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Comparative Study between Locked Plate and Retrograde Nail in Management of Extra Articular Distal Femur Fractures

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Abstract

Background: A variety of techniques, such as the retrograde intramedullary nail and the locked compression plate, can treat distal femur fractures. These are only two of the many management options available.

Aim and objectives: To look at the differences between a locked plate and a retrograde nail in fixing extraarticular distal femur fractures and see which one works better and causes fewer problems after surgery.

Patients and methods: Prospective research was performed on 20 cases of distal femoral fractures: 10 patients treated with femoral retrograde interlocking nails, ten patients who were treated with compression plates located in the distal femoral region at the Orthopedics Surgery Department, El-Salam Specialized Hospital, and El-Zahraa University Hospital, Cairo, Egypt.

Results: No significant variance was observed among the groups under investigation as regards time to union and knee range of motion ($P = 0.146$). In the retrograde nail group, infection wasn't observed; however, it was noticed in only one case in the locked plate group. We observed no significant variance among the two groups. Only one case in each group suffered from pain, so we observed no significant variance between the two groups.

Conclusion: Nail systems offer better outcomes, reduced surgical morbidities, and better rehabilitation, but they require significant surgical experience and careful preoperative planning.

Keywords: Locked plate; Retrograde nail; Extra articular distal femur fractures

1. Introduction

Distal femur fractures constitute fewer than one percent of entire fractures and between three and six % of wholly femoral fractures. There is a bimodal split associated with the fractures. A single subgroup consists of cases who are under the age of 50, primarily men, who have severe physical injury due to high-impact incidents like traffic accidents or falls from great heights. The second group comprises primarily female cases above fifty years old with osteoporosis and experience low-energy trauma.^{1,2}

The accepted procedure for treating supracondylar fractures, independent of age group, has traditionally been open reduction and internal fixation utilizing extra-medullary implants. Nevertheless, this method carries problems, including delayed bone regeneration, implant malfunction, and infection. Traditional

extra-medullary fixation can lead to iatrogenic soft tissue damage and devascularization of the periosteum, which can greatly contribute to the occurrence of contagion and late union. Therefore, further bone grafting is usually required.^{3,4}

The use of an intramedullary nail provides a biomechanical benefit compared to side plates & screws. This is due to the fact that the fact that the intramedullary location reduces stress on the implant & improves stress distribution, unlike the eccentric placement of side plates & screws. Additionally, they possess the capacity for load shearing. Their utilization results in minimum damage to soft tissues, a short duration of surgery, low blood loss during the perioperative period, and the opportunity to mobilize patients early. Disadvantages of intramedullary nails: difficulty in females, malunion, rotation, knee pain, stiffness, and infection.^{5,6}

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The purpose of the research was to determine the comparison between the functional results and postoperative complications of a locked plate versus a retrograde nail in the surgical treatment of fractures of the distal femur that are extra-articular.

2. Patients and methods

Prospective research was performed on 20 cases having distal femoral fractures; 10 patients underwent retrograde femoral interlocking nail treatment, & 10 patients received treatment of locked distal femoral compression devices at the Orthopaedics Surgery Department, El-Salam Specialised Hospital, & El-Zahraa University Hospital, Cairo, Egypt. The duration of the study was six months from the last case.

Inclusion criteria: age above eighteen years below sixty years, both genders; metaphyseal distal extraarticular femur fractures; fracture necessitating surgical intervention; responsiveness to distal femur locked plate or retrograde nail techniques.

Exclusion criteria: Age < 18 years and more than 60 years, open fractures involving the supracondylar femur, fractures of the supracondylar femur with intra-articular extension, and fractures of those bones' fractures caused by pathology, If the patient has a known metabolic bone disease or a current abnormality in the afflicted extremity, which can make plating or distal femoral nailing more difficult, they will refuse to participate in the procedure.

Cases that matched the previous criteria were separated into two groups: Group A was managed with retrograde nails, and Group B was treated with a distal femur-locked plate.

Sample size: The research enrolled 20 cases who matched the inclusion criteria. 10 patients with distal femur-locked plates & 10 patients with retrograde nails for six months, all cases were observed prospectively.

Randomization method: Randomization was achieved by utilizing the sealed envelope system. Group A comprised cases that were managed with retrograde nails, whereas Group B comprised cases that were treated with distal femur-locked plates.

Primary outcomes: function of the lower limb via knee range of motion and LEFS.

Secondary outcomes: postoperative consequences, operative duration, intraoperative blood loss, time of union.

Methods

All cases were exposed to the following:

Clinical assessment, careful history-taking, radiological assessment, laboratory testing, preoperative preparation, and informed consent.

Surgical procedure: retrograde nail

Operative procedures

The surgery time varies based on patient fitness, preparation, and comorbidity control. Cases were operated on utilizing spinal anesthesia or combined general and spinal anesthesia, with cefotaxime administered thirty minutes to an hour prior to surgery.

Surgical procedure retrograde nail: The site of entry is averaged 1.2 cm anterior to the posterior cruciate ligament attachment and centered in the inter-condylar groove on coronal view. In sagittal view, it is inserted at the anterior tip of the Blumensaat's intercondylar roof line in order to prevent damage to the cruciate ligaments when reaming.

Locked plate group: Complete lower leg imaging was achieved by placing cases in supine positions on a radiolucent table. Cushions or wrapped sheets maintained the knee, with the towel bulge positioned beneath the ipsilateral buttock. To access the distal femur, we employed a lateral criteria method. A mid-lateral incision was performed along the femoral shaft, curved anteriorly over the lateral femoral condyle, and progressed in the direction of the tibial tubercle. The muscle fibers comprising the vastus laterals exhibited a distal-to-proximal elevation. The metaphyseal diaphyseal reduction was performed using various aids, such as muscle relaxants, supracondylar towel bumps, manual traction, and bone reduction clamps. A plate representing the anatomical distal femur was affixed to the lateral femoral condyle. When viewed from the AP, the guide wire was inserted parallel to the surface of the tibiofemoral joint within the central hole. The distance between the distal margin of the plate and the distal condylar articular surface was one point, five centimeters. Typically, 1.0–1.5 centimetres separate the anterior margin of the distal portion of the plate from the anterior aspect of the femoral condyle. For the implantation of screws in every fragment, a minimum of two bicortical locked head screws were inserted. It is mandatory to insert all lag screws prior to any secured screws. Distal screws ought to be positioned anterior to Blumensaat's line; otherwise, they must be unicortical. The lesion was bandaged with closed layers.

Postoperative follow-up protocol

Postoperatively, patients were transferred to the ward and treated with intravenous cefotaxime and oral antibiotics for 2 days, followed by a subcutaneous, less molecular weight heparin (Enoxaparin) of 40 IU given 24 hrs postoperatively to all patients for 2 weeks as prophylaxis against DVT and pulmonary embolism. IV analgesics were given for 2 days postoperatively during the hospital stay. Mobilization: Joint mobilization was started immediately postoperatively in the form of active and passive motion of the knee and hip in the case

of retrograde nails. The allowance of partial weight bearing subsequently lasted six weeks. Weight-bearing was individualized based on clinical improvement, tolerance, and radiological considerations.

Outpatient clinic follow-up

Two weeks postoperative: The wound condition was checked, and the removal of stitches was done. Six weeks postoperatively, the patients were screened for any infection, follow-up x-rays were done, and they were allowed to start controlled partial weight bearing. Three months and 6 months postoperatively, the patient was checked for Radiographic union, which was defined as the presence of a bridging callus within three cortices on two radiographs taken at a 90-degree angle to each other. The clinical union was determined by the absence of pain when walking or standing on one leg, and the fracture site did not exhibit tenderness upon touch.⁷ Delayed union is usually considered at three to six months. Non-union is usually considered after six months.

Statistical analysis

The statistical performance and examination of the current research were performed utilizing SPSS V20, the standard deviation, the unpaired student t-test, and the mean chi-square test. Quantitative data were compared among both groups utilizing the unpaired student t-test. Chi-square, Fisher's exact test, and contingency table were utilized to determine the relationship between various qualitative variables. The levels of significance are as follows: if P is above 0.05 it considered non-Significant, if P is below 0.05 is considered significant, if P is below 0.001 considered highly Significant.

3. Results

No significant variance was observed among the groups under investigation as regards age, gender, comorbidities, & type P, which is above 0.05.

Table 1. represents the age distribution between both groups.

	RETROGRADE NAIL N=10	LOCKED PLATE N=10	P VALUE
AGE			
MEAN \pm SD	34.7 \pm 13.9	32.8 \pm 13.7	0.94
MEDIAN (IQR)	32.5 (24.3, 44.3)	28 (22, 44)	
GENDER			
MALE	9(90%)	8(80%)	0.531
FEMALE	1(10%)	2(20%)	
SIDE			
RIGHT	8(80%)	6(60%)	0.329
LEFT	2(20%)	4(40%)	
COMORBIDITIES			
HTN	4(40%)	3(30%)	0.656
DM	3(30%)	5(50%)	
TYPE			
33-A1	5(40%)	4(40%)	0.880
33-A2	3(30%)	4(40%)	
33-A3	2(20%)	2(20%)	

The operation time & blood loss were significantly higher in the locked plate group than in the in the locked retrograde nail group (P = 0.007, 0.021, respectively). (Table 2)

Table 2. shows the operation data between studied groups.

KNEE RANGE OF MOTION	RETROGRADE NAIL N=10	LOCKED PLATE N=10	P-VALUE
OPERATION TIME			0.007
MEAN \pm SD	81 \pm 13.3	97 \pm	
MEDIAN (IQR)	75 (75, 80)	14.2 79 (90, 107.5)	
INTRA-OPERATIVE BLOOD LOSS			0.021
AMOUNT	300 \pm 165	485 \pm	
MEAN \pm SD	200 (200, 437.5)	129.2 450 (400, 575)	

No significant variance was observed among both groups according to time to union & knee range of motion (P = 0.146). (Table 3)

Table 3. shows the outcome between studied groups

KNEE RANGE OF MOTION	RETROGRADE NAIL N=10	LOCKED PLATE N=10	P-VALUE
TIME TO UNION			0.146
MEAN \pm SD	24.9 \pm 1.9	26.3 \pm	
MEDIAN (IQR)	24 (24, 24.8)	2.58 26 (24, 27.5)	
KNEE RANGE OF MOTION (FLEXION) MORE THAN 100°			0.543
900-1000	9(90%)	8(80%)	
700-890	1(10%)	1(10%)	
	0(0%)	1(10%)	

In the retrograde nail group, infection was not observed; however, it was noticed in only one case in the locked plate group. We observed no significant variance among both groups. (Table 4)

Table 4. shows infection distribution among the both groups.

	RETROGRADE NAIL N=10	LOCKED PLATE N=10	P VALUE
YES	0 (0%)	1 (10%)	1
NO	10 (100%)	9 (90%)	

Only one case in each group suffered from pain, so we observed no significant variance among both groups. (Table 5)

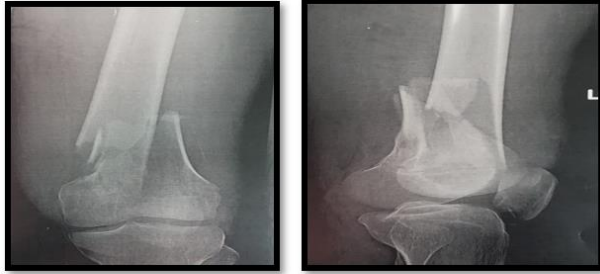
Table 5. shows knee pain distribution among the both groups.

	RETROGRADE NAIL N=10	LOCKED PLATE N=10	P VALUE
KNEE PAIN	1 (10%)	1 (90%)	1
NO KNEE PAIN	9 (90%)	9 (90%)	

CASE PRESENTATION

A 22-year-old man with a closed right distal femoral fracture type A2 following a RTA. On admission, a clinical assessment was performed and plain x-rays were taken. The patient was surgically ready the day following admittance, and the fracture was stabilised using a retrograde femoral nail. Sustained examination: At 12 weeks,

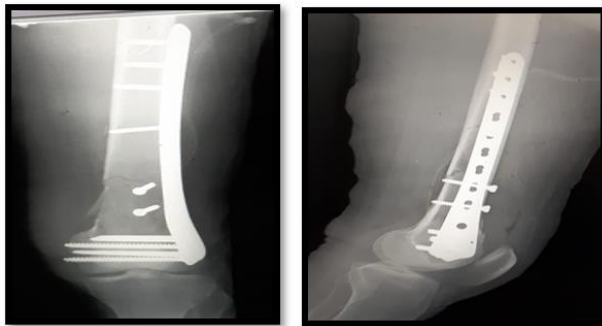
complete union took place; at 6 weeks, partial weight bearing commenced; and at 3 months, full weight bearing commenced. Knee range of motion was 0 ° to 120 °, and LEFS was 75 (93% = no difficulty).



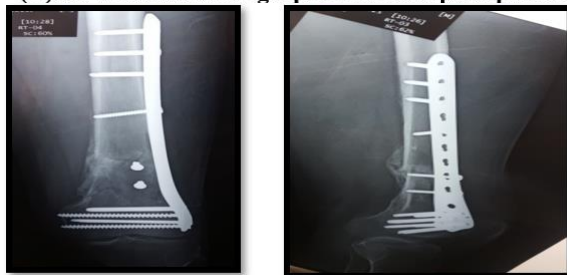
(A) Preoperative radiograph.



(B) Postoperative AP & lateral radiographs.



(C) AP & lateral radiographs 3 months postoperatively



(D) AP & lateral radiographs six months postoperatively



(E) Patient's knee ROM.

Figure 1. Shows case 1 (A-E)

4. Discussion

In our investigation, both groups were carefully selected to ensure that they had similar characteristics in terms of age, gender distribution, type, side, and comorbidities. This came in accordance with Atef M. et al.'s conclusion that the variance between the retrograde nail group and the locked plate group wasn't statistically significant regarding age, gender distribution, side effects, and comorbidities.⁸

In our research, we observed a statistically significant variance (p-value equals 0.007) in operating time among both groups. The retrograde nail group had a mean time of operation of 81 minutes, whereas the locked plate group had a mean time of operation of 97 minutes.

Markmiller et al. found that the average duration was one hundred forty-two minutes for the retrograde nail group and 155 minutes for the locked plate group, which exhibited a statistically significant.⁹

Gao et al. suggested that there wasn't a statistically significant variance in the average period of operation among the retrograde nail group (average period of 87.4 mins) and the locked plate group (average time of 79.7 minutes), with a p-value of 0.106.¹⁰

Atef M et al. revealed that a significant variance was observed (p-value equal to 0.017) in the operative period among both groups, with a mean time of 107.75 mins for the LP group and 93.56 mins for the retrograde nail group.⁸

Our research found statistically significant variance (p-value equals 0.021) in intraoperative blood loss among both groups. The retrograde nail group had a mean blood loss of 300 cc, whereas the locked plate group had a mean blood loss of 485 cc.

This came in accordance with Atef M et al., who documented a statistically significant variance among both groups according to blood loss, which was significantly greater in the locked plate group while comparing it with the retrograde nail

group.⁸

Gao et al. A statistically significant variance was observed among both groups in terms of mean intraoperative blood loss: 298 cc for the RN group and 200 cc for the locked plate group.¹⁰

The amount of blood loss in the RN group in this research was similar to that reported in other investigations. Nevertheless, a higher percentage of the loss of blood seen in the LP group in current research can be related to the utilisation of the open reduction approach.

The average duration for bone union in the retrograde nail group was 24.9 weeks, but in the locked plate group, it was 26.3 weeks, showing a notable distinction (p-value equals 0.146).

Henderson et al. found that periosteal callus was significantly less in fractures stabilized with locking plates than in fractures stabilized with nails.¹¹

Hierholzer et al. stated that there wasn't a significant variance in the period it took for the union to occur among groups.¹²

In contrast, Atef M et al. reported that the mean time to union in the retrograde nail group was eleven point four weeks, while in the LP group, it was fifteen point eight weeks, with a significant variance (p-value equal to 0.001).⁸

The observed significance of union time favoring the retrograde nail group in this research is likely attributed to the open reduction technique utilized in the locked plate group, which involved periosteal stripping at the fracture location. Additionally, in research conducted by Henderson et al., several patients in the locked plate group were treated using an open procedure, resulting in shorter union times in the retrograde nail group. In contrast, other trials utilized the LISS approach to manage the plate group, which yielded similar outcomes in terms of union time compared to the retrograde nail group.¹¹

In our investigation, the group treated with a retrograde nail showed a higher range of motion in the knee compared to the group treated with a locked plate. However, this variance was not found to be significant statistically, as shown by a p-value of 0.543.

The findings of this research, the trial conducted by Gao et al., were similar, with the retrograde nail group showing significant results. However, the difference was not statistically significant. This might be attributed to the knee capsule being opened in the locked plate group using the open reduction approach.¹⁰

Atef M et al. reported that the retrograde nail group had better knee ROM than the LP group. Nevertheless, it wasn't statistically significant (p-value = 0.44).⁸

Our current study showed that in the retrograde nail group, infection wasn't observed; however, it was noticed in only one case in the locked plate group. We observed no significant variance among 2 groups. Only one case in each group suffered from pain, so we observed no significant variance among 2 groups.

Along with our results, Gao K et al. revealed that no statistically significant variance was observed among both groups according to infection knee pain.¹⁰

Also, Atef M et al. reported that postoperative consequences were greater in the LP group, yet no statistically significant difference was observed in it (P value = 0.84).⁸

The intramedullary nail is preferred in cases with comorbidities as it has the best rehabilitation, as evident by: early weight bearing, fewer blood losses throughout the operation, range of motion, a shorter surgery period, & a lower incidence of infections in these cases.

Study Strengths: A follow-up radiological examination and a clinical assessment method (the Lower Extremity Functional Scale) were used in comparative case research and RCT.

Study Limitations: The research included a few patients and had a relatively short follow-up time of 6 months. The Locked Plate group utilizes an open reduction strategy instead of a closed reduction technique.

4. Conclusion

According to this research, approved results had been obtained using the two techniques. However, the nail system offers better outcomes, reduced surgical morbidities, and better rehabilitation. It reduces blood loss throughout surgery, shortens operative time, requires less union time, and causes an early callus appearance. But it requires accurate preoperative preparation & advanced operating experience.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article

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Conflicts of interest

There are no conflicts of interest.

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