

Comparative study of operative treatment of distal femur fractures using retrograde intramedullary nail versus locking plate; Retrospective study

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Abstract

Introduction: The overall incidence of distal femur fractures is approximately 37 per 100,000 person-years.¹ These fractures are either caused by high energy trauma in younger group or low energy falls in elderly population typically older women. As these fractures can lead to long term disability managing them is challenging task. Operative treatment for fracture fixation is recommended for optimal outcome. Although different modes of fracture fixation have evolved in and no single method is uniformly successful. In our study we have compared fixation of distal femur fracture using locking plate and intramedullary nail.

Materials and Methods: Retrospectively collected data of operated distal femur fracture of 60 patients was included. Out of these 30 patients were operated with retrograde distal femoral nail and 30 were operated with locking distal femur plate. Patients were assessed with plain radiographs and CT scan was done for complex and intra articular fractures. AO (Muller) classification was used to classify the fracture type. Postoperative functional results were evaluated using Schatzker and Lambert criteria at 1 year follow up.

Results: Mean age of the patients in the study was 45 yrs. with 73.33 % male and 26.67 % female patients. There were 41 extra articular fractures (type A) while 19 were intrarticular fractures (type C). 22 type A and 8 type C fractures were treated with retrograde nailing while 19 type A fractures and 11 type C fractures were treated with locking plate. In LCP group 28.57% cases had excellent result while 42.86% cases had good result while in retrograde supracondylar nail 13.33% had excellent result and 23.33 % had good result. There were 2 cases of infection, one in each group and 3 cases of malunion, which were managed with nail. Delayed union was encountered in 3 patients, two of them were managed with LCP.

Conclusion: Open reduction and internal fixation of distal femur has achieved excellent to good functional results with locking plate construct in all types of fractures while retrograde supracondylar nail can achieve comparable results when used in simple extraarticular fractures. For other fractures it is difficult to maintain length, alignment and rotation with retrograde nail.

Keywords: distal femur fracture, Retrograde intramedullary nail, locking distal femur plate, minimally invasive plating technique, Schatzker and Lambert criteria

Introduction

Distal femur fractures though considered as uncommon fractures account for about 4% of all femur fractures^[2]. The incident is highest in women older than 70 years and men in 30-50 year age group. The common mode of injury is low energy trauma, simple fall from standing height being the commonest^[3]. In younger patient these fractures typically occur after high energy trauma related to motor vehicle or motorcycle accidents. In these patients, there may be considerable fracture displacement, comminution, open wound and associated injuries. The mechanism of injury in most distal femur fractures is thought to be axial loading with varus, valgus or rotational forces^[4]. As the fracture is in proximity to knee joint, regaining function and full

range of motion is difficult. Historically distal femur fractures have been treated with great difficulty. They continue to pose a major challenge to orthopedic surgeons. There are significant deforming muscle forces acting on the fracture fragments, which cause difficulty in achieving and maintaining reduction making conservative treatment highly unsatisfactory. Regardless of the method of treatment severe soft tissue damage, comminution, intraarticular extension and injury to quadriceps mechanism lead to poor results in many cases. No single method of management has overcome all the problems associated with these fractures. In recent years, good results are achievable using open reduction and internal fixation with various implants like condylar blade plate, locking compression plate or intramedullary nails. With increasing incidents of motorcycle accidents these fractures are being seen more commonly in day-to-day practice especially in younger population. They can cause long-term disability if not treated properly. Hence it is necessary to formulate guidelines to treat these fractures and decrease overall morbidity associated with them. As there are multiple treatment options for distal femur fracture fixation our aim is to evaluate and compare two of the most commonly used surgical treatments that is retrograde supracondylar

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Table 1: Sex Distribution

Age group	Male patients	Female Patients	Total
20-40 yr	41	2	43
40-60 yr	3	7	10
60-80 yr	0	5	5
Total	44	14	58

nailing and anatomical locking plate and to determine the principles for sound fracture fixation.

Materials and methods

This is retrospective study of 60 patients with distal femur fracture. Patients were divided using simple random sampling and 30 patients were treated with plate fixation and 30 patients were treated with retrograde supracondylar nail. All cases are operated by single surgeon. All 60 patients were assessed clinically and radiologically with X-ray imaging and CT scan. Fractures were classified according to AO-ASIF (Muller's) classification. We included patients with type A (subtypes A1, A2, A3) and type C1 fractures in our study. Out of 60 patients 6 patients were having compound fractures (Gustilo and Anderson classification types 1 & 2).

Inclusion criteria:

1. Type A and type C1 fractures according to AO classification
2. Gustilo – Anderson type 1 and 2 injuries
3. Age group 20-80yrs.

Exclusion criteria:

1. Skeletally immature patients
2. Associated neurovascular injuries
3. Floating knee injuries
4. Pathological fractures.
5. All B, C2,3 type fractures
6. Age > 80yrs.
7. Compound grade III injuries,
8. Fractures > 2weeks old.

Post operatively all patients were initially placed in a knee immobilizer. Patients with stable fixation can be started on a continuous passive motion program in the first 24-48 hrs. after the surgery. Initially only toe touch weight bearing was allowed and progressively increased as callus formation occurred over the next 4-6 weeks. Patients with intercondylar fractures were not allowed full weight bearing for 12-16 weeks. Postoperatively check x-rays were taken in anteroposterior and lateral views. Patients were followed at 1 month, 3 month, 6 month and 1 year. Patients were assessed on the basis of time for union, rate of union, infection rate, range of motion and functional assessment. In our study, the functional results were assessed according to the criteria of Schatzker and Lambert (1970)[5].

Their criteria is:

Excellent: No pain, full extension, with less than 10° loss of flexion, no varus, valgus or rotational deformity and perfect joint congruence.

Table 2: Mean duration of union in different fracture types in weeks

Type of fracture	No. of cases	Mean (weeks)
A1	21	12.5
A2	12	14.8
A3	8	14
C1	19	15.5

Good: As for excellent but with minimal pain or one of the following: loss of more than 1.2cm of length, 10° varus or valgus deformity, loss of more than 20° flexion.

Fair: As for excellent, but with two or more of the criteria listed above.

Failure: Disabling pain or any of the following; flexion 90° or less, over 15° varus or valgus deformity, joint incongruency.

Results

The study consists of 60 cases of distal fracture of femur treated by 2 modalities. 2 cases were lost to follow up which were treated by locking plate. There were 44 (73.33%) males and 16 (26.67%) females. The average age was 58 in female patients and 34 in male patient. Most of the patients belonged to 20-40yr age group (71.66%). In this study, 49 (81.67%) cases were due to direct injury and 11 (18.33%) cases were due to indirect injury whereas 51 (85%) cases were due to road traffic accident, 09 (15%) cases were due to simple fall from slip.

Table 1:

Among the study, 21 cases were of type A1, (35%), 12 cases were of type A2 (20%), 8 cases were of type A3 (13.33%) and 19 cases were of type C1, (31.67%) fractures were encountered. Left femur was affected in 23 (38.33%) patients and right femur was affected in 37 (61.66%) patients. Out of 60 cases 57 (95%) cases were closed injuries and 3 cases were open injuries out of which one was type 1 Gustillo-Anderson and 2 cases were of type 2 Gustillo-Anderson open injuries. There were 2 (3.33%) cases of infection, one of which had compound injury. Malunion occurred in 3 (5.17%) patients treated by retrograde supracondylar nail. Delayed union occurred in 3 (5.17%) cases out of which one case was treated by retrograde supracondylar nail and 2 by locking condylar plate. None of the patient had non-union, Shortening occurred in 4 (6.9%) patients out of which 1 was treated by locking condylar plate, 3 were treated by retrograde supracondylar nail. Shortening was gross (> 2cms) in 2 patients treated by nail. Pain was present in 8 (13.79%) patients of which only one patient was treated by locking condylar plate, 7 patients were treated by retrograde supracondylar nail. The mean time for bony union in the cases operated by locking condylar plate was 12.3 weeks and for retrograde supracondylar nail it was 14.8 weeks. The average time for union for closed fractures was 12.8 weeks and for compound fractures was 17.2 weeks.

Table 2:

Mean duration of union in different fracture types Average flexion of knee was 100° in RSCN and 110° in locking condylar plate. The functional result were based on the criteria of Schatzker and Lambert

(1979)

Excellent: In the LCP group, 8(28.57%) cases had excellent result. In patients treated by retrograde supracondylar nailing 4(13.33%) cases had excellent results.

Good: In the LCP group, 12 (42.86%) cases had good results and in the retrograde supracondylar nailing group 7 (23.33%) cases had good results.

Fair: Fair results were achieved in 5(17.86 %) cases treated by a locking plate and in 11 (36.67%) patients treated by retrograde supracondylar nail.

Poor: Poor results were seen in 3 (10.71%) cases treated by locking condylar plate and in 8(26.67%) cases treated by retrograde supracondylar nail

Discussion:

Treatment of distal femoral fractures has long been a challenging subject and remains a significant surgical challenge. The literature over the past 30 years has shown an increasing trend towards satisfactory results with open reduction and internal fixation as opposed to historical controls with traction or a cast brace. Technological improvement of a variety of implant as well as improved surgical experience and standard surgical approaches have brought the surgical fixation of fracture as a main treatment in distal femur fracture. Retrograde nail obtain more "biological" fixation than plates because they are load-sharing, rather than load -sparing, implants. They offer greater soft-tissue preservation, and bone grafting is required less often. It has the potential to stabilize complex fractures with less soft- tissue dissection; and it can often be inserted quickly in a patient with multiple injuries. Intramedullary nail helps to maintain the anatomical axis and has a distinct advantage in osteoporotic bone[6]. It also has advantages of conventional intramedullary nail such as preservation of hematoma, minimal soft tissue damage, less operative time and less blood loss. Modern nailing systems also allow multiple distal locking screws in different planes to improve stabilization of the condylar block. In case of intrarticular fractures it is very difficult to achieve and maintain the anatomical reduction with nail. Though it has the advantage of less soft tissue dissection, preservation of fracture haematoma, reduced operative blood loss, stabilization of fracture is by a load sharing device and immediate motion with limited weight bearing can be started in selected cases, its disadvantage is in the limitation of its use in only simple fracture. The procedure involves the use of complex jigs with difficult interlocking and poor hold of the distal interlocking screws. The major disadvantages of nail fixation is that it provides less rigid stabilization of distal femoral fractures than plate fixation in biomechanical testing. The retrograde nail is also associated with higher level of knee pain and knee stiffness due to intrarticular entry site[7]. It is also known to cause angular Malalignment [8]. Locking compression plate on the other hand has advantages of combination of conventional compression plating as well as locking plate technique. These plates are anatomically contoured fixed angle construct and allows stable fixation. Locking plates can be used in osteoporotic patients, intraarticular or periarticular comminuted fractures of distal femur. These plates can be used with the conventional open technique or minimally invasive technique. Femoral distractor is an excellent tool to achieve the length and reduction. It also holds reduction while the plate is being applied reducing the manual work and errors associated with it. The locking plate represents a novel, bio friendly approach to internal fixation. It

acts as internal external fixator and allows axial micromotion to occur at fracture site. It resembles a plate but its biological and mechanical characteristics are different and it functions rather like a fully external fixator causes least vascular damage in comparison to conventional plate osteosynthesis. Functioning as a fixed angle device, the plate enhances fracture fixation in circumstances where fracture configuration or bone quality does not provide sufficient screw purchase to achieve the plate bone compression necessary to minimize gap strain with conventional plate screw construct. More biological techniques of plating has been advocated using indirect reduction techniques and minimal soft tissue stripping to reduce the incidence of postoperative infection and morbidity. It can obtain good fixation even in osteoporotic bone and has the capacity of revising non-unions. Using minimally invasive technique soft tissue trauma and blood loss can be minimized decreasing the chances of infection. Unless an intrarticular fracture is present joint is not opened and hence the chances of knee pain and knee stiffness are significantly less with plating. It also helps in postoperative rehabilitation and allows greater range of motion. The inherent rigidity of the locking condylar plates is superior to the retrograde supracondylar nail as proven by previous studies. Krishna C et al compared the outcome of retrograde femoral nail and distal femur locking plate in supracondylar femur fracture in a prospective study of 40 patients[9]. They found no statically significant difference in functional outcome, knee range of motion, extensor lag in both groups while time for fracture union was less in patients treated with nail as compared to locking plate. SKV Gupta et al evaluated 103 patients with distal femur fractures who had been treated by either retrograde intramedullary nail or locking compression plate. They concluded that average time of union, rate of non -union and post operative complications in either groups were not statically significant and both modalities can be used for treating distal femur fractures (type A)[10]. Hierholzer et al did retrospective analysis of retrograde nailing and less invasive stabilization system in distal femur fracture and concluded that both are adequate treatment options for distal femur fracture but the outcome mainly depends on surgical technique rather than choice of implant[11]. In our series, we found that minimally invasive plate osteosynthesis is superior than retrograde nailing. Also mainly AO type A1 fractures are suitable for nailing whereas locking plate can be used in all type of fractures with better stability and alignment.

Conclusion

Distal femur fractures are often difficult to treat. The technique demands good skill and sound judgment on the part of the surgeon. The entire patient, as well as his fracture pattern and bone density should be carefully reviewed to allow correct implant selection and use. In our series we have achieved good to excellent result with the locking condylar plates. Retrograde supracondylar nailing can achieve reasonably good results with type A1 fractures. For other fractures it is difficult to maintain length, alignment and rotation with retrograde nail. As the distal femur is flared portion the hold of nail is not good and the fracture is usually rotationally unstable leading to rotational malunion. Locking plates systems on the other hand provide absolute stability for intraarticular fracture and relative stability for extraarticular fragment. Length, alignment and rotation are better restored with locking plate as compared to the nail. The advantage lies in its use in all type A and type C fracture. Locking condylar plate needs skills and it is technically demanding procedure. Strict adherence to the

principles of minimally invasive bridge plating, understanding and considering working length of plate, plate screw density and working length of screws is important. Knowledge of the mechanics of individual surgical implants, postoperative fracture rehabilitation to provide early range of motion can lead to excellent result in the treatment of distal femur fracture with low rate of complications. This study has showed better results with locking plate than retrograde nailing but long term follow up is needed to study reoperation rate in both groups as well as functional outcome. Other limitations of this study are that it is retrospective study and lacks uniform patient distribution. We recommend use of locking plate for fixation of distal

femur fracture using minimally invasive technique though retrograde supracondylar nail can also be used in simple extraarticular fractures. The locking condylar plates provide a reliable, cost effective method to secure bone union, restore limb alignment, joint congruity and range of motion.

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