

Study to evaluate the efficacy of Reverse LISS Plate for unstable subtrochanteric femoral fractures

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Abstract

Introduction

Fractures of the subtrochanteric femur are common and the treatment of unstable fractures generally requires an operative approach. Despite the advancement of several fixation devices, treatment of unstable proximal femoral fractures remains a challenge. This study aims to find the efficacy of the Reverse LISS Plate for unstable subtrochanteric femoral fractures.

Materials and methods

The study was carried under the department of Orthopedics, SRG hospital and medical college, Jhalawar during the period of June 2019 to December 2020 including 20 patients with unstable proximal femur fractures treated with reverse LISS plating system. The mean follow-up period was 12 months. The functional outcome was evaluated by a modified Harris hip score.

Results

Out of 20 patients selected for the study, 12 were males and 8 were females. The mean age was 54.7 years. The union rate was 90% (18/20). Two patients presented with non-union. The average varus collapse was <10°. Two cases show limb shortening less than 2 cm. No case of hardware failure was noted. Modified Harris hip score was found to be excellent in 4 patients, good in 10 patients, fair in 4 patients, and poor in 2 patients.

Conclusion

Reverse LISS is effective for the treatment of subtrochanteric femoral fractures. Reverse LISS plate provides fixed angle block and provides angular stability with early functional rehabilitation.

Keywords Subtrochanteric femur fractures, Reverse LISS, Modified Harris hip score

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I. Introduction

In Subtrochanteric fractures, the fracture occurs below the lesser trochanter up to 5cm distally in the shaft of the femur. The bone-in subtrochanteric region is a thick cortical bone with less vascularity which results in increased chances of healing disturbances.

Fractures of the subtrochanteric femur are common and the treatment of unstable fractures generally requires an operative approach. In elderly patients, osteoporosis makes internal fixation problematic and frequently contributes to failed fixation and poor clinical results. Given the aging population, a rise in the number of subtrochanteric femur fractures is expected to occur. In elderly patients, subtrochanteric femoral fractures occur with low-energy trauma, as in a simple fall. Frequently, these patients have osteoporotic bones with thin cortices, there is little soft-tissue damage or extensive comminution, and the muscular forces are generally weaker¹.

Despite the advancement of several fixation devices, treatment of unstable proximal femoral fractures remains a challenge.

Failure to achieve a precise reduction of fractured fragments is often responsible for the failure of osteosynthesis and non-union. It leaves behind a complex situation to deal with due to the disturbing anatomy of the proximal femur and poor bone stock left for fracture fixation by other implants during re-osteosynthesis.

Many authors have reported that the only valid salvage option for failed intramedullary fixation in total hip arthroplasty but few patients and some local biological conditions like implant associated infection are not suitable for total hip arthroplasty so re-osteosynthesis is only one alternative for failed intramedullary fixation.

The less invasive stabilization system-distal femur (LISS-DF; Synthes, West Chester, PA, USA) and the newly designed locking compression plate-distal femur (LCP-DF, Synthes) based on “minimally invasive surgery” have been developed for the treatment of distal femur fractures².

In our study, we evaluate the efficacy of reversed LISS-DF as a minimally invasive technique for alternative surgical treatment methods of subtrochanteric fracture of the femur.

II. Aims and objectives

The study aims to evaluate the efficacy of a reverse LISS plate for unstable subtrochanteric femoral fracture fixation.

III. Materials and Methods

The study was carried under the department of Orthopedics, SRG hospital, and medical college, Jhalawar during the period of June 2019 to December 2020 including 20 patients who fulfilled the inclusion criteria operated by Reverse LISS plate.

The inclusion criteria included-

1. Patient is older than 18 years,
2. Close subtrochanteric femoral fracture
3. Patient with narrow medullary canal,
4. Reverse oblique intertrochanteric fracture.
5. No other associated injuries

The exclusion criteria included-

1. Patient is younger than 18 years
2. Pathological fractures
3. Open fractures
4. Multiple fractures
5. Not willing for surgery
6. Not fit for surgery

Patients were thoroughly assessed including history taking, physical examination, pre-anesthetic workup, and patient workup. Routine blood investigation and radiograph were taken. Analgesics, antibiotics, and blood transfusions were given as needed before surgery.

Operative technique-

The patients were taken up for surgery under Spinal anesthesia or Epidural anesthesia. Surgery is performed with the patient lying supine over the operating fracture table. Traction is applied and anatomically satisfactory reduction is achieved preoperatively under c-arm control, in both anteroposterior and lateral views. A lateral approach using a straight incision extending from the greater trochanter to 5–10 cm distally (figure 1), according to fracture configuration, is used. Superficial dissection is done (figure 2), cut the tensor fascia latae along the incision line, and expose the fracture site (figure 3).

In cases where the anatomically satisfactory reduction was achieved, the plate was inserted using the less invasive technique, while in others open reduction technique was used. The plate was temporarily fixed to the shaft by k-wires, and both, alignment of plate and reduction was checked in anteroposterior & lateral views. Guidewires were inserted through the guide sleeve in the proximal hooded portion.

After checking the correct position of the guidewire in AP & lateral views, the guidewire is removed and drill is inserted through drill sleeve and screws of adequate length inserted making sure that satisfactory subchondral purchase is obtained (figure 4). The position and length for all screws are rechecked on the c-arm, in both AP and lateral views. The plate is then fixed distally to the femoral shaft with a minimum of four cortical screws. In comminuted fractures, 3–4 holes of the plate were left empty at the level of fracture to increase working length.

All comminuted fractures with calcar comminution were additionally bone grafted and encircage was performed primarily. Soft tissue was closed in layers with a drain in situ. Sterile dressing was done.

Postoperatively patients were put on quadriceps exercise and allowed non-weight bearing ambulation the day after surgery. Toe-touch weight-bearing was started at 4 weeks & full weight-bearing at around 10 weeks. Patients were followed up at 4 weekly intervals for the first 3 months, 3rd month, 6th month, and 12th month and looked for signs of union (Clinical & Radiological), varus collapse, limb shortening, and hardware failure. The functional outcome was evaluated by a modified Harris hip score.

Intraoperative Image

Figure 1- Incision



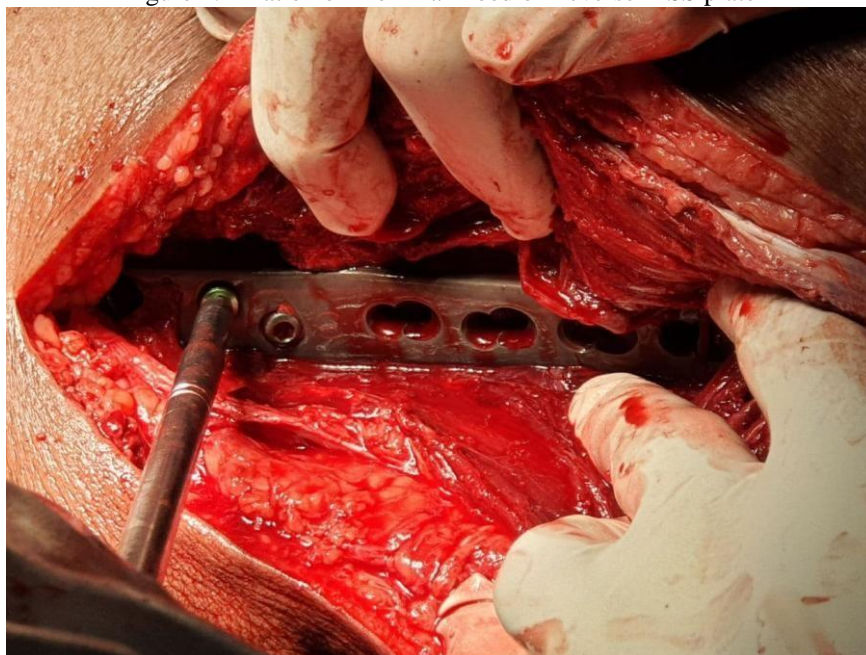
Figure 2: Superficial dissection



Figure 3: Exposure of fracture site



Figure 4: Fixation of Proximal Hood of Reverse LISS plate



IV. Results

Out of 20 patients selected for the study, 12 were males and 8 were females. The mean age was 54.7 years.

The median duration of surgery was 90 min (60–120 min). The mean blood loss was 280 ml. The mean length of the incision was 8 cm.

The union rate was 90% (18/20). The mean time of the clinical union was 14.6 weeks (12-16 weeks) and the meantime of the radiological union was 16.2 weeks (14-20weeks). Two patients showed delayed union at 6 months follow up. Two patients presented with non-union, one of which was managed with injection Denosumab 60 mg subcutaneously, and another one was revised with bone grafting. The average varus collapse was $<10^\circ$. Two cases show limb shortening less than 2 cm, which was managed with shoe lifting. No case of hardware failure was noted. None of the patients developed deep vein thrombosis, fat embolism, and ARDS.

Modified Harris hip score was found to be excellent in 4 patients, good in 10 patients, fair in 4 patients, and poor in 2 patients.

Radiological Outcome

Case 1

Figure 5: Preoperative X-Ray



Figure 6 Post operative X-Ray



Figure 7: Follow-up 2nd month



Figure 8: Follow-up 3rd month



Figure 9: Follow-up 6th month

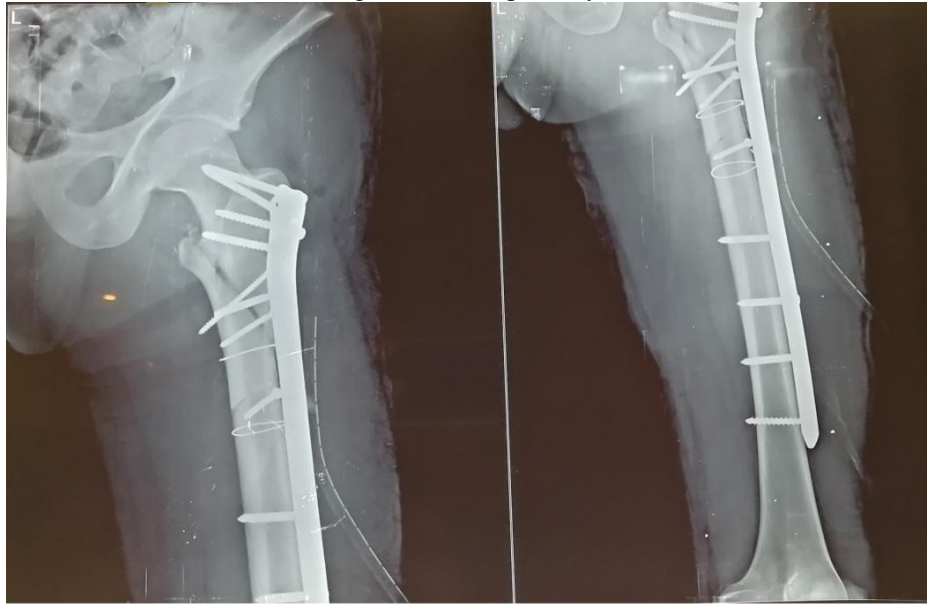


Case 2

Figure 10: Preop X-Ray



Figure 11: Postop X-Ray



Clinical Outcome

Figure 12: Hip flexion with knee extension



Figure 14: Hip flexion with knee flexion



Figure 15: figure of four



Figure 16: Crossed leg



Figure 17: Squatting



V. Discussion

Fractures in the subtrochanteric region are difficult to treat because of their anatomical and biomechanical features³. High compressive and tensile stresses across this region are related to nonunion⁴.

Kummer et al compared the intramedullary hip screw system and extra-medullary screw plate system. They found similar stability for fixation of two-part and three-part sub-trochanteric fractures.⁵

Simmermacher et al observed that the intra-medullary devices for the treatment of unstable trochanteric femoral fractures were technically demanding and had a considerable failure rate.⁶

Yao et al compared reverse less invasive stabilization system (LISS) plating to intramedullary nailing and concluded that reverse LISS plating can be done for rapid fixation in polytrauma patients.⁷

Ning et al concluded that LISS plating may be indicated for patients with very severe osteoporosis.⁸

Lewis et al. reported LISS could lower surgery-related complications administered to shorten the operative time when it was performed for proximal femoral fracture.⁹

Giarso et al., in his case series, aims to determine the functional scores on reverse distal femoral locking plate for subtrochanteric femur fracture. A 34-year-old male with a closed subtrochanteric fracture with Harris hip scores (HHS) 97 was obtained at 12 months. A 24-year-old male with a closed comminuted subtrochanteric fracture with HHS of 97 at 12 months. A 39-year-old male with a non-union subtrochanteric fracture yielded an HHS of 77 at 12 months. A 35-year-old female with close subtrochanteric yielded an HHS of 73 at 12 months. Mean HHS at 12 months reached 86. ¹⁰

Celebi et al. reported a 100% rate of fracture union in 33 subtrochanteric fractures after indirect reduction and biologic internal fixation using dynamic hip screws or angled blade plates.¹¹

Vaidya et al. also reported that union was achieved in all cases (100%) after biologic plating using a dynamic condylar screw. They posited that the use of biological (indirect) reduction techniques instead of anatomic, open reduction was effective, particularly in comminuted subtrochanteric fractures. Based on these results, we hypothesized that biologic plating with minimally invasive surgery, which preserves blood supply around the fracture site, allows good surgical outcomes in patients with subtrochanteric fracture of the femur.¹²

Acklin et al. reported bony union in 10 of the 14 cases of complex proximal femoral fracture (31A3) treated with indirect reduction and LISS-DF in a reversed contralateral application. In their study, 2 patients were lost to follow up, and 2 developed implant failure with early screw breakage and instability requiring re-operation. ¹³

Oh et al. reported very good surgical outcomes after minimally invasive plate osteosynthesis (MIPO) of subtrochanteric femur fractures with a locking plate, with all patients healing without bone grafts in a mean time of 20.1 weeks.¹⁴

The best treatment for unstable proximal femoral fractures is controversial. In this study, we assessed the outcomes of reverse less invasive stabilization system (LISS) plates for the treatment of unstable subtrochanteric femoral fractures that are expected to be difficult to nail.

For unstable subtrochanteric femoral fractures, the entry point for the screw of DHS and PFN is located at the fracture line which causes instability of nail or plate when it passes through the fracture line to the femoral neck, more likely to cause complications such as the collapse of plate and screw, loosening screw, periprosthetic fracture, and hip varus.

If femoral subtrochanteric fractures affect sinus piriformis, or if patients have poor reduction by closed traction, or free trochanteric bone blocks, ruptured coronal plane, narrowed femoral marrow cavity, big femoral anterior arch, or severe femoral deformity, there can be difficulties in the use of intramedullary nail, especially if the patient is obese.

In these cases, reverse femoral LISS is the optimum choice. It is characterized by minimal invasion, easy operation, reliable fixation, high safety, and fewer complications.

LISS plate and screw can be fixed at different angles through the screw thread. The locking of the plate and screw forms a frame structure to lower the incidence of screw penetration out of the femoral head and prevent loosening of the screw. In osteoporotic and comminuted fractures, screws have better binding force and anti-tensile strength. Lateral placement of LISS can reduce the tension of iliopsoas and adductor, which benefits the natural reduction of posteromedial fracture fragments and reduce stress on the proximal screw.

The result of our study shows that reverse LISS plate, 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.

VI. Conclusion

We concluded that reverse LISS is effective for the treatment of proximal femoral fracture, especially in osteoporotic bone. There may be difficulties in the application of intramedullary nailing. It has its advantages despite some unsuccessful cases. To improve the clinical outcomes, the procedures must be standardized and early weight-bearing must be prevented following surgery.

Reverse LISS plate provides fixed angle block and provides angular stability with early functional rehabilitation.

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