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Biological fixation of comminuted subtrochanteric fractures with proximal femur locking compression plate

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***Abstract*---**Introduction: Subtrochanteric fractures are challengeable fractures that are associated with high incidence of complications and various intramedullary and extramedullary implants, are available for their fixation.(1) Traditional extramedullary implants are associated with higher rate of implant failure and varus collapse while the intramedullary nails are biomechanically better but technically demanding and are associated with higher re-operation rates.(2)-(3) This study was done to evaluate the outcome following biological (indirect) fixation of comminuted subtrochanteric fractures with proximal femur locking plate (PF-LCP). Methods: Thirty patients with comminuted subtrochanteric fractures were operated upon with PF-LCP (Synthes) by using an indirect reduction technique. Russell Taylor types A and B fractures were included in the study. Operating time, blood loss and any technical difficulty with the implant were recorded. Patients were followed clinically and radiologically for union at fracture site and implantrelated complications. The Harris Hip Score was used to document hip function at final follow-up. Results: The mean operating time was 90.5 min and total blood loss averaged

241.4 ml. Union was achieved in all cases with an average time of 15.87weeks. Complications included two cases of delayed union and two cases of infection. Two cases had a shortening of 1 cm and one case had malunion with external rotation. Conclusion: Biological fixation of comminuted subtrochanteric fractures with PF-LCP provides stable fixation with high union rate and fewer complications.

***Keywords*---**biological, comminuted, subtrochanteric, proximal femur, compression plate.

Introduction

The subtrochanteric fractures of the femur lay in the area which is 5 cm below lesser trochanter, Such fractures are seen as independent entities or as extensions of intertrochanteric fracture (4), account for approximately 25% of all hip fractures and have a bimodal age distribution. (5) These fractures pose a great problem due to the diversity of fracture patterns and difficulty in attaining anatomical reduction. (6) The subtrochanteric region of the femur is subjected to many stresses resulting from bending movements and compressive forces generated by body weight and hip muscles, thus leading to the malunion and nonunion of the fractures and mechanical failure of the implants. Improved understanding of the complex biology and biomechanics of the proximal femoral region as well as the rapid development of orthopedic implants has led to agreement on the treatment of subtrochanteric fractures. However, the appropriate implant for the internal fixation of subtrochanteric fractures remains debatable; and a multitude of different intra- and extramedullary devices for their surgical fixation have been advocated. (7) in the new compression plate systems (LCP) the construct is very stable and provides fixed angle stable design and shows less risk of reduction loss. (7) For long time, the solution for such fractures was open reduction and internal fixation. The technique of open reduction has been changed substantially over the past decades.

Originally, anatomical reduction with rigid internal fixation was desired, entailing too much soft tissue dissection, leaving fragment avascular. (6) through the previous years , the principles of surgical treatment of those fractures have been changed from open anatomic reduction and becomes aiming for more preservation of the biology and the vascularity of the bone and achieving good alignment with stable fixation which helps a lot in more callus formation and lower infection rate . (8) in this study we are reporting the outcome of biological fixation of the comminuted subtrochanteric fracture femur by proximal femoral locked plate of Synthes.

Material and Method

Thirty patients suffering of comminuted subtrochanteric fractures were treated with minimally invasive plate osteosynthesis using the proximal

femoral locked plate of Synthes (PFLCP) from From June 2014 to December 2017 and were followed up till complete union. Russell Taylor types IA, IB, IIA, IIB fractures were included in the study. One case of open fracture due to gun shoot was include. pathological fractures and fractures in skeletally immature patients were excluded. we registered all preoperative data like the age ,sex, comorbidity, fracture classification type time to surgery and surgical data as intraoperative blood loss and the surgical time. We always give preoperative antibiotic cephalozolin 2gm I.V.

Implant properities

The Synthes PF-LCP is a limited-contact stainless steel plate. The proximal portion of the plate is precontoured for the proximal femur. The 2 proximal holes are designed for 7.3 mm cannulated locking screws and third locking hole is designed for 5.0 mm cannulated locking screw. The third screw is angled to converge with the proximal 7.3 mm screw and prevents further varus collapse of the proximal segment so its name kickstand screw , the remaining screw holes in the plate shaft are combi holes to provide the surgeon the ability to achieve Plate- to –bone apposition as well as axial compression or angular stability. (9). Plate specifically designed for left or right femur to accommodate average femoral neck anteversion. Plate lengths allow spanning of the entire diaphysis of the femur. Use of locking screws provides the option of angularly stable construct independent of bone quality. It is made from 316L stainless steel.

Surgical technique

In this series we put the patients supine on translucent traction table. Before scrubbing and drapping we took an image of the lesser trochanter of the healthy side while the patella is facing upward and we fix it on the c arm to use it as acontrol for the rotation of the injuried limb . after scrubbing and drapping in the usual manner we make a longitudinal incision about 5-7 cm from the tip of the greater trochanter downwards and sharply incise iliotibal band and the vastus lateralis muscle in the the same direction of the skin incision. Closed reduction is achieved by correcting the deformity. The proximal segment was most often flexed, abducted and externally rotated. The distal femoral shaft was usually sagging posteriorly relative to the proximal segment. Under C arm control a large(6mm) Schanz screw was inserted in the proximal fragment either through the proximal incision or through a separate one (fig. 1,2), with its direction from anterolateral to posteromedial. Then, another 6mm Schanz screw was inserted in the distal fragment (shaft) within 5cm of the distal end of the fracture in the anteroposterior direction to control the position of the posteriorly sagged shaft fragment (Fig 3). Then a T-handle was applied to every Schanz screw to joystick.

After checking the reduction by c arm image ,we insert the plate extraperiosteally and under the vastus lateralis muscle ,under the c-arm we made another incision at the end of the plate extending it proximally

for about 5cm. ,after deep dissection of the vastus lateralis muscle we expose the plate and fix it to the shaft of the femur by plate holding forceps .after rechecking the reduction and plate position in the sagittal and frontal planes ,we start fixing the plate proximally and distally firstly by ordinary 4.5mm screws to compress the plate to the bone and decrease the plate bone distance as we can then we apply the locked screws proximally and distally consecutively and at the end replace the ordinary screws by locked ones. The length of the plate is determined by plate span ratio (fracture to plate)at least 1:3. At the end the plate was fixed by 3 locked screws proximally and three or four distal locking screws with applying the rule of screw hole ratio 0.4:0.5.

The wounds were closed in layers after inserting a suction drains fig 4. We kept the drain one to two days . Patients walked only toe touch weight bearing on the second postoperative day . the patients started Partial weight bearing after 6 weeks with appearing callus in the x rays and then increased the weightbearing gradually as tolerated. Patients were evaluated clinically and radiologically at 3 months, 6 months and after complete union they were evaluated with the Harris Hip Score.

Fig. 1. Schanz screw was inserted in the proximal fragment either through the proximal incision or through a separate one

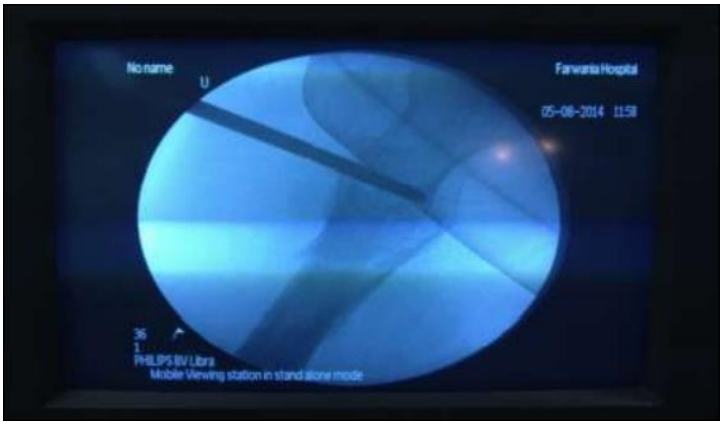

Fig 2. checking the proximal Schanz screw in lateral view

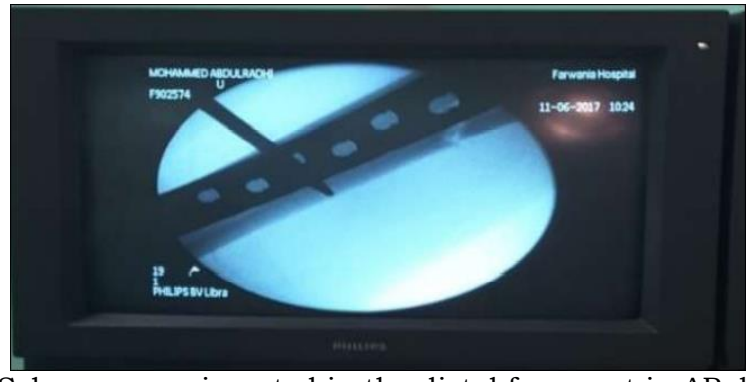

Fig. 3. Schanz screw inserted in the distal fragment in AP direction

Fig 4. post operative wound

Fig 5. comminuted subtrochanteric fracture type IA and the immediate post operative x ray

Fig.6. x ray after 2 years

Fig 7. comminuted subtrochanteric fracture type IIB with x ray after one year

Results

All the patient in the study were male. The mood of trauma included gun shoot in one case , while eleven patients were injuired after falling from high distance and eighteen patients were victims of traffic accidents . The fractures were classified according to Russell Taylor classification system ,type 1Awere found in 18 patients ,type 1B were encounterd in two patients ,type IIA was found in two patients and IIB in 8 patients. The preoperative hospitalization was in an average of 3.6 days (1-9). The surgical procedure time ranged from78-120 minutes (mean 90.5).Intraoperative blood loss ranged from 190-450 ml with mean of 241

ml. All of the patients showed good clinical and radiological limb alignment(less than 10 degrees of varus and less than 15 degress of malrotation) (Figs. 1 and 2). Postoperatively, wound complications was encountered in only 2 cases in the form of serous wound discharge in the early post operative period that was cultured and the result was negative for any organisms and the discharge stopped after repeated dressing and correction of the blood albumin concentration.

The mean follow-up time was 20.3 months (ranged from 6 to 37). The mean duration of healing was 15.86 weeks (ranged from 12 to 36) with one cases suffered delayed healing. In this case of delayed union the cause was early full weight bearing by the patient himself without our instruction and it was managed by removing the broken plate and refixation by longer PFLP of Synthes and the fracture completely united without bone grafting.Limb length was measured clinically by a tape and discrepancy less than 2 cm was detected in 3 cases and did not cause problems for the patients . Two cases (6.7%) healed with slight external rotation (about 10 degrees) and was well tolerated without complaints. Varus up to 10 degrees mal-alignment was detected in 3 cases (10%). Three patients suffered of trochanteric bursitis, which were managed conservatively except in one patient we removed the plate and excised the bursa. The final evaluation according to Harris hip score was, 20 patients (66.7%) with excellent results and 9 patients (30%) with good results and one patient (3.3 %) with fair result.

Discussion

Subtrochanteric fractures of the femur present a challenge to orthopedic surgeons, due to high rates of non-unions and implant failures. (1)and this may caused by the high stresses that acting on this compact bone area . there is no agreement on the most suitable implant in fixation of such difficult fractures . Because of their good biological and biomechanical properties , Intramedullary nails have been recommended for management of the subtrochanteric fractures, However, in some particular conditions the results with intramedullary nails are not often satisfactory [10, 11]. Nailing of comminuted subtrochanteric fracture Rusell Tylor type II where the fracture extends to the pyriformis fossa will be difficult . in some patients with chest trauma in polytrauma patients plating will be more preferred than nailing in long bone fixations . Condylar blade plate , dynamic hip screws ,and dynamic condylar screw were used in management of subtrochanteric fractures but in many situations they were complicated by implant failure ,nonunion and malunion when they were used in tradition way of open anatomical reduction and absolute stability.

So the principles of management has been shifted to more biological fixation aspects and relative stability with preservation of the fragments vascularity to decrease the infection rate and helps in early excessive callus formation to protect the implant and achieve sound union .(12-13). The use of the proximal femoral locked plate in enough length in

minimally invasive technique with its fixed angle stable construct works as internal fixator that helps in callus formation and secondary bone healing and has the advantage of easy insertion and fixation as was found in this study. Celebi et al. used indirect reduction and plate fixation (angle blade plate, DHS,DCS) and get complete union in all cases .They were faced by one case of superficial infection ,and the mean blood loss was 1210 ml. (14) In the current study the union rate was 100% ,there was no case of infection and the mean blood loss was 241 ml. Union occurred in 100% of the cases when indirect reduction and fracture fixation with DCS were used by Vaidya et al. (15)

Siebenrock et al. a have gotten 93% union rate after using closed reduction and blade plate fixation.(16) Biomechanical analysis has shown the PF-LCP to be superior to the DCS,(17) equivalent to an angled blade plate(18,19) but inferior to intramedullary nails (,17) in terms of strength of the construct was used by Chang-Wug Oh et al. used . LCP distal femur of contralateral limb inserted by minimally invasive technique in 20 comminuted subtrochanteric fractures and got 100% union.(20) Wieser et al. (21) reported four cases of secondary varus collapse of the fracture with hardware failure of the implant in unstable intertrochanteric and subtrochanteric fractures. In 2013 Pramod Saini et al, used the proximal femoral locked plate in biological manner for fixation of the comminuted subtrochanteric fracture(7) like in the current series. The plate they used is different from Synthes plate that we used in that the three proximal screws is for 6.5-mm locking head screws that are inserted at angles of 95, 120 and 135, respectively, in relation to the shaft of the femur while in the current thesis, we used Synthes plate with 3 locking screws inserted at the same angles but the 2 most proximal ones are 7.3 mm and the third one is 5.0 mm. The results were comparable in both studies regarding , the mean operative duration which was 90.5 (range :78-120) in this study and 79.5 min (range: 60–95 min) their series, the average blood loss during surgery which was was 241ml (190-450) in this series and was 233.13 ml (245– 315 ml)in their series. Five patients in their series needed blood transfusion in contrast to 2 patients in current study.

Postoperative radiographs showed acceptable alignment in all cases in both series. Inspite of having one case of open fracture due to gun shot ,the result regarding postoperative wound infection (no infection was encountered)in this study is superior to their series in which, there were two cases of infection. Three patients in this study had limb length discrepancy less than 2cm in comparative to 2 patients in their study. 10 cases in this series versus 12 patients in their series complained of pain trochanteric bursitis, which was common in lean and thin patients. In our series we removed the plate after complete consolidation from 3 cases as per their request. regarding Harris Hip Score, in our series 20 patients had excellent outcome, 9 patients had good and one patient had faire outcome .

Conclusion

The results of this study show that Proximal femoral locked plate is a suitable implant for fixation of the comminuted subtrochanteric fracture femur and is good alternative intramedullary nail fixation of commniuted subtrochanteric fractures in condition that we preserve the vascularity of the bone by biological fixation, achieve perfect placement of the plate along the proximal femur to prevent varus malalignment and get adequate length of the plate to decrease the stiffness of the construct.

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