was seen, necessary clinical and radiological evaluation was carried out and was admitted to the ward after necessary resuscitation along with splintage using skin traction of adequate weights depending upon his/her nutritional built. Analgesics and appropriate antibiotics were given accordingly through required routes of administration. Patients were assessed for associated medical problems and cross reference was obtained from other concerned departments, if needed. Associated injuries were evaluated and treated simultaneously with remedial measures as early as possible. All patients were operated on planned elective basis.

After adequate preoperative planning, under spinal or epidural anesthesia, patients were positioned supine on the fracture table, reduction achieved, maintained and confirmed under image intensifier paying special attention to the posterior and medial cortical contact. A 15 cm vertical incision was taken from the tip of trochanter in distal direction along the shaft of involved femur. Fascia lata was split in line with the incision and gluteus medius along with vastus lateralis muscles were opened in line with the fibers and tip of the trochanter, thereby exposing the proximal femur with fracture.

Fig. 1 – Proximal femur locking compression plate with screws set.

The ultimate plate position and screw position depends upon the fracture reduction achieved and placement of guide wires into the involved femoral head and neck (Fig. 1). The fixed-angle guide wires are threaded to the proximal three holes of the plate, and the plate is approximated to the proximal femur. Next, a guide wire was advanced through the most proximal (95-degree) hole. The correct path of this wire is approximately 1 cm inferior to the piriformis fossa into the inferior femoral head on the Anteroposterior (AP) view, and central in the femoral head on the lateral view. A guide wire is inserted into the next distal (120-degree) hole, and because this is in a different plane than the first hole, the surgeon must visualize its position on the lateral x-ray. The third guide wire, in the 135-degree hole, is then placed, which is in the same plane as the first hole and may alternatively be inserted near the end of the procedure without compromising the stability of the gained construct. All three guide wires should be in subchondral bone of the femur head before inserting the screws which is confirmed by image intensifier in the AP and Lateral views. The screw lengths are measured using an indirect device over the guide wires with the wire guides still attached and the appropriate, fully threaded, cannulated screws (7.3 mm for the two proximal holes and 5.0 mm for the third proximal hole) are selected. These cannulated screws are inserted over the guide wires following after which the guide wires are removed.

During distal screws fixation, in subtrochantric fractures first fracture should be reduced, then fix the nonlocking screws in compression mode followed by locking screws whereas in intertrochantric fracture can be fixed with locking

Fig. 2 – (a, b) Pre-operative X-rays of 60 years female with left complex proximal femoral fracture; (c, d) immediate post-op X-rays after PF-LCP fixation; (e, f) X-rays showing united fracture at one year follow-up; (g, h) clinical picture showing excellent functional outcome as well as the Parker and Palmar mobility score of 5.7 for the patient.

screws directly. After the completion of the fixation, thorough wash of the wound was given with normal saline and antiseptic solution. Suction drain was inserted at the entry point and wound closed in layers with adequate sterile dressing.

Post-operatively, adequate analgesics, appropriate intravenous antibiotics were given for subsequent five days. Prophylactically, in all patients, subcutaneous Low Molecular Weight Heparin (LMWH) was given for three consecutive days to reduce the risk of bed ridden complications such as deep vein thrombosis, pulmonary etc. Post operative check X-ray was obtained. Drain was removed after 48 h. Bedside knee bending exercises were initiated when pain reduced on third or fourth post-operative day. Patients were reviewed at six weeks, three months, six months and one year after operation with clinical and radiographic assessment for the progress of fracture healing and other complications. The functional outcome was assessed by Harris Hip Score and Parker and Palmer mobility score one year after the surgery.[15]

Results

The patients were followed up for an average of 13 months (12–17 months). The average operating time was 60 min with a mean blood loss of 250 ml (including operative and wound drainage). The average length of incision was 9 cm (8–16 cm). Average image intensifier time was 10 min.

Of the proximal femoral fractures, it was found out, subtrochanteric fractures, took longer operative time, radiation exposure and had more bleeding when compared to intertrochanteric fractures. Amongst the 21 cases, 19 cases healed with no loss of implant position and fracture reduction at the one year follow up check up. There were two cases with delayed union which was severely comminuted, needed additional bone grafting. One case had superficial infection due to uncontrolled diabetes which got settled later on. There were no cases of hip screw cutting the femoral head. There was no post operative mortality in our study.

The average Harris Hip Score was 84.5 (83–94). The results were excellent in 12 cases (57%) (Fig. 2), good in four cases (19%) (Fig. 3) fair in five cases (24%). There were no poor results. The assessment by Parker and Palmar mobility score was 7.5 (range: 4–9).

Discussion

Early surgical treatment of proximal femoral fractures reduces mortality as well as morbidity and thereby reducing the risks

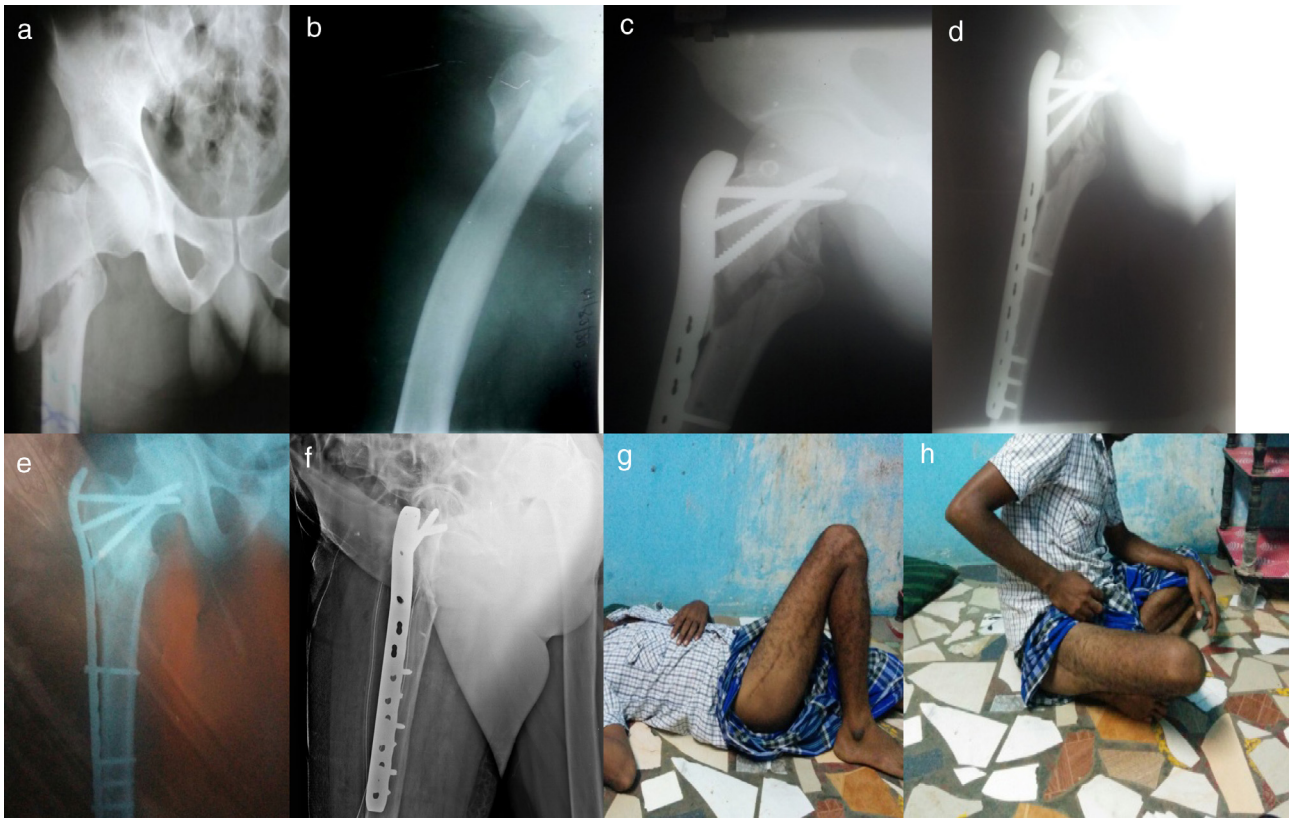

Fig. 3 – (a, b) Pre-operative X-rays of 36 year male with right complex proximal femoral fracture; (c, d) 3 month post-op X-rays after PF-LCP fixation showing delayed union and required additional bone grafting; (e, f) X-rays showing good fracture union at end of one year; (g, h) clinical picture showing fair functional outcome and Parker–Palmar mobility score of 7.7 for the patient.

of prolonged bed rest and associated complications. The ideal treatment of these fractures remains controversial.[16] The fixation method ranges from dynamic hip screw (DHS) in stable fractures and intra medullary devices in unstable fractures which has some theoretical advantage over DHS because they don't depend on the screw fixation of a plate to the lateral cortex which is a problem in a very osteoporotic bone. The failure rate in intramedullary devices ranges from 12.7 to 15% in various studies.[17,18] Finsen found that there was no difference in the time taken to reduce the fracture or the length of operating time by preoperative traction.[19] Resch and Thorngren[20] compared skin traction versus skeletal traction. 50% of skeletal traction compared with 20% of skin traction group. He also found no difference between the two groups as he stated that many patients found the application of skeletal traction painfull, both Finsen and Resch reported no significant difference in the length of operation. These were comparable as same to our case series.

As for the PFN, Fogagnolo et al.[21] found the intraoperative technical or mechanical complication rate as high as 23.4%. Uzun et al.[22] reported non-union 5.7%, secondary varus displacement 25.7%, screw cut-out 5.7%, reverse Z effect 14.3%. Ekström et al.[23] reported a lower complication rate of 8%. In the current study, we found that the management of pertrochanteric fractures fixed with PF-LCP could lower the complication rate than other treatment modalities described above. In our study, there were no cases of inter operative and technical complications as par to other studies compared.[24] Other parameters such as operating time, operative blood loss, radiation exposure time and length of incision are better to those in previous studies using other devices.[11,12,25]

In our study, the union rate with proximal femoral fractures at the end of three months was 88%, at the end of 6 months was 93% and had 100% union at one year follow up. No cases had cut-out of the femoral head screw possibly due to mechanical advantage of three dimension and angular stable fixation by PF-LCP. The implant is biologically and biomechanically suitable in complex femoral fractures associated with severe osteoporosis. From previous studies, the so-called kickstand screw played an important role in preventing varus collapse of the construct.[26,27] The PF-LCP with the "kickstand" screw was reported to have similar biomechanical properties of 95-degree angle blade plate observed. For better results with PF-LCP, the fracture must be adequately reduced and all proximal femoral locking screws (including the 'kickstand' screw) should be inserted to increase the mechanical strength of the construct.[28] PF-LCP locks the fracture in a position without controlled collapse, so varus malalingment is avoided. The multiple locking screws increase the bone

purchase in the femoral neck so it is appropriate for complex proximal femoral fracture fixation even in osteoporotic bone.

Good preoperative templating with good selection of appropriate implant along with adequate fracture reduction as well as all the three proximal femoral locking screws including the "kickstand" screw should be inserted to increase the mechanical strength of the made construct. The indication for PF-LCP is narrower and is used only in special situation. The main disadvantage of PF-LCP is open reduction which can result in increase blood loss and requires skilled technique.[12,25]

Our study has several limitations as the sample size was small and we didn't differentiate trochanteric from subtrochanteric fracture pattern and lack of comparison with other modalities of treatment protocols.

Conclusion

Our study shows PF-LCP is a good alternative for treating complex proximal femoral fractures. The complication rates are much lower. So the treatment of complex femoral fractures is individualized based on patient assessment and experience of the operating orthopaedician team. The PF-LCP provides good to excellent bone healing with a limited number of complications.

Conflicts of interest

The authors declare no conflicts of interest.

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