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Original Research Article

A comparative prospective study of retrograde nailing versus locked compression plating in distal third femur fractures

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ABSTRACT

Background: Treatment of distal femur fractures is complicated by the fact that the majority of these fractures occur near to transverse neurovascular structures. Present study aimed to assess the outcome in patients undergoing retrograde nailing vs locked compression plating in distal third femur fractures.
Methods: The present prospective study was conducted among all the patients visiting Mamata general hospital Khammam with distal third femur fractures between age 18-80 years during the period of October 2020- September 2022. The patients were treated with retrograde nailing in group and locked compression plating in another group of patients with distal third femur fracture.
Results: On assessment of the clinical outcome during the follow-up period, there is significantly lower clinical outcome score among the patients in the nailing group compared to the plate. Similarly, the radiological scores between the groups, there is significantly higher mean score among the patients in the nail group compared to the plate group.
Conclusions: The present study showed a significant clinical outcome and radiological score among the patients treated with retrograde nailing compared to the patients treated with locking compression plating technique for distal third fracture of femur.

Keywords: Distal third femur fractures, Retrograde femur nailing, Locked compression plating

INTRODUCTION

Fractures of the distal femur are complex injuries that pose a challenge to the orthopaedic surgeon. It constitutes about 7% of all the femoral fractures.[1] It usually occurs during high energy trauma in younger patients and frequently are associated with concomitant injuries.

In contrast, elderly patients with severe osteopenia might sustain solitary distal femoral fractures from minor trauma such as simple fall.[2]

Treatment of distal femur fractures is complicated by the fact that the majority of these fractures occur near to transverse neurovascular structures. As a result, they are more vulnerable to vessel damage. Because these fractures are at the articular area of the knee joint, mobility of this joint is compromised very early, necessitating proper physiotherapy for a good functional result.

Significant advances have been made in treatment of these fractures in the past few decades. It is recognized that operative fixation with the ability to maintain anatomical reduction of the joint surface,[3] restoring axial ligament and early range of motion presents clear advantages over closed means of treatment.

Numerous devices have been proposed for the treatment of these fractures. These include anatomical reduction of distal femoral articular surface, stable internal fixation,

minimal soft tissue stripping and early active mobilization.[4]

Intermedullary implants offer potential biomechanical advantages over plate and screws because their intermedullary location results in less stress on the implant, they have potential for load sharing and they can be inserted with minimal soft tissue stripping.[5-11]

The advantages of locking compression plate procedures include rigid and anatomical reduction and stability. Because it contains several purchases in the distal piece, it has demonstrated good stability and rotation control in all planes. This implant was chosen by osteoporotic senior patients due to its locking screw design.

However, significant soft tissue injury and open reduction approaches in plating processes have their own drawbacks.

Hence the present study is taken up for a comparative study of retrograde nailing versus locked compression plating at Mamata medical college and general hospital, Khammam.

METHODS

Study design

It was prospective study

Study period

Study carried out for 24 months, from October 2020 to September 2022.

Place of study

Study conducted at department of orthopaedic surgery and traumatology, Mamata medical college and general hospital, Khammam.

Sample size

Minimum 40 patients were included.

Inclusion criteria

All patients visiting Mamata general hospital Khammam with distal third femur fractures between ages of 18-80 years, patients with polytrauma and patients having closed or Gustilo I/II open fractures were included in this study.

Exclusion criteria

Patients who were Aged below 18 years and above 80 years, with underlying neuromuscular disorders, metabolic bone disorders or pathological fractures were excluded from the study.

Source of data

This study was conducted in the department of orthopaedic surgery and traumatology at Mamata medical college and general hospital, Khammam between October 2020 to September 2022.

Methods of collection

Data was collected in the form of history by verbal communication, clinical examination (both local and systemic), blood investigations (complete blood picture, bleeding time, clotting time, random blood sugar, RFT), radiological examination: X-ray femur AP and lateral view, chest X-ray PA view and ECG recordings.

Written and informed consent was taken. Photographic documentation of fracture (pre operative, intraoperative and post operative) was done and also post-operative wound care was noted.

Follow up period

Regular clinical and radiological evaluation was done initially for every 4 weeks for the first 3 months and then every 6 weeks for the next 9 months till the completion of fracture union.

Statistical analysis

All the data was collected in approved proforma and data was entered in MS excel.

Statistical methods used

The outcomes were recorded and analysed at the end of the study using statistical package for social sciences**.**

Methods of treatment

In the decade of 1960s, conservative methods such as traction of involved limb and cast bracing produced better results than operative management, because of the lack of adequate internal fixation of the fractures.

With the development of improved internal fixation devices, treatment options began to change in the 1980s. The blade plate designed by the AO group was one of the first used devices and gained wide acceptance for management of fractures of the distal femur.

As it was technically complicated, a less technically demanding device dynamic condylar screw was introduced. Those fractures for which both dynamic condylar screw and condylar blade plate could not be used remained a problem which was sorted out by the introduction of condylar Buttress plate.

The intramedullary nailing was used in the treatment of distal femoral fractures, because they obtained more

biological fixation. Nails have been designed specifically for retrograde insertion through inter condylar notch for the treatment of supracondylar and inter condylar femoral fractures.

Flexible intramedullary implants like Zickel's supracondylar device, ender rods, rush rods have been used with success to treat distal femoral fractures. External fixation was used as either temporary (or) definitive fixation in severe open distal femur fractures especially those associated with vascular injury.

A recent advance in technology for the treatment of distal femoral fractures includes less invasive skeletal stabilization system (LISS) and locking compression condylar plates (LCP). They offer multiple points of fixed angle contact between plate and screws in distal femur (Angle stable construct), reducing tendency for varus collapse and at same time afford better stability. Hence management of distal femur fracture can be divided into 2 broad categories: Conservative and operative treatment.

Surgical management

In past 25 years, internal fixation of displaced fractures of lower end of femur has gained widespread acceptance as operative technique and implants have improved. Combination of properly designed implant, better understanding of fracture pattern, meticulous soft tissue handling, judicious use of antibiotics, and improved anesthetic methods have made internal fixation safe and practical.[13-16]

Since 1970, all studies comparing the results of conservative and operative methods have favored operative stabilization of distal femur fractures.

The goals of operative treatment of distal femur fractures are: Anatomical realignment of fractures, stable fixation of the fractures, early mobilization of the knee joint, early functional rehabilitation of joint by physiotherapy.

Indications for operative management include: Displaced intra articular fragments, polytrauma patients with multi system injuries, open fractures, associated vascular injuries requiring repair, Severe same limb injuries (patellar fracture, tibial plateau fractures), Major associated knee ligamentous injuries, Irreducible fractures, Pathological fractures and fractures around TKR (Peri prosthetic).

Contraindications to internal fixation include: Active infection elsewhere, severely contaminated open fracture (type III B), massive comminution (or) bone loss, severe osteopenia, inadequate facilities and inexperienced surgeons.

Principles of internal fixation

Sequences in the surgical management of supracondylar fracture includes: Restoration of articular surface, metaphyseal alignment, impaction of fracture in osteoporotic patients and early mobilization of knee.

In operative treatment, various modalities include: open reduction internal fixation (dynamic condylar screw, condylar blade plate, condylar buttress plate, locking compression plate and cancellous screws), closed reduction and internal fixation (ante grade locking nails, supracondylar nail and flexible intramedullary nail), ilizarov ring fixation and external fixation.

95 degree condylar blade plate (CBP)

It is the first implant used for supracondylar fractures. When used by an experienced surgeon, this restores alignment and provides stable internal fixation. Because it is a one piece device, it affords the best control of the fracture. However, placing of 95 degree condylar plate is technically demanding procedure, leaving little room for error. It can be used for inter condylar fractures, provided the lateral cortex is not comminuted.[17-19]

The main advantages of CBP is increased strength and increased corrosion resistance of the implant. The disadvantage is the increased difficulty of insertion.

In the distal femur, the blade has to be inserted so that it will line up with the axis of the shaft and with joint axis and with the inclination of patellofemoral joint and be inserted exactly in the middle of anterior half of the femoral condyle at a predetermined distance from the joint and has to line up with the axis of femoral shaft.

Initially the 130° plate was used for the distal femur also. With time it became evident that the 95° plate was the physiological one.

Condylar buttress plate

Blade plates and condylar screws are unsuitable for use in fractures with <3-4 cm of intact femoral condylar bone and in fracture with a large amount of articular comminution. For these fractures, the condylar buttress plate is the most commonly used implant. It is one piece device specifically designed for the lateral surface of distal femur.[20]

It is essentially a broad DCP with a cloverleaf shaped distal portion designed to accommodate up to 6 cancellous screws. Because the posterior portion of cloverleaf is larger than the anterior portion. It is manufactured separately for right and left sides. Mechanically it is not as strong as a blade plate or condylar screw with side plate and therefore should not be used or substituted for these preferred implants.

The problem with condylar buttress plate is that the screws passing through the distal holes do not have a fixed relationship to the plate., With indirect reduction techniques (such as the use of distraction device) the

screws may shift relative to the plate producing varus deformity or valgus deformity, so its use should be restricted to cases in which the lateral femoral condyle is comminuted or there are multiple intra articular fractures in coronal plane or sagittal plane.

In cases with extensive medial comminution a second medial plate needs to be used to prevent varus deformity.

Locking compression plate

The plate system has many similarities to traditional plate fixation methods with few improvements such as- Locking screws provides fixed angle construct and improved fixation in osteoporotic bones.[12,20-24]

Some salient features include: The screws do not rely on plate bone compression; multiple screw fixation in distal femoral condyle allows improved fixation in type C3 fractures; anatomically shaped distal end is contoured to match distal femur and hence intra-operative contouring is not required; combi-holes have additional dynamic compression holes providing options for axial compression in addition to locking mechanism; Lateralisation of proximal femur is prevented by maintaining a gap between the proximal fragment and the plate until locking screw is applied after which the alignment is maintained.

It combines the advantages of the dynamic compression plate principle with the locking screw head principle, giving the surgeons great flexibility of choice within a single implant. Screw holes in plate have been specially designed to accept either a standard cortical screw with a hemispherical head/locking screw with a threaded head.

LCP combi-holes

Intraoperative choice between angular stability and compression. Guiding jig: Enables easy and correct mounting of the plate and enables screw fixation through guide and centering sleeves. There is no consensus on the best treatment of complex intra articular fractures and high energy diaphyseal fractures of the long bones. The new screw-plate systems seem to offer an excellent alternative for the operative fixation in these cases.

Retrograde nailing

In general, reamed nailing allows for bigger diameter implants, which may give improved initial stability. According to certain research, reaming results in decreased malunion and nonunion. On other hand, fat embolization is a worry, and pressures necessary to accomplish nail twisting are greater with solid unreamed nails. Typical approach for most facilities is reamed nailing.

Correct nail placement is critical for optimal seating in the distal major fragment. Because of potential of damaging the patella articular cartilage, the nail should never be excessively long or extend into the knee joint. If the nail is sunk more than 2 cm into the cortex at entrance site, the locking screws will be too close together. It would also be difficult to remove the hardware if this was needed later.

Postoperative management

Post-op management depends upon individual patient needs. If patient has type C and other system involvement like chest injury, head/pelvic injury, it is better to have management in multi centric intensive setup. Antibiotics given according to severity and nature of injury.

In stable internal fixation the patients were started on knee mobilization and CPM exercise from 24-48 hours after surgery once the patient tolerates pain, Isometric muscle strengthening exercises and limited active assisted knee range of motion is encouraged. Patients initially encouraged to tiptoe down walking will increase callus formation over 6 weeks, complete weight bearing advised only after 12 weeks.

RESULTS

In the present study a total of 40 patients fulfilling inclusion criteria are included with mean age of 58.38±8.98 years. The patients were equally distributed into two groups based randomly.

Table 1: Mean age of the study participants.

N	Min age (in years)	Max age (in years)	Mean	SD
40	36	72	58.383	8.98

Table 2: Gender distribution among study participants.

Gender	Frequency	Percent (%)
Female	14	35
Male	26	65
Total	40	100

Among 40 patients, 35% female and 65% male patients with male preponderance in the present study.

Table 3: Presence of history of smoking among study participants between the groups.

H/O smoking	Nail		Plate		P value
	Count	Column, N (%)	Count	Column, N (%)	
Absent	14	70.00	14	70.00	0.774
Present	6	30.00	6	30.00	

*Comparison of the history of smoking, there is no significant difference between the groups (p>0.05).

Table 4: Presence of history of alcohol consumption among study participants between the groups.

H/O alcohol	Nail		Plate		P value
	Count	Column, N (%)	Count	Column, N (%)	
Absent	17	85	18	90.00	1
Present	3	15	2	10.00	

*Comparison of the history of alcohol consumption, there is no significant difference between the groups (p>0.05).

Table 5: Presence of history of diabetes mellitus among study participants between the groups.

H/O DM	Nail		Plate		P value
	Count	Column, N (%)	Count	Column, N (%)	
Absent	11	55.00	13	65.00	0.428
Present	9	45.00	7	35.00	

*Comparison of the history of diabetes mellitus, there is no significant difference between the groups (p>0.05).

Table 6: Presence of history of hypertension among study participants between the groups.

H/O HTN	Nail		Plate		P value
	Count	Column, N (%)	Count	Column, N (%)	
Absent	13	65.00	14	70.00	0.781
Present	7	35.00	6	30.00	

*Comparison of the history of hypertension, there is no significant difference between the groups (p>0.05).

Table 7: Comparison of the pre and post-operative mean clinical score between the groups.

Variables	Nail		Plate		P value
	Mean	SD	Mean	SD	
Pre-op clinical score	8.2	0.7	8.2	0.6	0.709
Post-op clinical score	8.1	0.7	8.1	0.7	0.854

*On assessment of the preoperative and postoperative clinical score, there is no significant difference noted between the groups.

Table 8: Comparison of the pre and post-operative mean radiological score between the groups.

Variables	Nail		Plate		P value
	Mean	SD	Mean	SD	
Pre-op radiological score	36.4	3.3	37.7	3.3	0.145
Post-op radiological score	36.9	3.4	36.7	3.4	0.765

*In the present study on assessment of the pre and post op radiological scores between the groups, there is no significant difference noted between the groups.

Table 9: Comparison of the clinical outcome score between the groups at different interval of follow-up period.

Clinical outcome	Nail		Plate		P value
	Mean	SD	Mean	SD	
1 week	8.2	0.6	8.2	0.6	0.827
1st month	8.2	0.6	8.2	0.6	0.717
3rd month	4.6	1	4.8	1.1	0.02*
6th month	1.8	1.2	2.6	1.5	0.02*
9th month	0.3	0.5	0.4	0.5	0.315

On assessment of the clinical outcome during the follow-up period, there is significant lower clinical outcome score among the patients in nailing group compared to the plate at 3rd month and 6th month *(p<0.05).

Table 10: Comparison of the radiological outcome score between the groups at different intervals of follow-up period.

Radiological outcome	Nail		Plate		P value
	Mean	SD	Mean	SD	
1 week	36	6.8	31.5	5.2	0.05*
1st month	40.3	7.8	35.7	7.4	0.02*

Continued.

Radiological outcome	Nail		Plate		P value
	Mean	SD	Mean	SD	
3rd month	81.5	4.9	71.7	4.6	0.01*
6th month	93.3	3.1	86.2	5.9	0.01*
9th month	93.9	2.4	86.7	5.3	0.01*

*On assessment of the radiological scores between the groups, there is significant higher mean. score among the patients in nail group compared to the plate group at all the interval of 1 week, 1st, 3rd, 6th and 9th month of follow-up (p<0.05).

DISCUSSION

Treatment of distal femur fractures is complicated by the fact that the majority of these fractures occur near to transverse neurovascular structures. As a result, they are more vulnerable to vessel damage.

Because these fractures are at the articular area of the knee joint, mobility of this joint is compromised very early, necessitating proper physiotherapy for a good functional result. Significant advances have been made in treatment of these fractures in the past few decades.

It is recognized that operative fixation with the ability to maintain anatomical reduction of the joint surface restoring axial ligament and early range of motion presents clear advantages over closed means of treatment.[3]

The advantages of locking compression plate procedures include rigid and anatomical reduction and stability. Because it contains several purchases in the distal piece, it has demonstrated good stability and rotation control in all planes. This implant was chosen by osteoporotic senior patients due to its locking screw design. However, significant soft tissue injury and open reduction approaches in plating processes have their own drawbacks.

Newer biological fixation procedures have minimized the issue of union and infection in distal femur fractures. The therapy is still a problem for orthopedic surgeons. Both distal femoral locking plates and distal femoral nailing produce nearly equivocal results, with considerable variation in knee discomfort and union time.[26]

Early surgical stabilization can help with soft tissue care, allow for early mobility, and lessen the complexity of nursing care. The use of implants such as angled blade plate, fickle devices, rush rods, ender nails, dynamic condylar screw, condylar buttress plate and interlocking nails, locking compression plate has been proposed.

A locking plate reduces screw-plate toggling and motion at bone-screw interface, resulting in a more firm fixation. Rigid fixation is thought to be one of keys to effective treatment of these fractures. Traditional plates have drawbacks such as screw withdrawal, implant failure, and unstable fixation requiring postoperative immobilization.

Hence the present study is taken up for comparative study of retrograde nailing vs locked compression plating at Mamata medical college and general hospital, Khammam.

In the present study, a total of 40 patients fulfilling inclusion criteria are included with mean age of 58.38±8.98 years.

The patients were equally distributed into two groups based randomly. Among 40 patients, 35% were female and 65% were male patients with male preponderance in the present study. The history of smoking, alcohol consumption, diabetes mellitus and hypertension were present in both the groups and it was comparable statistically.

Similarly, Singh et al documented mean age of groups I and II was 48.00±15.65 years and 40.43±14.39 years, respectively. Both groups' female-to-male ratios were matched (p=0.075) with male preponderance.[26]

The baseline clinical and radiological scores were comparable between two groups of patients. On assessment of the clinical outcome during the follow-up period, there is significant lower clinical outcome score among the patients in nailing group compared to the plate at 3rd month and 6th month (p<0.05) Similarly the radiological scores between the groups, there is significant higher mean score among the patients in nail group compared to the plate group at all the interval of 1 week, 1st, 3rd, 6th and 9th month of follow-up (p<0.05).

In study by Yuan et al documented the average duration of follow-up was 16 months (range, 12-24 months). All fractures healed after 6.5 months on average (range 4-12 months), and one patient had further bone graft surgery that did not include a bone transplant during the RIN revision procedure (this eventually healed at 12 months post-operatively).

The mean ROM before the operation was 86.92±12.34°. At the final follow-up, the mean ROM was 112.69±9.27°. There was a significant difference between pre-operative and postoperative ROM (p<0.01). The mean HSS score improved significantly from 38.85±9.62 points preoperatively to 79.62±5.42 points post-operatively. There was a significant difference between pre-operative and post-operative HSS scores (p<0.01). RIN revision surgery achieved excellent clinical results in patients with LCP failure.[28]

The period spent bearing full weight was substantially (p=0.004) shorter in the nailing group in study by Singh et al. Bone union was first observed in group II (DFN), and it became statistically significant (p=0.0006). Knee

discomfort was reported by 42.86% of patients in group II, and it was statistically significant (p<0.001).

Group II had a considerably higher flexion score (p=0.029). In terms of knee flexion, early weight bearing, and union time, distal femoral nails performed better than plates, however the incidence of knee discomfort was considerably greater in the nailing group compared to the plating group.[26]

On assessment of the complications there was higher incidence of the infection, mal-union and knee stiffness among plate group compared to nail group however this was not significantly different between the groups.

Similar to present study, Jankowski et al documented no differences in the union rate, malalignment, time to union, average arc of motion, or complication rates that necessitated a return to the operating room. IMN or LP are suitable means of therapy for native distal femoral fractures until higher level randomized data is available.[41]

Yuan et al documented the average operating duration was 155 minutes (range: 120-210 minutes), with a blood loss volume of 650 ml (range, 200-1350 ml). Complications occurred in two patients (15.38%): one was calf muscle vein thrombosis and the other was a superficial infection. There was no post-operative deep tissue infection or deep vein thrombosis.[28]

Neradi et al documented Surgical duration (95% CI 2.90 to 17.13, p=0.01) and blood loss (95% CI=69.60 to123.18, p=0.01) favoured plating group and the difference was significant. However, when we looked at factors like implant failure, knee range of motion, non-union, and union time, our findings favoured the nailing group, although the difference was not statistically significant.

Overall, locked plating and retrograde intramedullary nailing are equivalent in terms of union and morbidity in distal femur fractures, although bigger and higher quality randomized studies are needed to assess the difference.

The operational time, functional score, time-to-union, non-union rates, and revision rates were all taken into account. Ten trials were included, totalling 531 periprosthetic fractures. According to the findings of this meta-analysis, there is no significant difference in any of the outcome indicators studied. Furthermore, more significant research on the issue is necessary to reach more solid findings.[29]

According to study by Agarwal et al using modified Neer's criteria, retrograde nailing achieved 70% outstanding outcomes and locked compression plating achieved 65% excellent results. Retrograde nailing is an effective fixing method for distal femur fractures, with improved outcomes in terms of range of motion, early mobilisation, decreased operational time, and blood loss.[27]

Krishna et al documented the total amount of knee flexion in the distal femoral locking plate is 104.75±8.19, while in the distal femoral nail is 109.5±11.46, p=0.14, which is not significant. Indicated that both techniques produce better outcomes when performed correctly surgically. The plate may be used for all types of fractures, although retrograde nailing is more suited for extra-articular fractures.[25]

Another study by Markmiller et al who evaluated the outcomes of a condylar blade plate and a retrograde intramedullary nail in a prospective study. At 12 months, there were no statistically significant differences in non-union, fixation failure, infection, or secondary surgical operation.

The present study documented an overall better outcome among the patients undergoing retrograde nailing compared to patients undergoing locked compression plating in distal third femur fractures. Also, the complications in both the groups were minimal, however the incidence of complications were lower in the patients treated by retrograde nailing compared to the patients treated by locked compression plating for distal third fracture of femur.

There were some limitations in the above study. As a single-center investigation, the data that could be obtained was limited. Many patients were excluded as a result of adhering to the eligibility requirements for inclusion. Some independent variables (e.g., usage of corticosteroids).

That predict healing difficulties were not evaluated, even though we identified some that did, such as soft tissue damage or patient age. Furthermore, the number of cases included can be considered low (40 cases) although this is one of the few studies with a comparatively high number of cases when compared to other studies of similar nature.

CONCLUSION

The present study showed a significant clinical outcome and radiological score among the patients treated with retrograde nailing compared to the patients treated with locking compression plating technique for distal third fracture of femur.

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