

Distal Femur Fractures and its Treatment with Distal Femur Locking Plate

Kanav Padha, Sandeep Singh, Abdul Ghani, Harish Dang

Abstract

In this prospective study, 50 patients with distal femur fracture were treated using distal femur locking plate. Extra-articular fractures were fixed with minimal invasive technique without exposing the fracture site and intra-articular fractures were treated by open technique. Schatzker and Lambert (1979) criteria is used for functional assessment. In our series majority of the patients were males (70%), predominantly with AO type C fracture. RTA was the major mode of trauma (80%). Average union time was 14.2 weeks and average range of motion was 109.50. According to Schatzker and Lambert's criteria 22 patients had excellent results, 16 patients had good results, 8 patients had fair results and 4 patients had failure. We conclude that this implant should be used in distal femur fractures especially in, fractures with articular extension and comminution. Locking compression plate allows early weight bearing which is an additional advantage for good vocational, mental, social and physical health.

Key Words

Extra-articular fractures, Distal Femur Fracture, Femur Locking Plate, Intraarticular Fractures

Introduction

The incidence of distal femur fractures is around 37/100,000 patients per year. If the fractures around hip are excluded, 31% femoral fractures involve distal portion (1). Fractures of the distal femur whether supracondylar or intercondylar have been historically difficult to treat because of their unstable nature and degree of comminution. The proximity of these fractures to knee joint further makes full range of motion and function difficult. The incidence of malunion, nonunion, and infection is also high. Anatomical reduction of the articular surface, restoration of limb alignment and early mobilization has shown to be effective ways of managing most distal femoral fractures. Despite the advances in techniques and the improvement in surgical implants, treatment of distal femoral fractures remains a challenge. Long term disability can occur in patients with extensive articular cartilage damage, marked bone comminution and severe soft tissue injury (2). Many treatment modalities have been used for the management of these fractures. Currently popular devices are Dynamic condylar screw (DCS), GSH (Green Seligson Henry) nail, and fixed angle locking plates.

As the complexity of fractures needing treatment has changed from simple extra articular supracondylar types to intercondylar comminuted types, DCS or nail may not be ideal. So there is a need for an implant which overcomes the potential limitations of these earlier implants. A newer implant distal femoral-locking compression plate has been designed that combines biologically friendly minimally invasive submuscular plate placement with screws that lock into the plate to create fixed angle contact. The plate is anatomically precontoured to match lateral side of femur. So we undertook a study to determine the treatment outcomes of distal femur fractures with distal femoral locking plate.

Material and Methods

This prospective study was conducted in the Post Graduate Department of Orthopaedics, Government Medical College, Jammu with patients having followed up for one year. All the adult patients, of either sex with distal femoral fractures (lower 9 to 15 cm of femur) attending the emergency services were taken up for the study. Old and fresh cases and, simple or compound fractures were taken up. Fifty consecutive patients were

From the Deptt. of Orthopedics, Govt. Medical College Jammu- J&K India

Correspondence to : Dr. Kanav Padha Senior Resident Postgraduate Deptt. of Orthopedics, Govt. Medical College, Jammu J&K India



included in the study. There were 30 males and 15 females. The average age at time of surgery was 47.47 yrs. All patients were initially managed by ATLS protocol. The antero-posterior (AP) and lateral x-rays of the distal femur with knee joint were performed. CT scan of the knee joint was performed in all intra-articular fractures.

Surgical Technique: The patients were positioned supine on a radiolucent table that allowed unimpeded fluoroscopic imaging in both planes. A small bump was placed beneath the ipsilateral hip to ensure that the femur remained in neutral rotation. The knee was placed in slight flexion over a custom ramp with an additional small rolled bump at the fracture site. This position facilitates intraoperative, lateral fluoroscopic imaging of the proximal thigh without obstruction from the contralateral extremity and also relaxes gastro-soleus muscle. A sterile tourniquet was applied proximally if desired. In extra-articular fractures minimally invasive approach to the distal femur was used. Two longitudinal 4-5 cms incisions, one at the articular end of femur and other at desired length depending on the length of plate to be used was given. A submuscular tunnel under vastus lateralis was formed with epiperiosteal elevator. Care was taken not to disrupt the periosteum. Indirect reduction using manual traction, reduction clamps, Homen retractors or combination of all above methods was used. Perfect anatomical reduction was not desired. Depending on the fracture geometry two cortex screws or locking screws were put adjacent to the fracture site on both sides, and then the plate was secured to the bone with locking screws. At least 5 screw holes were secured proximal to fracture site. An antero-lateral parapatellar approach was used in fracture patterns with significant intercondylar comminution and in coronal plane fractures. After proper exposure temporary fixation was done by 2mm K-wires which may also act as joysticks. Before the application of plate, intra-fragmentary compression in the articular fragments was achieved by 6.5 mm cannulated cancellous screws. Plate was then slid and fixed to the articular block by locking screws. Then the plate was secured to the diaphyseal portion by giving stab incisions at the screw sites and fixing by locking screws. Infrequently, a medial approach may be required in cases of severe medial articular comminution. Reduction was confirmed using image intensifier. Deep suction drains were placed, the wound was closed in layers, and sterile wound dressing was applied. The POP back slab was applied for initial 3 to 4 days until the first dressing. If two consecutive dressings were satisfactory, patient was discharged. Active and active assisted physiotherapy was initiated within 2 days following surgery. Mobilization was initiated

with touch-down weight bearing under close supervision of a physical therapist. After attaining sufficient quadriceps power, patient was mobilized with the help of walker with instruction of partial weight bearing. Only after three months post operative or radiological evidence of fracture union full weight bearing was allowed. Clinical and radiographic studies were performed on 6, 12, 24 and 36 weeks respectively. In case of delayed or non union, further follow-up was performed. Patients with follow up to one year are included in study.

Osseous healing was defined radiographically as the presence of at least three of four healed cortices, with bridging callus formation and crossing trabeculae on AP and lateral radiographs. Clinical healing was defined as the absence of functional pain and local tenderness at the previous fracture site. Assessment of result was done with criteria laid down by Schatzker and Lambert (3) for supracondylar fractures which is given below.

Excellent: Full extension, No varus, valgus or rotational deformity, No pain, Perfect joint congruency

Good: Not more than one of the following. Loss of length not more than 1.2 cm, Less than 100 valgus or varus deformity, Flexion loss more than 200, Minimal pain

Fair: Any of two criteria in good category.

Failure: Flexion to 90° or less, Varus or valgus deformity more than 150, Joint incongruency, Disabling pain no matter how perfect the X-ray.

Results

The present study is based on 50 cases of distal femur fractures (Supracondylar and intercondylar fractures). They were managed by surgical treatment with distal femoral locking compression plate. Patients were assessed at regular intervals of time both clinically and radiologically for a period of six months to one year. (Fig 1-7) Out of 50 cases, five (10%) were less than 30 yrs old. Thirty (60%) were in age group of 30-60 yrs. Rest fifteen (30%) were above 60 yrs of age. Mean age of patients was 47.5 yrs. Thirty five (70%) were males and fifteen (30%) were females. RTA was the primary mode of trauma with forty (80%) cases. In rest all the cases; fall was the cause of injury. In ten females fall was the mode of injury. Left side (n=27) was involved more than right (n=23). Only six fractures were compound injuries. According to AO/OTA classification system, eleven (22%) fractures were classified as type A, eight (16%) as type B and 31 (62%) as type C fractures (Fig 1). Clearly type C fractures were more common as compared to others. Associated injuries were Colles' fractures in two cases, tibial plateau fractures in four cases and vertebral compression fractures in three cases. The average hospital stay was 12.2 days (range

Fig 1. Epidemiology of Distal Femur Fractures

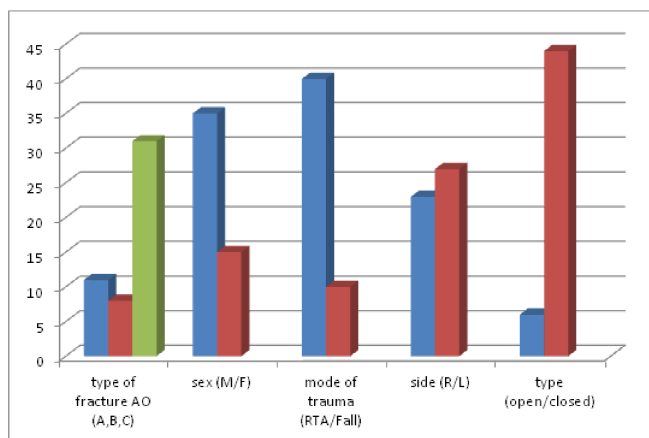
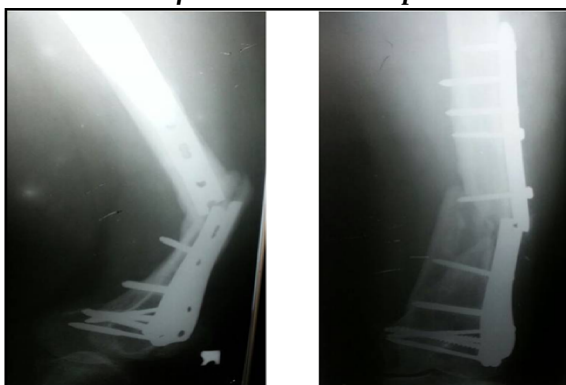


Fig 2. Lateral And AP View Showing Implant Failure And Non Union After 3 Months Post Operative



7-22) from injury to discharge. Average operating time was 128 minutes (range 100-160 min). At the end of one year the average range of movement of knee joint in this study was 109.50°. Forty seven of the patients had range of movement between 100-130 degrees. Three patients had range of movement less than 90°. The average union time was 14.2 weeks (range 12-30 weeks). Union time was directly related to the severity of trauma with average union time of 15.4 weeks in type C to 13.2 weeks in type A fractures. Following complications were treated: superficial infection in two cases, deep infection in one case which completely resolved with in tens days of i.v antibiotic course. Non union in two cases, one of whom had implant failure (Fig 2). Varus angulations of 5-10 degrees were noted in four patients. All these four patients had C3 fracture configuration with compound fracture in one case. Knee stiffness was noted in three patients who didn't improve even after vigorous physiotherapy. These patients were subjected to manipulation under anesthesia. Improvement was noted, but they never attained full range of motion at one year of follow-up. It was also

Fig 3. Biological Fixation-Non Anatomical Reduction



Fig 4. Same Patient Showing Complete Union at 4 Months



Fig 5a&b. Initial Radiographs AP and LAT of a Female Having Type c Fracture Configuration



noted that less range of motion was attained by two groups of patients; fractures with type C injuries and fractures in which very long plates were used even if the fractures were extra-articular. Hardware problem occurred in four patients and their implant was removed. According to Schatzker and Lambert criteria 22 patients had excellent results, 16 patients had good results, 8 patients had fair results and 4 patients had poor results.

Discussion

The violent nature of injury in young who sustains high velocity injuries during road traffic accidents and

Table 1. Study Population as per Schatzker's & Lambert's Criteria

Results.	No. of cases	Percentage. (%)
Excellent.	22	44
Good.	16	32
Fair.	8	16
Failure.	4	8
Total.	50	100

Fig. 6a&b Immediate Post Operative X rays



osteoporotic bones in elderly patients makes conservative treatment unsatisfactory option, in such cases internal fixation is the better option in distal femur fractures. The goal of treatment in such cases is to achieve a painless stable joint with normal range of motion. This can be achieved by fixation with such a device which allows rigid fixation of the articular surface, gives respect to soft tissues and allows early weight bearing. The DF-LCP is a single beam construct where the strength of its fixation is equal to the sum of all screw-bone interfaces rather than a single screw's axial stiffness and pullout resistance as in unlocked plates. When applied via a minimally invasive technique, it allows for prompt healing, lower rates of infection and reduced bone resorption as blood supply is preserved. Locking plates have biological advantages over standard plates (5). A standard plate grips the bone by friction created by the compression of plate against the bone by screws. This leads to impaired blood supply resulting in decreased cortical thickness and cancellous transformation of bone which in contrast to locking plates, as the locking plates are more biology friendly. In the present study 50 cases of fracture of distal femur admitted in Department Of Orthopedics, Govt. Medical College Jammu were operated upon using distal femoral locking compression plate.

The age incidence in the present study is average of 47.5 yrs. Our study is comparable with the study of Kregor *et al* (6) and Wright and Collinge (7) which reported the

Fig 7a&b. Radiographs - Complete Union at 6 Mths



age incidence of 49 yrs and 44 yrs respectively. Distal femoral fractures occur in middle age group, where RTA is the most common cause. In the present study the most susceptible sex is males. The recent study published by Kregor *et al* (6) showed equal distribution in males and females and study done by Yeap and Deepak (8) showed that 63% affected were males. This can very well be explained by the fact that over the years road traffic has increased and in country like India, males are the predominant drivers. In the present study most of the fractures were type C. Comminuted intra-articular fracture were more common probably because RTA was the major mode of trauma and distal femur taking most of the brunt of injury because of the flexed position of knee joint during driving. Frankhauser *et al* (9) and Schultz *et al* (10) reported the same incidence of type C fracture i.e. 63%. The average range of motion of knee joint was 109.5 degrees in our series. Markmiller *et al* (11) reported average range of movement of knee joint of 110 degrees. Range of motion in distal femur intra-articular fractures as in any other intra-articular fractures depends on the early rehabilitation program. The average radiological union time was 14.2 weeks ranging from 12 to 30 weeks (Table 1). Kregor *et al* (12) in his study in 2004 showed that fracture united in 12 weeks. Wright & Collinge *et al* (7) in 2004 also showed in their study that fractures united in 13 weeks. Union radiologically was defined when at least 3 cortices showed signs of union and clinically when patient was able to bear full weight. Complications such as superficial infections, deep infections, implant removal due to pain and malalignment in the form of varus malalignment was found. In all the cases varus malalignment didn't exceed more than 10°. There was no obvious limb length discrepancy in any case. Revision due to implant failure was done in one case. One patient (2%) got deep infection. Kregor *et al* in 2001 and 2004 (6,12) and Schultz *et al* in 2005 (10) showed that deep

infection occurred in 3% of their patients. In our series only four patients (8%) of the patients showed failure that is compatible with poor function. Rest of the patients were satisfied with the treatment outcome. Main advantage of the anatomically precontoured LISS plate is soft-tissue protection using a limited approach and submuscular plate insertion, as well as percutaneous screw insertion facilitated by the aiming device. Fracture stabilization with the LISS system may render adequate reduction more difficult since the plate and the locking screws are not designed to approximate the fracture toward the plate (13). In fact, prior to plate fixation, fracture reduction has to be performed and completed. Once a locking screw has been placed through the plate into bone, this particular bone segment can no longer be manipulated by insertion of additional screws or by using compression devices.

The sequence of screw placement has to be well planned to avoid fracture malreduction. Useful tool includes "nohands" traction, femoral distractors, and percutaneous clamps (14). Distal screws are inserted perfectly parallel to the distal femoral joint line. Any angulation of screws in projection to the joint line may result in increased valgus or more detrimentally, in varus deviation. The concept of bridging osteosynthesis implicates that the final fracture construct should be elastic and not too stiff to prevent formation of nonunion. Indication for DF-LCP plate osteosynthesis are as follows (15-17). Periprosthetic femur fracture, open injury, short distal fragment, C2 and C3 fracture configuration, failed closed reduction with IM nailing, salvage implant for revision surgery and complicated situations.

The ideal treatment for such fractures will include anatomical reduction and rigid fixation of articular surface and early function of knee joint. This can only be provided by such an implant which holds the metaphyseal bone strongly and at the same time provides stable fixation in the shaft to promote callus formation (18,19).

Conclusion

Distal femoral locking plate by virtue of its combi holes in the stem and locking bolts in the expanded head area fulfills these criteria. It was also concluded that distal femoral locking compression plate can be used in treating highly comminuted fractures. Locking compression plate allows early weight bearing which is an additional advantage for good vocational, mental, social and physical health.

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