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Comparative study between results of retrograde intramedullary nailing (RN) vs locked plating (LP) in treatment of extra articular distal femur fracture: A prospective analysis

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Abstract
Introduction: Fractures of the distal femur are complex injuries that pose a challenge to the orthopaedic surgeon. It constitutes about 7 % of all femoral fractures. 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 a simple fall. Despite advances in implants, much confusion exist regarding choice of implant.
Method and Material: we conducted a prospective randomized study from 2017 to 2019 in which, analysis of 30 patients was done out of which 15 cases were treated in each group with follow-up at 6,12,24 weeks. Muller classification was used to grade the fractures, taking type A1-3 in inclusion criteria and type B, C under exclusion criteria.
Results: KOOS scoring was used to evaluate final outcomes which demonstrated that in RN group, 2 cases were excellent, 7 cases were good, 6 cases were fair, while in LP group: 1 case was excellent, 6 cases were Good and 8 cases were fair and 1 case was poor. Over 80% of fractures under RN and LP healed within 6 months with average time being 21.0 weeks (range 12 to 28 weeks) in RN and 23.03 weeks (range 12-32 weeks) in LP group.
Conclusion: Both retrograde IM nailing and LCP plating may be adequate treatment options for distal femur fractures. Early healing, increase range of movement, less average surgical time, more complications are seen in nailing compared to plating but are statistically insignificant, the reason for these results is mostly due to simple fractures treated by nailing and complex ones by plating. No significant differences in outcome between implants regarding fracture healing, non-union were found for both the techniques. However, both procedures need correct preoperative planning and adequate surgical experience so as to avoid revision surgery.

Keywords: RN-retrograde nailing, LP-locked plating, KOOS score-knee injury osteoarthritis severity score

Introduction
Fractures of the distal femur are complex injuries that pose a challenge to the orthopaedic surgeon. It constitutes about 7 % of all femoral fractures. It usually occurs during high energy trauma in younger patients and are associated with concomitant injuries. In contrast, elderly patients with severe osteopenia might sustain solitary distal femoral fractures from minor trauma such as a simple fall. Significant advances has been made in treatment of these fractures in the past few decades. Neer in 1967 concluded that these fractures were not suitable for internal fixation and treated with traction & cast bracing.
It is recognized that operative fixation with the ability to maintain anatomical reduction of the joint surface, restoring axial alignment 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 the distal femoral articular surface, stable internal fixation, minimal soft tissue stripping and early active mobilization. Fixation with a lateral blade plate or its modifications became popular because it allowed fixation of intraarticular fractures and early mobilization. Their use requires significant soft tissue stripping, which can affect osseous healing and a potential risk of infection.

Intramedullary implants offer potential biomechanical advantages over plate and screws because their intramedullary location results in less stress on the implant, they have potential for load sharing and they can be inserted with minimal soft tissue stripping. However the use of antegrade intramedullary nail in the treatment of supracondylar femoral fractures has been associated with angular deformities because of the inability of distal interlock of antegrade nail to achieve control of the small distal fracture fragment. To extend the practical and theoretical advantages of intramedullary nailing in distal femoral fractures, the supracondylar Nail was designed by Green, Seligson and Henry in 1988.

In this prospective study, we evaluated and compared clinical and radiological outcomes of distal femur fracture stabilization using Retrograde Nailing (RN) and Locking compression plate (LCP) techniques. Our aim of the study is to evaluate and compare the results and outcome of retrograde nail and locking compression plate in extra articular distal femur fractures, and to study the functional outcome in both procedures with the help of KOOS score

AIMS & Objectives

To compare functional outcome of surgical management of distal femur extra articular fracture treated with Retrograde nailing vs locked compression plating.

To look for the complications associated with both the surgical techniques.

Material and Methods

Our study was conducted on 30 patients with extra articular distal femur fractures, who that presented to the hospital emergency room between 2017 and 2019. The patients were treated at Department of Orthopaedics and Traumatology, M.Y. Hospital, Indore.

The patients who completed the following criteria were included in the study

- All patients Of type A(according to muller classification)
- Age 18-60 years
- Duration less than 3 weeks and unilateral fractures with no other fractures in ipsilateral limb
- Grade 1 compound fractures of Gustilio anderson classification

The following were excluded from our study

- Type B and Type C fractures as per muller classification
- Grade 2 and Grade 3 compound fractures
- Patients with Uncontrolled Diabetes mellitus

Patients with neurologic conditions

Fig 1: Fracture supracondylar femur in a 42 year old male patient.

Fig 2: 6 weeks, 12 weeks and 24 weeks follow up AP and lateral radiographs of the same patient.

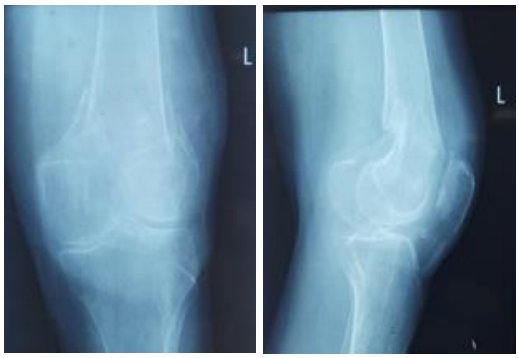

Fig 3: Fracture supracondylar femur in a 57 year old female patient.

Fig 4: 6 weeks, 12 weeks and 24 weeks follow up AP and lateral radiographs of the same patient.

Post-Operative Assessment

- Postoperatively, a well-padded splint was applied and patients were encouraged to keep the limb elevated in

order to minimize swelling. On post operative day 2, check dress was done. following drain removal.
- On 2nd week follow up, suture removal was done and the patient was mobilized with 2 elbow clutchers. Gait training exercises were given and partial weight bearing exercises encouraged.
- Stair climbing permitted after 7-14days

After removal of the drain, quadriceps strengthening exercise are initiated within the first week after surgery including actively and passively. Patients were further followed up 12 and 24

Statistical Analysis
Statistical analysis was done using p values. A probability (p value) of <0.05 was considered to be statistically significant.

Observation and Results
The details of the various variables and data is presented as follows.

Age Distribution

Age Group	No. of Patients
18-30 years	10
31-40 years	6
41-50 years	3
51-60 years	11

Sex Distribution

Group	Male	Female	Total
Retrograde Intramedullary Nailing	10	5	15
Locked plating	9	6	15
Total	19	11	30

Laterality

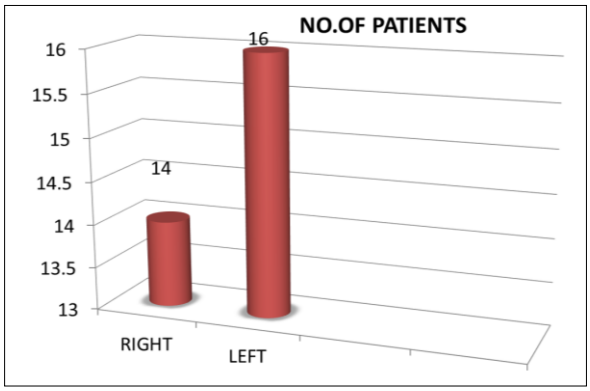

Fig 5: No. of Patients

4. Mode of Injury

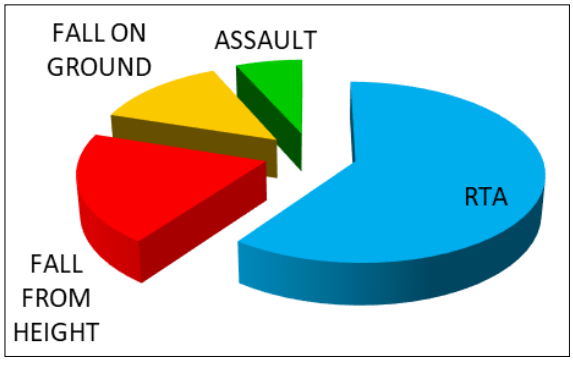

Fig 6: Type of fracture

Table 1: Distribution of patients according to AO Classification

AO Fracture Type	Nail Group	Plate Group	Total
A1	6 20.0%	4 13.33%	10 33.33%
A2	4 13.33%	4 13.33%	8 26.67%
A3	5 16.66%	7 23.33%	12 40%

P value = 0.4, Not significant

Operating Time

Table 2: mean operative time (minutes) between the two groups

Group	Mean ± SD	P value
Nail group	85.68 ± 7.35	0.000*
Plate group	113.50 ± 6.87	

P value = 0.003, Significant

Union Time

Table 3: union time (weeks) between the two groups

Group	Mean ± SD	P value
Nail group	21.0 ± 3.2	0.064 NS
Plate group	23.02 ± 2.9	

Range of Motion
Type A1

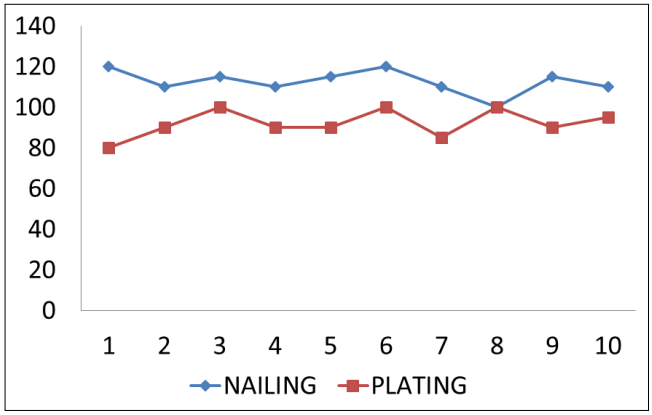

Fig 7: Type A1

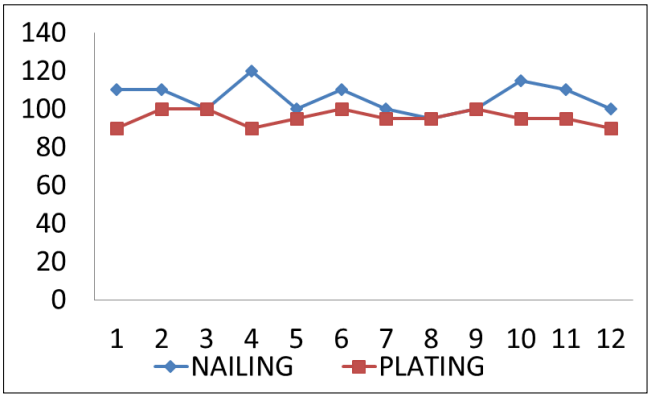

Fig 8: Type A3 fracture

Table 4: Comparison of mean KOOS score between the two groups

Group	No.	Mean ± SD	P value
Nail group	15	74.39 ± 7.82	0.039*
Plate group	15	69.32 ± 6.37	

Table 5: Show the Complication RN Group LP Group

S. No	Complication	RN Group	LP Group
1	Delayed union	NIL	1
2	Joint stiffness	1	2
3	Knee pain	2	1
4	Infection	1	2
5	Impingement	1	0
6	shortening	0	0

Table 6: Final Koos Score Results

Koos Score	Nailing	Plating	Total
Excellent	2	1	3
Good	7	6	13
Fair	6	8	14
Poor	0	1	1

Discussion

Fractures of distal femur are complex injuries that can be difficult to manage and have the potential to produce significant long term morbidity. Operative treatment is the treatment of choice in these injuries nowadays, resulting in anatomic reduction and early mobilization combined with early weight bearing. Previously stabilization was usually achieved with a condylar screw and plate. Retrograde intramedullary nailing has been developed in order to address some of the previous problems associated with distal femur fractures. Benefits of retrograde nailing include less extensive exposure, no periosteal stripping, reduced blood loss, decreased operating time and hospital stay.

In our study 30 patients with supracondylar & distal femoral type A fractures extra articular type underwent retrograde intramedullary nailing and locked plating. The mean age of occurrence of fracture in our study was 32.4 years (19-65 years). In our study sex distribution was found to be comparable in both the groups. In our study, the incidence of fracture was high in the age group between 18-40 years. The most common mode of injury was road traffic accidents in our study similar to other studies. There was a definite male preponderance (72%) in our study as was reorted by 0strum [1] 75% in his study and 60% was reported by Seifert *et al.* [2]. The mean age in males were found to be 32 as against 56 years in females in our study. Minimum follow up in our study was of 6 months the follow up period is short due to the fact our study period was between 2017 and 2019. In our study relatively percentage of type A fracture is more as we have not taken onto account of type B and type C fractures in our study.

Out of 30 patients, 40 percent of fractures were grade 1 compound fractures, with rest being simple closed. Distribution of fractures as per AO classification was found to be comparable in both the groups, with p vale being non significant.

Mean operating time in our study in case of RN group was found to be 86 minutes as compared to LP group were it was 113 minutes, with p value being significant.90 percent of patient showed union within 6 months, the mean union time in case of RN group was found to be earlier, 21 weeks as compared to LP group were it was 23 weeks with values bein insignificant.

The mean range of motion in case of RN group was found to be more as compared to LP group with values being non significant for all subtypes of type A fractures. Studies by Papadokostasis *et al.* [3] in 2004 showed that mean range of motion was 104 ± 17.2 and 93 degrees by Henry *et al.* [5].

Looking on to complications, we got 2 cases of superficial infection in LP group as compared to 1 case in RN group, these poatients were treated with iv antibiotics and regular dressing. There was 1 case of delayed union in LP group, the fracture had not yet united completely at the completion of the study. Anterior knee pain was found to be more in RN group as compared to LP group Knee pain has been encountered as a major problem in 30% of our patients. In the series by Lauri. Handolin *et al.* [4] in 2004 anterior knee pain seen patienyts were managed with physiotherapy exercises. Rate of complications were comparable to studies by Iannacone *et al.* [5] in 1994. He had reported 41 complex distal femoral fractures treated with GSH nail resulting in four nonunion, and five delayed unions. This he attributed to the use of open technique in his study.

He had concluded that treatment of supracondylar fractures should be placed percutaneous with distinct advantages of decreased operating time, decreased blood loss and avoidance of extensive surgical dissection.

In our study of 30 patients, 63% had good to excellent results and 15.1% had poor results as against the study by Gellman *et al.* [6] which showed higher percentage (80%) of good results. In our study, excellent results were obtained in patients operated early and in those with closed non articular type of fracture. There has been a concern expressed regarding the use of intraarticular entry and development of arthrofibrosis and stiffness of the knee. In our study, younger patients regained higher range of motion than the elderly similar to other studies 9, 12. The cause of knee stiffness could be due to prolonged immobilization after surgery with a knee brace done 65 based on fracture patterns stability, delay in taking up patients for surgery, lack of patient compliance regarding knee mobilization & presence of associated injuries. In our study, patients with stable fixation were mobilized in the first or second postoperative day. Static quadriceps exercises and knee mobilisation exercises were taught. In some patients with less stable fixation, knee was immobilsed in a knee brace for 3 weeks.

The main problem encountered was non compliance of patients regarding physiotherapy exercises at home possibly due to lack of awareness regarding its importance or may be due to fear. In summary, retrograde supracondylar nailing is a excellent technique with good union rates in the management of supracondylar fractures. However in view of some of the complications associated with it, less invasive stabilization system and locking plates has been gaining popularity nowadays. Long term comparative study regarding the use of different methods of fixation should be undertaken in the future.

Summary and Conclusion

Distal femoral fracture poses a challenging problem to the orthopaedics surgeon as it occurs in young with high velocity and elderly with low velocity trauma. Early internal fixation and mobilization of the patients is of utmost importance. Presence of osteoporotic bone and presence of other injuries around the knee complicate the problem further. Both retrograde IM nailing and LCP plating may be adequate treatment options for distal femur fractures. Early healing, increase range of movement, less average surgical time, more complications are seen in nailing compared to plating but are statistically insignificant, the reason for these results is mostly due to simple fractures treated by nailing and complex ones by plating. No significant differences in outcome between implants regarding fracture healing, non-union were found for both the techniques. However, both procedures need correct

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