Original Research Paper

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Orthopaedics

SURGICAL OUTCOME OF EXTRA ARTICULAR FRACTURES OF DISTAL FEMUR FIXED WITH DISTAL FEMUR LOCKING PLATE

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ABSTRACT **INTRODUCTION:** The distal femoral fractures accounts for the 7% of all femoral fractures and can be attributed to be caused by two types of injuries

A. High velocity vehicular accidents commonly observed in young patients.

B. Low energy mechanisms such as trivial fall in the older population especially women.

A thorough history of the trauma and clinical examination is required in all patients having distal femur fracture , after sustaining fracture of femur at any level there is significant bleeding into the surrounding soft tissues of the thigh and could lead to hypovolemic shock,and so indicators of shock should be checked for and immediately treated.Since last two decades incidence of distal femoral fracture has increased a lot due to rise in road traffic accidents.The management of distal femur fractures is challenging because of various factors like the bone quality,age of the patient, articular surface involvement, presence of small fragments, fixation system and associated soft tissue injuries.There has not been a single management strategy that has solved all the issues that has arisen because of this injury. Before 1970 ,most of the supracondylar femur cases were treated non operatively.However angulatory deformities , knee joint stiffness,loss of knee joint motion and the complication due to prolongedbed rest necissitated better treatment options.The Open reduction and Internal fixation have become standard treatment in the recent years with excellent outcomes obtained with locking compression plate.The LCPs are fracture fixation devices with threaded screw holes , that allow screws to thread to the plate and function as a fixed angle device. Since the plate does not depend on the friction created at the bone-plate interface to provide stability ,the plate does not have to contact the bone directly which helps in preserving the periosteal blood supply.The LCP is a single beam construct where strength of its fixation is equal to the sum of all screw-bone interfaces rather than a single screw's axial stiffness or pull out resistance as seen in non - locking plates. This study intends to obtain the functional outcome of extra articular fractures of distal femur treated by open reduction and internal fixation with distal femur locking plate. **MATERIALS AND METHODS:** The present study was undertaken at the Department of Orthopaedics, RANGARAYA MEDICAL COLLEGE , kakinada after obtaining ethical clearance. Based on the inclusion and exclusion criteria, a total of 20 patients with extraarticular distal femur fractures were sampled and included in the study. A thorough evaluation of the patient was conducted following stabilisation and admission. The fracture configuration was then observed on conventional Antero-Posterior and Lateral views of the radiographs. . Limb immobilization is done in a Thomas splint , by using either upper or lower tibial pin traction to maintain the length & alignment of the fractures. When necessary, computer tomography was performed to determine the precise alignment of the fragments. These fractures were categorised using AO Muller's system. Open reduction and internal fixation is done with distal femur locking plate. **RESULTS:** The final analysis of the Neer's score revealed that 60 percent (12 patients) had excellent outcomes, while 30 percent (6 patients) had satisfactory results. It was unsatisfactory in 10 percent of cases (2 patients), with no patients failing. **CONCLUSION:** In the treatment of distal femoral fractures, the LCP condylar plate is the preferred option, especially in Type A fractures where we have observed higher Neer scores. Additionally, LCP avoids periosteal vessels from being compressed. Although it may not entirely resolve the enduring issues of any fractures with old age , such as malunion and nonunion, it is a useful approach in the care of these fractures

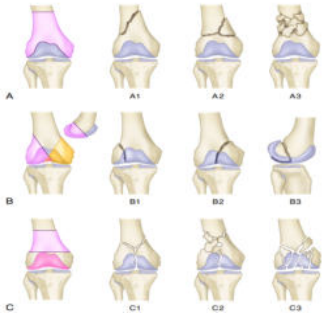
KEYWORDS : Thomas splint, Distal femur, LCP

INTRODUCTION

Over the past ten years, there has been debate over how to treat distal femoral fractures. Surgical approaches to treating femur supracondylar fractures have changed throughout time. Up until 1970, close management of these fractures was the recommended course of care. This was brought on by the lack of suitable implants and acceptable procedures. In addition to the typical issues associated with limiting elderly patients to beds, knee stiffness, malunion, and nonunion can complicate conservative approaches at any age. Early surgical stabilisation can help with soft tissue care, enable early mobility, and simplify nursing care. A locking plate offers a more firm attachment by reducing the screw-plate toggle and motion at the bonescrew interface. One factor considered important for the effective management of these fractures is rigid fixation. Conventional plates have drawbacks of their own, including screw pullout, implant failure, and unstable fixation requiring postoperative immobilization. The degree of the fracture, the anatomic reduction, the cause, the quality of the bone, the amount of time between the injury and surgery, any concurrent injuries, and the precise placement and fixation of the implant all appear to have an impact on the prognosis. We used MULLER'S AO classification for assessing the fracture pattern.

The classification of fractures of distal femur described by Müller et al. and expanded in the AO/OTA classification is useful in determining treatment and prognosis. It is based on the location and pattern of the fracture and considers all fractures within the trans-epicondylar width of the knee.

Type A fractures involve the distal shaft only with varying degrees of comminution. Type B fractures are condylar fractures; type B1 is a sagittal split of the lateral condyle, type B2 is a sagittal split of the medial condyle, and type B3 is a coronal plane fracture. Type C fractures are T-condylar and Y-condylar fractures; type C1 fractures have no comminution, type C2 fractures have a comminuted shaft fracture with two principal articular fragments, and type C3 fractures have intraarticular comminution.



MATERIALS AND METHODS

This is a prospective non-randomised study, conducted between August 2020 and June 2022, in 20 patients with AO type A1, A2 and A3 distal femoral fractures who came to the emergency department and got admitted under the department of orthopaedics , Rangaraya Medical College, Kakinada. The average age is 45.1 years, with a range of 20 to 70 years. The youngest participant in current study was

24 years old, and the oldest was 69 years old. Fractures were more common in the age categories of 31-40 years (20 percent) and 41-50 years (40%). Males made up 60% of all cases, making them the most often involved gender. Due to the fact that men are more prone than women to be involved in high-energy trauma events, men are more likely to suffer distal femur fractures with intraarticular extension. Of the 20 cases 60% were closed fractures, 40% are open fractures, these corresponded to grade I & II of Gustilo-Anderson classification. The majority of the fractures in present study, which is focused only on extraarticular distal femur fractures, are of type A. The most common AO type of fracture incidence in type A was A1, which accounted for 45 percent, A2 for 30 percent, A3 for 25 percent.

CRITERIA

Inclusion criteria

1. Adult age groups (more than 20 years)
2. Includes both sexes
3. Post traumatic cases
4. Closed and Gustillo-Anderson Compound Type I and II, AO Type A1, A2 and A3

Exclusion criteria:

1. Age group below 18 years
2. Medically unfit patients
3. Pathological fractures

OPERATIVE TECHNIQUE

Positioning of the patient

In order to let the posterior vasculature fall away from the surgical area, patients were positioned in the supine posture with both lower limbs extended. A tiny triangular bolster was then put under the operating limb's thigh to help the hip rotate in a neutral position and keep the knee in flexion.

IMPLANTS USED

lateral distal femur locking compression plate

Surgical approach

Lateral approach for Distal femur

Begin the skin incision in the mid-lateral line of the femoral shaft at Gerdy's tubercle and curve it proximally over the lateral femoral condyle. The proximal starting point for the skin incision depends on the most proximal extent of the fracture.The need for a distal extension of the skin incision depends on whether an arthrotomy needs to be performed. If joint visualization is required, the incision is carried to the level of the Gerdy's tubercle (dashed line). If an arthrotomy is not necessary, you can stop the skin incision approximately 1-2 cm distal to the joint line.

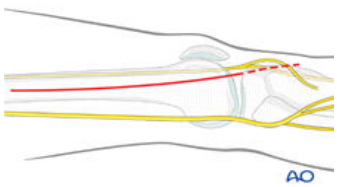


Figure 19

Divide the iliotibial band (tract) in line with the skin incision. Distally, the fibers slope anteriorly towards the Gerdy's tubercle. The incision through the iliotibial band should follow the muscle fiber orientation. To facilitate a perfect closure, the iliotibial band should be divided in one precise incision only.

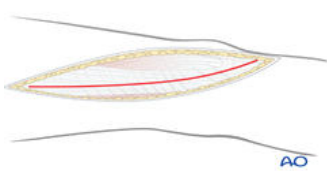


Figure 20

Beneath the iliotibial band, the muscle fibers of the vastus lateralis are minimal in the distal 8-10 cm of the femur. Incise the muscle fascia surrounding the vastus lateralis just anterior to the lateral intermuscular septum and elevate the muscle fibers off the septum, working from distal to proximal. This is most easily accomplished by the use of a large elevator.

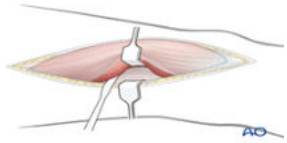
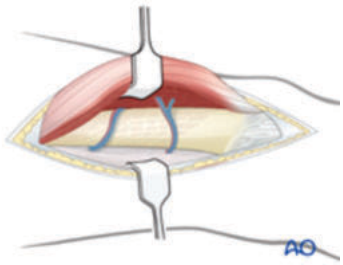


Figure 21

Retract the vastus lateralis anteromedially. Several perforating vessels of the profunda femoris artery and vein must be ligated. Failure to do so will result in excessive bleeding. It is important to only remove muscles from the lateral surface of the distal femur and protect as much periosteum surrounding the distal femur as possible for later fracture healing.



The reduction of the fracture is achieved , held with clamps and is confirmed under image intensifier. The reduction is held temporarily using two K wires by avoiding disturbance to plate positioning. The plate, is placed along the shaft using the bevel. The plate is held with a distal condylar portion with a temporary K-wire. The condylar fragment is aligned with that of the metaphyseal fragment by adequate manipulation (traction and rotation) under radiographic control. The reduction is then held temporarily with k wire after aligning the plate along the shaft of the femur. Once the reduction and plate position parallel to the condyles is confirmed, the second K wire passed into the plate, and condyle. In this position, the anatomically pre-bent implant matches the distal femur. With the reduction still in place, 6.5mm cannulated locking cancellous screws were used to secure the condyles to the plate. Clinical and image intensifier controls were used to regulate the reduction and the plate position (axis, length, and rotation). Using the plate sleeve assembly with an image intensifier and pre-operative planning, locking head screws were inserted. The k wires are taken out, and a vacuum drain is placed within the wound to close it. It is covered with a clean, non-bulky dressing.

POSTOPERATIVE PROTOCOL

The recovery of the patient's range of motion and the enhancement of the quadriceps mechanism and joint functions are both significantly aided by postoperative therapy. Early therapy can begin if the fracture fixation is stable. In the initial postoperative weeks, range of motion can be attained.

Initial phase (1 to 3weeks)

If the fixation is stable, the main objective is full range of motion, which is initiated on day two. Exercises for hamstring stretching and quadriceps strengthening are encouraged. Exercises for hip and ankle mobilisation are kept up.

Continuous passive motion

1. Improves early range of motion of the knee.
2. Decreases incidence of deep vein thrombosis and inturn pulmonary embolus.
3. Pain relief and Early discharge.
4. Better results are attained with a rate of 1 cycle/ min, with 40-50 degrees of maximum flexion for the first three days.
5. Walker support for non – weight bearing walking started in 1st week if fixation is stable. Sutures are removed between the 10th - 12th postoperative days.

Late Phase (After 3weeks)

Continue your active and passive range of motion and isometric quadriceps exercises. After the third week, partial weight-bearing is permitted. After radiological recovery is confirmed, full weight-bearing is permitted.

Protocol for follow-up

Each patient underwent post-operative X-ray of the thigh with anteroposterior and lateral views following surgery. Then, on 6 weeks, 10 weeks, and for every 3 months for two years.. Radiographic evaluation is used for fracture alignment, sagittal and coronal plane alignment, fixation stability assessment, and fracture healing evaluation. Documentation was kept of any reduction loss, plate lift-off, or implant breakage. At each follow-up appointment, the patients' range of flexion, extension lag, and pain level were evaluated. Then, a functional evaluation was carried out to determine the patient's capacity for walking, ascending stairs, and returning to work.

Outcome assessment:

The functional outcome was evaluated with NEER score at end of 3-6 months of follow op . It has total score of 100 points.

Patients final outcome functional status graded as
1. excellent (>85 points)
2. satisfactory (70-85)
3. unsatisfactory (55-70)
4. failure (less than 50)

CASES

DISCUSSION

Over the past ten years, there has been debate over how to treat distal femoral fractures. Surgical approaches to treating femur supracondylar fractures have changed throughout time. Up until 1970, close management of these fractures was the recommended course of care. This was brought on by the lack of suitable implants and acceptable procedures. In addition to the typical issues associated with limiting elderly patients to beds, knee stiffness, malunion, and nonunion can complicate conservative approaches at any age.

Early surgical stabilisation can help with soft tissue care, enable early mobility, and simplify nursing care. The use of implants such as angled blade plates, fickle devices, Rush rods, Ender nails, Dynamic condylar screws, condylar buttress plates, interlocking nails, and locking compression plates has been promoted for open reduction and internal fixation.

The use of fixed angle devices, such as the condylar blade plate and dynamic condylar screw (DCS), is limited by the fact that they require a certain amount of healthy bone stock to be present before the lag screw .can be inserted, and that doing so causes significant bone loss from the entry site, which compromises already fractured condyles. Condylar buttress plates for comminuted fractures were created as a result. However, these fractures frequently develop a varus deformity with conventional buttress plating.

Biomechanical investigations showed that the toggle at the screw-plate interface caused early implant loosening, which resulted in implant fracture and varus/valgus collapse of the distal fragment. This caused severe loosening of the typical condylar buttress plate and DCS. A first-generation locking condylar plate was created to overcome these problems.

A locking plate offers a more firm attachment by reducing the screw-plate toggle and motion at the bonescrew interface. One factor considered important for the effective management of these fractures is rigid fixation. Conventional plates have drawbacks of their own, including screw pullout, implant failure, and unstable fixation requiring postoperative immobilization.

Knee stiffness, a sign of a poor prognosis, is caused by a delay in postoperative mobilisation. The locking condylar buttress plate was developed to solve the problem of fixation in osteoporotic and comminuted fractures, which was previously problematic. Therefore, many of the earlier drawbacks could now be addressed with the development of locking compression plating for distal femoral fractures, especially for the comminuted intra-articular fractures, including the increased stability due to the locking compression plating principle, multiple screw options in the distal fragment providing option for fixing the multiple fragments restoring the anatomical congruity, and providing stable fixation of the distal fragment with locking compression plating.

Due to the huge two-wheeler population in nations like India and the presence of high speed vehicles, the fracture patterns we currently see are complex comminuted forms. Longer lifespans as a result of better healthcare expose us to more osteoporotic fractures that were previously treated with conservative techniques.

Instead of using a single screw's axial stiffness and pullout resistance in unlocked plates, the LCP is a single beam construct whose strength of fixation is equal to the sum of all screw-bone contacts. Its special biomechanical function, which relies on splinting rather than compression, results in flexible stabilisation, avoids stress shielding, and promotes the development of calluses. Without affecting the fracture site, it can also be employed as a biological fixation.

The LISS, which was first launched in the middle to late 1990s, was subsequently developed into the Distal Femur-LCP. The LISS uses an outrigger device for shaft holes, basically acting as a locking guide jig, which is attached to the distal part of the plate and directs the placement of the proximal locking screws. This is the primary distinction between the Distal Femur-LCP and the LISS. Oval shaft holes on the Distal Femur-LCP allow for the use of either a locking screw or a compression screw.

The plate can then be compressed closer to the bone, allowing for a more accurate implantation. Although Distal Femur-LCP is designed to fit the anatomy of the distal femur, we were worried about the fit in our local Asian population where shorter and smaller femurs are the normal. It was challenging to keep the reduction in good alignment and apply the first screw during fixation in delayed instances, particularly if there was severe comminution. There is no additional benefit of early healing, and the average time of union was 15.3 weeks, which is comparable to the other fixation modalities. Our current numbers, however, show that this is not a problem.

Comparable trials using the Distal femur LCP only show transient improvements. Although the follow-up period of our series was short, studies have shown that early function is comparable to final long term outcome.

The degree of the fracture, the anatomic reduction, the cause, the quality of the bone, the amount of time between the injury and surgery, any concurrent injuries, and the precise placement and fixation of the implant all appear to have an impact on the prognosis.

Additionally, although there is now no proof of this, the initial acute concurrent cartilage degradation may contribute to early osteoarthritis. This study was conducted in 20 patients with AO type A1, A2 and A3 distal femoral fractures who came to the emergency medicine department and got admitted under Department of Orthopaedics , Rangaraya Medical College And Government General Hospital Kakinada. This was a prospective interventional clinical study and was approved by the institute ethical committee. We explained about the purpose of study,treatment details and possible complications and gave alternative options to the patients and got written informed consent.

Incidence of age and sex

The average age in the present study was 45.1 years, with a range of 20

to 70 years. The youngest participant in current study was 24 years old, and the oldest was 69 years old. Fractures were more common in the age categories of 31-40 years (20 percent) and 41-50 years (40%). As opposed to earlier studies, the patient population in this one does not feature a biphasic age distribution (M.Ehlinger ,G.Ducrot)

Males made up 60% of all cases, making them the most often involved gender. Due to the fact that men are more prone than women to be involved in high-energy trauma events, men are more likely to suffer distal femur fractures with intraarticular extension. Males had a higher incidence than females, according to Yeap and Deepak's investigation of 11 patients with Titanium Distal Femur Locking Compression Plate Fixation, with a mean age of 44 years. With a mean age of 40 years, Gaurav Singla examined 25 patients who had distal femur fractures treated with locking compression plates. The incidence was higher in men than in women. The recent study published by Kregor et al. showed equal distribution in males and females.

STUDY	MEAN YEARS OF AGE
M.EHLINGER et al	50
Yeah and Deepak	44
GAURAV SINGLA	40
CURRENT STUDY	45.1

Mode of injury

The majority of the injuries in Present study were caused by road traffic accidents, which primarily affected men. RTA injuries accounted for 17 (85%) and falls accounted for 3 (15%).

In a 2019 study by Gaurav Singla on the result fractures of the distal femur, 76 percent of patients had a history of a road traffic collision, compared to 24% who had fallen down.

STUDY	RTA	FALL
GAURAV et al	76%	24%
TRIVEDHI[29]	96%	4%
Present study	85%	15%

Fracture classification

The majority of the fractures in present study, which is focused only on extraarticular distal femur fractures, are of type A. The most common AO type of fracture incidence in type A was A1, which accounted for 45 percent, A2 for 30 percent, A3 for 25 percent.

Type of fracture and final NEER outcome is excellent in 77% of A1, 66% of A2, 20% of A3, satisfactory in 22% of A1, 16% A2, 60% OF A3, unsatisfactory in 16% of A2 and 60% A3 injuries. M Schutz30 et al dis study in 112 patients with 49 type A, 20 Type B and 57 Type C fractures.

Type of fracture

In this study ,Of the 20 cases 60% were closed fractures, 40% are open fractures, these corresponded to grade I & II of Gustilo-Anderson classification.

Study series	% of open injuries
Schandelmaier et al	19
Fankhauser et al	47
Kregor et al	34
Kayali et al	26
Our study	40

Assosciated injuries

Associated injuries were evident in 65% percent of patients but not in 35 percent. Two patients suffered from , contralateral clavicle fracture, ipsilateral metatarsal fracture, contralateral patella fracture, and spine fracture

Comorbidities

Systemic illness like Hypertension, Diabetes mellitus was associated with 30% of present study.

Complications

Local and persistent problems were found in 30% of patients, whereas 70 percent were free of them. Movement restrictions, thigh soreness, superficial infection, malalignment, and nonunion are all common complications.

Complications post operatively and final NEER outcome is excellent in 78% without complications and satisfactory in 22% without complications whereas excellent in 16% patients with complications, satisfactory in 50% with complications and 33% with complications, unsatisfactory in 11.8% of both groups.

NEER'S Score Results

The final analysis of the Neer's score revealed that 60 percent (12 patients) had excellent outcomes, while 30 percent (6 patients) had satisfactory results. It was unsatisfactory in 10 percent of cases (2 patients), with no patients failing.

NEER'S FUNCTIONAL SCORING SYSTEM

FUNCTIONAL(70)	ANATOMIC(30)
Pain(20)	Gross Anatomy(15)
Function (20)	
Motion(20)	Roentgenogram(15)
Work(10)	

Comparison of NEER'S scores with other studies

Previous studies	Excellent	Satisfactory	Unsatisfactory	Failure
Srinath et al[31]	26%	57%	17%	0%
Krishna et al[32]	50%	36.6%	10%	3.3%
Rao LL et al[33]	32%	48%	16%	4%
Girisha et al[34]	24%	71%	5%	0%
Our study	70%	20%	10%	0%

The average NEER Score is 84.6, 12 patient had outstanding results , 6 had fair results and 2 had bad results with no failure instances. Patient who were younger got better results than who were older.outcome was delayed in patient who had complications showing that complications significantly effects final outcome. It took long time for the type A3 fractures than other types. Some patients complained post operative knee pain, All pain sufferers were treated conservatively with 86 analgesics. During immediate post-operative non-weight bearing mobility, all patients employed a walking frame, which they continued to use during partial weight bearing until the fracture union/painless full weight bearing.

CONCLUSION

In the treatment of distal femoral fractures, the LCP condylar plate is the preferred option, especially in Type A fractures where we have observed higher Neer scores. Additionally, LCP avoids periosteal vessels from being compressed. Although it may not entirely resolve the enduring issues of any fractures with old age , such as malunion and nonunion, it is a useful approach in the care of these fractures. The prognosis is worse in fractures of type C, though. However, LCP continues to be the implant of choice for type C fractures as well. Although they occasionally have problems like knee stiffness and extensor lag, they produce superior results than Dynamic condylar screw and Angle Blade Plate. This is the best way to avoid metaphyseal collapse and to keep limb length in severely comminuted fractures. However, careful patient selection and rigorous attention to the fundamental principles of fracture fixation will go a long way in avoiding the consequences of fracture fixation utilising locking compression plates. This approach has a lower probability of complications such plate or screw breakage. Despite the fact that this study only provides Level III evidence, more Randomized Control Trials with better statistical significance are required to determine the effectiveness and selection of implants for distal femur fractures.

SUMMARY

We treated 20 patients of AO Type A distal femoral fractures and in this study we observed the radiological and functional outcomes.A lateral or anterolateral approach with a Distal femur locking compression plate was used to treat the fractures. The age of the patients in this study ranged from 20 to 70 years old with a mean average of 45.1 years. There were 8(40%) females and 12(60) males in the group. RTA was the major mode of injury constituting about 17 (85%) while fall accounted for only 3(15%). Right sided injury 11(55%) was more when compared to left sided 9 (45%),12 (60%) of the fractures were closed type and 8(40%) were open type and was graded under Gustillo Anderson type I and II.

As per AO Muller classification ,9 (45%) of the fractures were of the type A1 , 6(30%) were of the type A2 and 5 (25%) were of the type A3. Most of the cases were operated within the first week and those that were delayed was mainly because of the associated injuries and comorbidites. 6(30%) had comorbidites whereas 14 (70%) were not having any comorbid conditions.Complications were present in 6(30%) while 14(70%) had no complications. One patient had non union, one had knew stiffness, another had a superficial infection. All patients underwent physiotherapy jand 3-6months were the average time taken for union. Neer scoring was excellent in 12 (60%), satisfactory in 6(30%) and unsatisfactory in 2(10%) and the failure rate was 0.

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