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TO EVALUATE THE OUTCOME OF SUBTROCHANTERIC FEMORAL FRACTURES FIXATION USING CONTRALATERAL REVERSED DISTAL FEMORAL LOCKING PLATE-PROSPECTIVE AND SINGLE CENTRIC STUDY

PRASHANT PANDEY[a1], H.S. VARMA[b], K.K. PANDEY[c] AND D. PEEPRA[d]

[abcd]Department of Orthopaedics, Traumatology and Rehabilitation, NSCB MCH, Jabalpur, M.P., India

ABSTRACT

The two primary options for treatment of sub trochanteric fractures are intramedullary fixation and extra medullary fixation. However as several complications may be encountered with all these methods, there is still no ideal treatment. In our study we intend to present a reversed (upside down) contralateral (plate of opposite limb) distal femoral locking compression plate (DFLCP) as a biomechanically sound alternative extra medullary device for this fracture fixation. 30 (21 male and 9 female) patients with mean age 30 year of sub trochanteric femoral fracture were fixed with Contralateral Reversed Distal Femoral Locking Plate. Outcome was assessed by using Harris hip score and VAS score. Mean time of union was 13 wk. Mean Harris hip score and VAS Score at final follow up was 88.3 and 1.27 respectively. In our study one patient had plate bending and two patients had screw breakdown which leads to varus deformity at fracture site. Our study showed that reversed contralateral DFLCP, when used for fixation of the subtrochanteric fractures shows results comparable to those achieved by using other extramedullary implants as well as intramedullary devices.

KEYWORDS: Subtrochanteric, Contralateral, Reversed, DFLP

Subtrochanteric fractures are femoral fractures where the fracture occurs below the lesser trochanter up to 5cm distally in the shaft of femur (Marsh *et al.*, 2001). The bone in this region is a thick cortical bone with less vascularity and results in increased potential for healing disturbances. Subtrochanteric fracture is difficult to manage and associated with many complications (McLaurin and Lawler, 2004). The two primary options for treatment of subtrochanteric fractures are intramedullary fixation and extra medullary fixation. However, as several complications may be encountered with all these methods, there is still no ideal treatment choice (Baumgaertner, 2002) (Adams *et al.*, 2001). The anatomic structure of the region and biomechanical properties make treatment difficult and increase the risk of complication-related additional surgical interventions (Ahrengart *et al.*, 2002) (Ekstrom *et al.*, 2007).

Intramedullary nails have been considered the technique of choice for treating simple subtrochanteric femoral fracture (Winquist *et al.*, 2001). However various problems are associated with the application of intramedullary nails such as nonunion, delayed union, varus deformity, shaft fracture during surgery, fracture of the trochanter major, perforation in the femoral neck or knee joint and fixation device breakage (Kakkar *et al.*, 2005). Many internal fixation devices have been recommended, but because of high incidence of complications like non-union and implant failure, a series of evolution in designing a perfect implant has begun. Various extra medullary devices have also been developed and used over time for fixing subtrochanteric fractures such as angled blade plate, dynamic condylar screw, proximal femur locking plate and sliding ones that have been most widely used in this area (Schatzker *et al.*, 1989) (Wolfgang *et al.*, 1982) (Yoo *et al.*, 2005). These extra medullary devices when used through a minimally invasive technique, put in the sub muscular zone, preserve both the periosteal and endosteal blood supply in addition to providing stability and environment for fracture healing (van Meeteren et al., 1996).

In our study we intend to present a reversed (upside down) contralateral (plate of opposite limb) distal femoral locking compression plate (DFLCP) as a biomechanically sound alternative extra medullary device for fixation of subtrochanteric fractures in adult, as it provide an added number of screw options for proximal femoral fragments, thus resulting in a more stable construct with higher pull out resistance (Yao *et al.*, 2011) (Zhou *et al.*, 2012) (Tao *et al.*, 2013).

MATERIALS AND METHODS

Sample Size: 30 patients of subtrochanteric femoral fracture were fixed with Contralateral Reversed Distal Femoral Locking Plate.

Inclusion Criteria

Age of more than 18 yrs, Subtrochanteric femoral fracture with extension into piriform fossa, patient with narrow medullary canal**,** Reverse oblique intertrochanteric fracture.

Exclusion Criteria

Pathological fractures, Fracture in children, Old neglected fracture and soft tissue infection at fracture site,

[1]**Corresponding Author**

Open injury, Previous surgery for proximal femoral fracture, Associated Pelvic fracture, ipsilateral distal femur fracture, On-going CT or RT for any malignancy.

30 patients of subtrochanteric fracture of femur were operated at our centre by using Contralateral Reversed Distal Femoral Locking Plate. These all were included in our study and were followed up prospectively at the time of discharge, at 4 week, at 3 month, at 6 month, at 1yr, at 1.5yr and at 2yr.

Surgical Approach

In this study we had used lateral approach for proximal femur which was used for plate insertion in sub muscular plane and we also used another incision on lateral aspect of thigh over distal end of plate.

Proximal skin incision was made at the centre of proximal femur begin at the tip of the greater trochanter and extending distally about 5 to 7 cm. Subcutaneous tissue cut along the skin incision. Than fascia lata was cut along the skin incision. Now fascia of vastus lateralis splited and we elevate the proximal part of vastus lateralis muscle off the intermuscular septum. Now we release the origin of vastus lateralis muscle from the trochanteric ridge. Now we made sub muscular plane to insert the plate.

Contralateral (left sided plate for right side) Reversed (upside down) plate of appropriate length(mostly 10 hole) was placed with its proximal part at Trochanteric ridge with proximal most screw at the level of superior border of neck. We fix the plate to the proximal fragment with the help of screw placed in second or third 6.5mm locking cancellous screw hole. Than we reduce the fracture and fix non locking cortical screw in distal fragment just below fracture to stabilize the fracture and to reduce the bone plate interface. We introduce 4-5 proximal locking screws. While inserting proximal screw, C arm is used to confirm their placement in the neck in anteroposterior and lateral view.

During proximal screw placement in the neck we use technique of sounding of the screw hole with the help of depth gauze to reduce the fluoroscopy time. We tried to place the screws in line of neck and used most of the locking screws in the proximal fragment. We put 4-5 screws distal to the fracture. We did not denude the bone only fracture site was exposed to attain direct anatomical reduction. Being a locking plate, it did not require any periosteal stripping. For the purpose of fixation in the proximal femur, the target was to drive long screw in two rows of locking screw through the proximal expanded part of locking plate and 4-5 screws in distal fracture fragment. All wound were closed over drain which was removed after 24 hrs. of surgery.

Postoperative Details

Postoperatively patient kept in general ward, post op haematological investigation, postoperative x-rays was obtained, dressing notes collected. From second post op day patients was allowed to sit on the bed and knee and hip physiotherapy was started. Average duration of inpatient care was 6 to 8 days. Patients strictly advised not to bear weight at least for 3 months.

Follow up

Follow up was recorded at immediate post op, at discharge, at 1 month, at 3 month, at 6 month and at 1yr, at 1.5 yr and at 2 yr.

OUT COME ASSESSMENT

Functional outcome was assessed using Harris hip score and pain was measured in terms of visual analogue score (VAS). Radiological parameters assessed on x-ray film on AP and lateral view including neck shaft angle, radiological signs of union (callus size, cortical bridging, progressive loss of fracture line). Clinical union was assessed by absence of pain at fracture site on weight bearing, absence of pain on palpation, ability to bear weight. Complications were assessed with patient's complaints, clinical examination, and with radiological examination. (Figure 1 & 2).

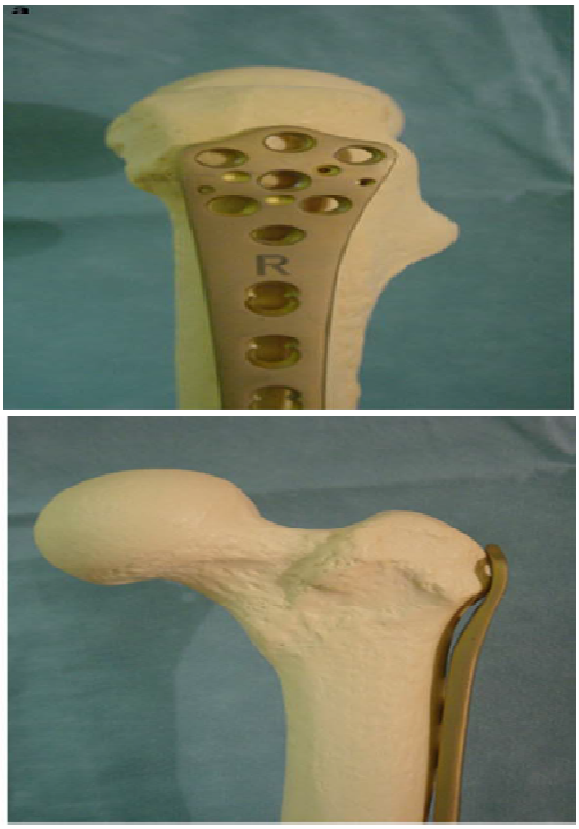
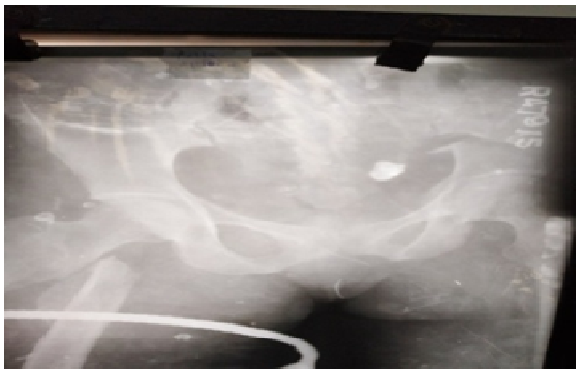
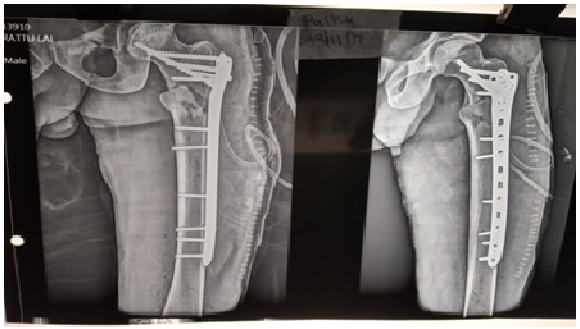


Figure 1: Positioning of the plate on the proximal femur facing the greater trochanter's offset. Frontal and lateral positioning on dry bone reversed right distal femur plate on left proximal femur

Figure 2: Both proximal and distal incisions showing plate inserted in sub muscular plane



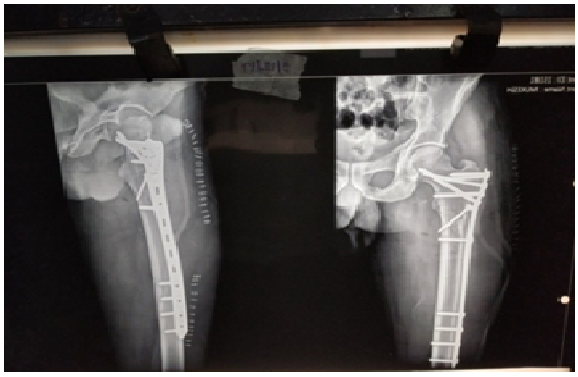
Pre OP X-Ray



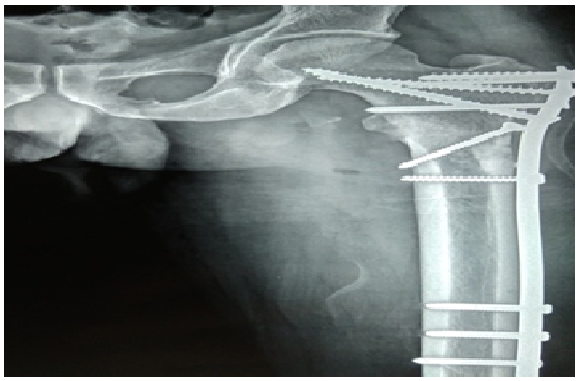
Immediate Post OP X-Ray

6 Month Follow up

Pre OP X-Ray



Immediate Post OP X-Ray



6 Month Follow up

RESULTS

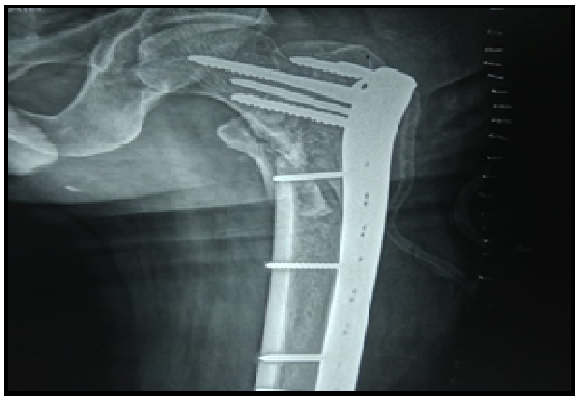
Union rate obtained was 90%. Mean Harris hip score at the one year follow up was 88.3. Mean Visual analogue scale was 1.37 at final follow up .Mean neck shaft angle at final follow-up was133.23^0 and change in angle was not significant. We mostly used plate of size 10 hole (80%) in 80% cases for bridging the fracture. Our study had shown that mean duration of surgery was 80.77 min, mean blood loss was 172.83ml, mean fluoroscopy time 19.27 shoots per surgery, mean size of proximal incision was 7 and distal incision was 4.47cm. Mean time of the clinical union was 13.8 weeks (12-16 weeks) and

mean time of the radiological union was the 14.20 weeks (11-18weeks). All patients had allowed to bear weight at around 12 to 13 weeks.

COMPLICATIONS

In our study one patient had plate bending due to early weight bearing which leads to varus deformity. Two patients had screw breakdown which leads to varus deformity at fracture site. One patient had limb length discrepancy of 2cm. None of the patient had screw cut out or screw loosening.

Pre OP X-Ray



Immediate Post OP X-Ray

4 Month Follow up

Pre OP X-Ray

Immediate Post OP X-Ray

3 Month Follow up

DISCUSSION

The DFLCP has long been used for the distal femoral fractures. It is also a biomechanically sound implant for the subtrochanteric femoral fractures. Shape of the reversed contralateral DFLCP fits well with the contour of the proximal femur. Locking screws leave a gap between plate and bone which leaves periosteal blood supply intact. Some screws are put into the calcar region

which enhances stability. In our study we allowed full weight bearing allowed at 12 weeks.

Gonga *et al.*, 2015 used reversed DFLCP for 24 patients of subtrochanteric fractures. He observed that mean time of union was 11 weeks (9-16). Mean Harris hip score at final follow up was 90.63(82-97). They reported two cases of nonunion. They concluded that reversed DFLCP is the biomechanically sound implant for the fixation of sub trochanteric fractures and results are comparable to those achieved by using other extramedullary implants as well as intramedullary devices.

Ouyang *et al.*, 2012 conducted study with reverse LISS plating system in sub trochanteric fractures in 26 elderly patients. They reported mean Harris hip score of 78.9 at final follow up. They reported mean operating time of 45 min (25-75), mean fluoroscopy time was 120 min, mean perioperative blood loss was 120 ml, mean collodiaphyseal angle at final follow up was 134 degree (129-138) and all patients achieved union at a median of 4 months. There were no collapse no cut out no backing out of screws. They concluded that the LISS device offers an alternative management of STF in elderly patients.

Ul Haq *et al.*, in 2014 compared proximal femoral nail (PFN) (20) with contralateral reverse distal femoral locking compression plate (reverse-DFLCP) (20) in the management of unstable intertrochanteric fractures with compromised lateral wall. Duration of surgery (p=0.022), blood loss during surgery (p=0.008) and fluoroscopy time (p=0.0001) were significantly less in the PFN group than in the reverse- DFLCP group. The PFN group had better functional outcome than the reverse-DFLCP group. HHS for the PFN group was 81.53±13.21 and for the reverse-DFLCP group it was 68.43±14.36 (p=0.018). There was one failure in the PFN group as compared to six in the reverse- DFLCP group (p=0.036). They concluded that PFN is a better implant than reverse-DFLCP for intertrochanteric fractures with compromised lateral wall.

Mutlu *et al.*, in 2016, evaluated the results of the minimally invasive internal fixation method using reverse Less Invasive Stabilization System locking plate in 42 patients with unstable proximal femur extracapsular fractures. Union was achieved in 38 (90%) patients in mean 14 weeks (range: 12-20 weeks). Complications were seen in 4 (9%) patients and additional surgical interventions were made. At the 12-month follow-up, the mean Harris Hip Score was 88,6 (range 59-100) and mean Visual Analogue Scale score was 2.19 (range: 0-9). In the surgical treatment of unstable extracapsular proximal femur fractures, reverse Less Invasive Stabilization System plate could be easily applied with a minimally invasive fixation method as an alternative to other.

Chen *et al.*, in 2016, evaluated the treatment effects of reverse Less Invasive Stabilization System (LISS) on femoral intertrochanteric fractures in 22 patients. The haemorrhage was 130.5 ± 60 ml during the surgery and the operation time was 55 ± 15 min. The fracture healing time was 10-27 W (average 13.4 W). According to the Harris functional scoring, the results were excellent in 11, good in 8, fair in 2 and poor in 1, excellent and good rate of clinical results were 86.4%. Plate collapse was found in 1 case. The rest 19 cases had no surgical site infection, no varus deformity of hip, any implant failure and displacement of fracture, no backing out or loosening of the locking screws. Reverse LISS plate is an effective way for femoral intertrochanteric fractures, although there is certain failure rate. In order to improve the clinical effect, intraoperative normative operation and avoiding early weight bearing are very important.

Yao *et al.*, in 2017, reported one femoral neck fracture and one subtrochanteric fracture in polio survivors successfully treated with reverse less invasive stabilization system (LISS) plating technique. Both fractures were on polio-affected limbs with significant skeletal deformities and low bone density. Both patients had uneventful bone union and good functional recovery. Conclusions: Reverse LISS plating is a safe and effective technique to treat hip fractures with skeletal deformities caused by poliomyelitis.

Giarso *et al.*, in 2018, In these case series, we used titanium locking compression plate-distal femur (LCP-DF) plate (Synthes) 9–11 hole using less invasive stabilization system or open reduction technique. This case series aims to determine the functional scores on reverse distal femoral locking plate for subtrochanteric femur fracture. A 34-year-old male with closed subtrochanteric fracture with Harris hip scores (HHS) 97 obtained at 12 months. A 24 year old male with closed comminuted subtrochanteric fracture with HHS of 97 at 12 months. A 39-year-old male with non-union subtrochanteric fracture yielded HHS of 77 at 12 months. A 35-year-old female with close subtrochanteric yielded HHS of 73 at 12 months. Mean HHS at 12 months reached 86.

Vaishya *et al.*, in 2015, Showed that failure of proximal femoral fracture managed by proximal femoral nail (PFN) leads to a very difficult situation to handle with conventional techniques, and reversed distal femoral locking compression plate (DF-LCP) is of great benefit in these selective cases. Twelve patients with ununited proximal femoral fractures including subtrochanteric fractures with a failed PFN implant were included in study. All fractures went into union in an average time of nine months and 15 days with no implant failures. Mean surgical time of reosteosynthesis was 110 minutes, and average blood loss during surgery was 550 ml. The PFN is one of the most

commonly used implant for unstable proximal femur fractures. The use of PFN is technically demanding and is associated with high failure rates. Although dynamic compression screw (DCS), proximal femoral locking plate (PF-LCP) and other implants can be used in these failed situations, they are associated with a high complication rate. The reversed DF-LCP is a rescue implant for these complex situations. They conclude that DF-LCP is a potential and safe implant of choice for the management of nonunion associated with failed PFN. It may be considered an implant of choice as rescue from such a complex situation.

The DFLCP has long been used in distal fractures of the femur with good long-term results. It is a biomechanically sound implant to be used in the subtrochanteric region as well. The shape of a reversed contralateral distal femoral plate fits well with the contour of the greater trochanter and the shaft of the plate fits well with the anterolateral curve of the femur. The use of locking screws further leaves a gap between the bone and the implant thus preserving the periosteal blood supply of the bone. The placement of the proximal end of the plate at the trochanteric ridge ensures at least one row of screws in the femoral calcar. Also, it was observed even if the most proximal screw went into the neck. It, being of a locking nature ensured sufficient hold. We achieved a union rate of 90 percent which is very much comparable with other studies**.**

Pakuts (2004) compared intramedullary devices with extramedullary implants for fixation of unstable intertrochanteric fractures. He observed that the mean time to union was 10 weeks when he used an intramedullary device (Gamma nail) as against 15 weeks in the group of patients treated with dynamic condylar screw. They concluded that extramedulary devices result in early ambulation; however we were able to achieve union in a mean time period of 12weeks, which is comparable to the Gamma Nail group in their series.

Use of locking plate as an internal fixator reduces the plate contact area thus preserving the vascularity and enhances healing, the chances of osteoporosis at the plate bone interface is also reduced. Thus, using an extra-medullary implant with minimal soft tissue stripping we can achieve a quick callus formation and good union rate thus allowing our patients an early rehabilitation and weight bearing comparable to that by an intramedullary fixation. Of the various extramedullary devices available for fixation of a fracture in this region, the angled blade plate and the dynamic condylar screw are the ones most widely used. Although the angled blade achieves good results particularly in comminuted fractures, its use is technically demanding requiring a tri-planar orientation.The use of the dynamic condylar screw also requires significant level of skill and an image intensifier. using a mini incision technique of dynamic condylar screw fixation achieved results comparable to ours. They showed union at a mean interval of 16 weeks post surgery with full weight bearing at a mean of 11 weeks post surgery.

Although Van Meeteren *et al.*, 1996 reported higher complication rates with the use of intra-medullary devices and higher rates of refracture and fixation failure put against extramedullary devices, intramedullary devices seem to be the implant of choice at most centers for subtrochanteric fracture fixation today, with reports suggesting better postoperative restoration of walking ability. The recovery after intramedullary nailing may be faster and better with less complication because of its biomechanical benefit with central buttress and a shortened lever arm.

The use of the reversed contralateral distal femoral plate is however a good option by surgeons working at centers without access to an image intensifier; with results comparable to that achieved by other modes of fixation, whether intramedullary or extramedullary. Our results are also comparable to the results of previously held studies.

The reason why we chose DFLCP rather than any other plates in our series is that it is readily available and familiar, provides multiple options for screw fixation in the proximal part of the fracture, it adheres closely to the anatomy of the proximal femur and the implant is cheaper compared with the LISS. With contralateral reversed DFLCP, the surgeon is able to insert at least two rows of long screws up to the femoral calcar providing enough stability.

We also used the technique of sounding of screw hole to reduce the time of fluoroscopy, which was not used in any other studies.

However, the strength of the study is that it is a single institutional study with cases treated by the same team of surgeons. The findings of our study show that reversed contralateral DFLCP, when used for fixation of the subtrochanteric fractures shows results comparable to those achieved by using other extra-medullary implants as well as intramedullary devices. The added advantages of this implant are its familiarity by the surgeons and usability in the absence of an image intensifier.

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