International Journal of Orthopaedics Sciences

**E-ISSN:** 2395-1958
**P-ISSN:** 2706-6630
IJOS 2024; 10(2): 265-272

https://www.orthopaper.com
Received: 18-03-2024
Accepted: 21-04-2024

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# Outcome of dual plating in comminuted unstable distal femur fractures

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**DOI:** https://doi.org/10.22271/ortho.2024.v10.i2d.3564

**Abstract**
**Background:** In order to lower failure rates, distal femur fractures are treated with double fixation constructs. These constructs provide a solid framework that allows for early partial weight-bearing and early and immediate range of motion. This study aimed to evaluate the functional and radiological effects of treating comminuted unstable distal femur fractures in adult patients using double plating, which consists of a lateral locking plate and a medial buttress plate.
**Methods:** This prospective study was conducted on 21 participant with 18 years old or more, both sexes, with acute comminuted distal femur fractures Grade (A3, C2, and C3) according to AO Classification of distal femur fractures, closed and open (Grade I) distal femur Fractures. All patients were subjected to lateral and medial approach of distal femur.
**Results:** Time of union showed a moderate positive correlation with age (r=0.607, P=0.004), while it showed a moderate negative correlation with smoking (r=-0.507, P=0.019) and diabetes mellitus (DM) (r=-0.539, P=0.012). Functional score had negative correlation with age, smoking, DM, time of union, Infection, and stiffness. Radiological score had negative correlation with age, smoking, diabetes mellitus, time of union, Infection, and stiffness. On multiple regression analysis, age, DM, time of union, and delayed union were significant predictors of complications. The functional score was significant increase at 6 and 12 months compared to at 3 months, and significant increase r at 12 months vs. 6 months ($p<0.05$).
**Conclusion:** There was encouraging evidence that double plating comminuted unstable distal femur fractures sped up the healing process, improved function, early rehabilitation and reduced complications. Double plating emerged as an effective option with significant benefits for patients with comminuted unstable distal femur fractures.

**Keywords:** Outcomes, dual plating, unstable distal femur fractures, radiological score, double fixation

## Introduction

Roughly 3-6% of all femoral fractures are distal, and fewer than 10% of those are comminuted [1, 2]. People over the age of 60 account for almost 50% of all cases of distal femoral fractures, and this trend is even more pronounced in the younger population. Two common surgical procedures for distal femoral fractures are lateral locking compression plating (LCP) and retrograde intramedullary nailing (RIMN). But it's not uncommon for patients to experience healing difficulties after using locking plates [3].

Implant failure rates can reach 20% and non-union rates can reach up to 19% [2]. Various considerations, including the level of comminution, patient characteristics, revision history, and the possibility of prosthesis involvement, make distal femoral fractures particularly challenging. As with proximal femoral fractures, these injuries are linked to significant rates of mortality and comorbidity [4-6].

Serious metaphyseal comminution, fractures that extend into the articular surface, significant bone abnormalities, or a shortened distal segment are common outcomes of high-energy trauma. Hardware failure and non-union can occur as a result of varus collapse, which can be caused by eccentric loading [7]. Osteoporotic bone makes fractures in the elderly more complex because it can lead to insufficient implant anchoring and screw purchase, which can compromise stability [8].

With an increase in the number of elderly patients presenting with distal femoral fractures, there is a growing concern about patient compliance and the difficulty to follow postoperative partial weight-bearing protocols. Limiting patients' ability to bear weight after surgery may worsen their quality of life, lengthen the time it takes to recover, and increase the likelihood of complications [9].

Maintaining secure fixation to sustain physiological stress till union while enabling callus development requires surgeons to strike a delicate balance. A solitary retrograde intramedullary nail (R-IMN) or lateral locking compression plate (LCP) would not be able to accomplish this equilibrium in some intricate clinical situations. By providing a robust framework that allows for early and immediate range of motion and early partial weight-bearing, double fixation designs aim to lower the failure rate.

This study set intended to assess the radiological and functional results of treating comminuted unstable distal femur fractures in adults using double plating, which consists of a medial buttress plate and a lateral locking plate.

## Patients and Methods

This prospective study was conducted on 21 patients, aged over 18 years, of both sexes, who presented with acute comminuted distal femur fractures classified as Grade A3, C2, and C3 according to the AO Classification of Distal Femur Fractures. The study included both closed and Grade I open distal femur fractures. The research was carried out from April 2022 to April 2023 following approval from the Ethical Committee of Tanta University Hospitals, Tanta, Egypt. Informed written consent was obtained from all participants.

Exclusion criteria were open fractures other than (Grade I), pathological fractures, fractures associated with vascular injury or neurological insult and local acute or chronic infections.

All patients were subjected to history taking, general and local examination, laboratory investigations [complete blood count (CBC), renal and liver function test and random blood sugar (RBS)] and radiological investigations [X-rays (Anteroposterior, lateral) views and computed tomography (CT) scans (Sagittal, coronal, axial cuts and 3D reconstruction)].

### Intraoperative preparation

With the patient's knee bent at a 30-degree angle, they were placed supine on a radiolucent surgical table. Antibiotics were administered intravenously 30 minutes to 1 hour before surgery. Tourniquet wasn’t applied to any case. The distal femoral distractor wasn’t used in any case. The distal femur was approached by two different incisions: laterally and medially. All of the cases had extensively comminuted fractures, so open reduction was used in all cases. The distal femur was approached laterally first, and then medially. After reduction, the fracture was platted with the lateral plate first then fracture buttressing by the medial plate done. Anatomical locked plates for distal femur used also T or L shaped plates for medial buttressing. Patients with severely comminuted distal femur fractures had their recovery accelerated with the application of Iliac Crest Bone Graft. Drains were used in every instance.

### Double plating technique

A lateral distal femoral locking plate and a medial buttress plate were used for fixation, following two distinct techniques (Medial and lateral distal femur approaches) [10].

### Lateral approach of distal femur

A skin incision is made from Gerdy's tubercle along the lateral aspect of the thigh then bended it proximally to pass over the lateral femoral condyle. The skin incision's proximal beginning location is determined by the fracture's most proximal extent. An arthrotomy was done by a distal extension of the skin incision. An incision was made at the level of Gerdy's tubercle (Dashed line) for joint visualization. In some cases, arthrotomy wasn't required, so the incision on the skin ended about 1 to 2 centimeters from the joint line. Division of the iliotibial band then done along the line of skin incision. Towards Gerdy's tubercle, the fibers slant anteriorly distally. A single accurate incision was made to split the iliotibial band in order to permit a flawless closure. The vastus lateralis muscle fibers were sparse in the last 8 to 10 centimeters of the femur, just behind the iliotibial band. The fascia that surrounds the vastus lateralis muscle opened and the fibers of that muscle rose off the lateral intermuscular septum. The vastus lateralis muscle pulled backwards and to the side. Extreme hemorrhage was prevented by ligating many profunda femoris arteries and veins. It was crucial to preserve as much of the periosteum around the distal femur as feasible and to limit muscle removal to its lateral side to facilitate subsequent fracture healing. A joint capsule arthrotomy was performed in order to expose the articular surface. Across the front part of the lateral femoral condyle, an incision of the joint capsule distally was made all the way to the lateral meniscus. A blunt angled retractor used for exposing the articular surface.

### Medial approach of distal femur

An incision was created on the skin along the adductor magnus tendon's path. A line was drawn proximally on the adductor tendon, and the adductor tubercle is located. The adductor magnus tendon's backside was cut using a straight-line incision. The extent of the incision was adjusted based on the pattern of the fracture. To facilitate dissection, the front border of the Sartorius muscle was located, and the knee bent so that it may be drawn backwards. As a result, the adductor magnus tendon was exposed. The tendon of the adductor magnus attaches to the adductor tubercle at an anterior position. It is possible to access the popliteal neurovascular bundle, which is located in the area below the femur, using this method if it is required. To do this, an incision is made just beneath the adductor magnus. It may be challenging to provide sufficient access to the posterior joint surface during a capsulotomy, but it is possible to examine the joint surface if necessary. A medial plate was placed using a distinct medial technique. For the purpose of fixing the medial plate, two cortical screws were used proximally and at least two cancellous screws were used distally.

**Final check of fracture reduction and fixation:** Assessment of the rotational profile was made clinically. Final x-rays taken to check the sagittal plane alignment (Extension/flexion) and the frontal plane alignment (Varus/valgus). Intraoperative radiographic assessment of fracture reduction and fixation. The following perspectives may greatly improve fluoroscopic vision of distal femur implant placement and anatomical fracture reduction: Standard views: [AP, Lateral and Notch]. Notch view: [Patella, femoral notch, medial and lateral condyle, and medial and lateral tibial spine] are some of the lines and landmarks that can be seen. Figure 1.

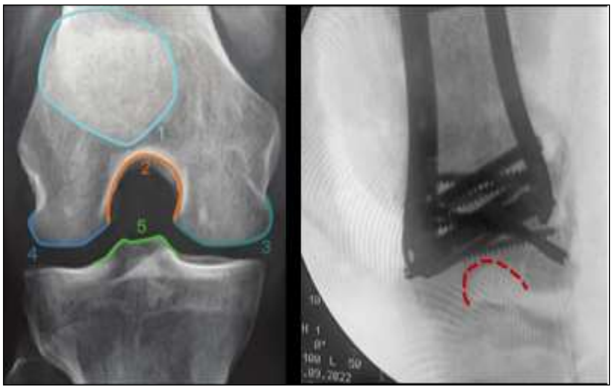

**Fig 1:** Notch view

Drains were placed on all instances after meticulous hemostasis, and the wounds were closed in layers. The iliotibial band closed watertight using absorbable sutures. As usual, seal the dermal and subcutaneous tissues.

### Post-operative care

All patients had X-rays (Anteroposterior and lateral) immediately after surgery. Two or three days after the operation, the drains were taken out. The sutures were taken out no later than two weeks after the surgery. All patients were given early mobilization instructions to wear a hinged knee brace for protection. The results of the radiological and clinical examinations conducted at the following follow-up appointments determined whether weight-bearing could be done. The unification of the three cortices of the bone on the anteroposterior (AP) and lateral radiographs of the bone is the hallmark of radiographic healing. When the damaged region no longer hurts when examined under pressure or while bearing weight, it is said to have healed clinically. Figure 2.

**Fig 2:** Immediate post-operative X-rays

### Follow up

During first two months after fixation, outpatient follow-up visits were (Every two weeks). Also at 3, 6, and 12 months, patients had outpatient follow-up visits. A clinical evaluation based on Sander's Scoring System. A radiological evaluation done by X-rays (Anteroposterior and lateral images of the distal femur) and Lane-Sandhu radiological grading system.

### Sander's Scoring System

In Sanders's outlined approach, the functional assessment score was used to categorize the clinical and functional outcomes [11].

### Interpretation of Sander's Scoring System

**[**Excellent: 36 - 40 points, good: 26 - 35 points, fair: 16 - 25 points and poor: 0 - 15 points].

Bone formation at the fracture gap, the existence of the fracture line, and evidence of remodeling are the three elements that make up the Lane-Sandhu radiographic scoring system, which analyzes fracture healing. The scores from each dimension are added together to generate the final score. Each dimension in this system is given a score of 0, 2, or 4 on a scale from 0 to 12. A comprehensive evaluation of the healing process was documented in compliance with the AO-ASIF protocols for long bone fractures that are not yet joined or have ambiguous borders [12].

### Statistical analysis

To conduct the statistical analysis, we used SPSS version 26 (IBM Inc., Chicago, IL, USA). The three groups were compared using the ANOVA (F) test and the post hoc Tukey test for quantitative variables, which were reported as mean and standard deviation (SD). We used the Chi-square test to examine qualitative variables, which were given as percentages and reported as frequencies. We used the Pearson moment correlation coefficient to look for relationships between all of the variables. To be deemed statistically significant, a two-tailed P value has to be less than 0.05.

### Results

Demographic data, comorbidities, mode of trauma, type of fracture and fracture classification were presented in this table. Table 1.

**Table 1:** Demographic data, comorbidities, mode of trauma, type of fracture and fracture classification of the studied patients

| | | **N=21** |
|---|---|---|
| Age (Years) | | 39±13.27 |
| Sex | Male | 12 (57.14%) |
| | Female | 9 (42.86%) |
| Weight (Kg) | | 68.7±7.86 |
| Height (m) | | 1.7±0.07 |
| Residence | Urban | 8 (38.1%) |
| | Rural | 13 (61.9%) |
| BMI (Kg/m$^2$) | | 24.8±3.32 |
| Smoking | Smoker | 7 (33.33%) |
| | Non-smoker | 14 (66.67%) |
| DM | Diabetic | 3 (14.29%) |
| | Non- diabetic | 18 (85.71%) |
| HTN | Hypertensive | 4 (19.05%) |
| | Non- hypertensive | 17 (80.95%) |
| Mode of trauma | High energy trauma | 18 (85.71%) |
| | Low energy trauma | 3 (14.29%) |
| Type of fracture | Open (grade I) | 8 (38.1%) |
| | Close | 13 (61.9%) |
| Fracture classification | A3 | 7 (33.33%) |
| | C2 | 9 (42.86%) |
| | C3 | 5 (23.81%) |

Data are presented as mean ± SD or frequency (%). BMI: Body mass index, DM: Diabetes mellitus, HTN: Hypertension

The mean of operative time was 157.80±12.84 min, post-operative stay was 2.1±0.83 days, time of union was 5.52±1.24 months. Four patients had knee stiffness. Three of these cases had associated fractures. One had fracture of first lumbar vertebra and bilateral calcaneus fractures treated all conservatively. The Second case had ipsilateral fracture tibia treated by Open reduction and fixation by plating. The third case had ipsilateral fractures of both bones of leg fixed by interlocking nailing of the tibia. Table 2.

**Table 2:** Operative duration, post-operative stay, time of union and complications of the studied patients

| | | N=21 |
|---|---|---|
| Operative time (min) | | 157.80±12.84 |
| Post-operative stay (days) | | 2.1±0.83 |
| Time of union (Months) | | 5.52±1.24 |
| Complications | Delayed union | 3 (14.29%) |
| | Infection | 3 (14.29%) |
| | Knee stiffness | 4 (19.05%) |

Data are presented as mean ± SD or frequency (%)

The functional score was significant increase at 6 months and 12 months compared to at 3 months, and significant increase at 12 months compared to 6 months (*p*<0.05). The radiological score was significant increase at 6 months and 12 months compared to at 3 months, and significant increase at 12 months compared to 6 months (*p*<0.05). Table 3.

**Table 3:** Functional, radiological score, fracture classification, radiological and function score of the studied patients

| | 3m | 6m | 12m | P |
|---|---|---|---|---|
| Functional score | 14.7±2.74 | 27.5±1.86 | 37.9±1.77 | <0.001* |
| | P1<0.001*, P2<0.001*, P3<0.001* | | | |
| Radiological score | 4.7±1.06 | 7.4±1.25 | 10.1±0.94 | <0.001* |
| | P1<0.001*, P2<0.001*, P3<0.001* | | | |
| | A3 (n=7) | C2 (n=9) | C3 (n=5) | P |
| Radiological score | 6.33± 0.51 | 10±0.5 | 6.75±0.5 | <0.001* |
| Functional score | 13.33±1.75 | 28.33±5.50 | 14.25±1.26 | <0.001* |

Data are presented as mean ± SD or frequency (%). * Significant p value <0.05

There was a significant difference between infection and non-infection group as regard Functional score, Radiological score, Stiffness, and Time of union. Radiological and Functional score were significantly lower in infection group compared to non-infection group. Stiffness and time of union was significantly higher in infection group compared to non-infection group. Table 4.

**Table 4:** Complications of the studied patients

| | Infection (n=3) | Non infection (n=18) | P |
|---|---|---|---|
| Functional score | 13.33 ± 1.52 | 38.33 ± 2.08 | <0.001* |
| Radiological score | 7.6 ± 1.50 | 10.28 ± 0.91 | <0.001* |
| Stiffness | 3(100%) | 1(5%) | 0.003* |
| Time of union | 7.33 ± 0.57 | 4.93 ± 0.89 | <0.001* |

Data are presented as mean ± SD or frequency (%). * Significant p value <0.05

Time of union showed a moderate positive correlation with age (r=0.607, P=0.004), while it showed a moderate negative correlation with smoking (r=-0.507, P=0.019) and DM (r=-0.539, P=0.012). Type of fracture and infection showed a correlation with time of union. Functional score had negative correlation with age, smoking, DM, time of union, Infection, and stiffness. Radiological score had negative correlation with age, smoking, DM, time of union, Infection, and stiffness. Table 5.

**Table 5:** Correlation between time of union, functional and radiological score and different variables

| | | Time of union | Functional score | Radiological score |
|---|---|---|---|---|
| Age | r | 0.607 | -0.107 | -0.310 |
| | P | 0.004* | 0.042* | 0.035* |
| Sex | r | 0.260 | -0.144 | 0.108 |
| | P | 0.255 | 0.533 | 0.642 |
| Smoking | r | -0.507 | -0.111 | -0.351 |
| | P | 0.019* | 0.016* | <0.001* |
| DM | r | -0.539 | -0.638 | -0.231 |
| | P | 0.012* | <0.001* | <0.001* |
| HTN | r | -0.047 | -0.130 | 0.395 |
| | P | 0.839 | 0.573 | 0.077 |
| Mode of trauma | r | 0.356 | -0.306 | 0.410 |
| | P | 0.113 | 0.178 | 0.065 |
| Type of fracture | r | 0.033 | 0.024 | 0.329 |
| | P | <0.001* | 0.916 | 0.145 |
| Time of union | r | -- | -0.014 | -0.305 |
| | P | -- | <0.001* | 0.017* |
| Operative time | r | 0.857 | 0.062 | 0.039 |
| | P | 0.235 | 0.790 | 0.868 |
| Infection | r | 0.739 | -0.518 | -0.631 |
| | P | <0.001* | 0.016* | <0.001* |
| Stiffness | r | -- | -0.811 | -0.811 |
| | P | -- | <0.001* | <0.001* |

r: Pearson coefficient, * significant p value < 0.05, DM: Diabetes mellitus, HTN: Hypertension.

On multiple regression analysis, age, DM, time of union, and delayed union were significant predictors of complications. On Multiple regression analysis, other variables (HTN, operative time, type of fracture) were insignificant predictors of complications. Table 6.

**Table 6:** Multiple regression analysis for prediction of complications

| | Coefficient | Std. Error | t | P | R partial | R semipartial |
|---|---|---|---|---|---|---|
| DM | 0.319 | 0.3939 | 0.0227 | 0.043* | 0.006288 | 0.004171 |
| HTN | -0.3508 | 0.546 | -0.642 | 0.5317 | -0.1754 | 0.1182 |
| Operative time | -0.00455 | 0.01369 | -0.332 | 0.7451 | -0.09171 | 0.06109 |
| Time of union | 0.1655 | 0.07653 | 2.163 | 0.0498* | 0.5144 | 0.3979 |
| Type of fracture | -0.04113 | 0.2873 | -0.143 | 0.8884 | -0.03967 | 0.02634 |
| Age | -0.0094 | 0.003662 | -2.566 | 0.0194* | -0.5175 | 0.5032 |
| Delayed union | 0.8706 | 0.1871 | 4.653 | <0.001* | 0.7389 | 0.7185 |

DM: Diabetes mellitus, HTN: Hypertension

**Case 2:** was explained in this figure. Figure 4.

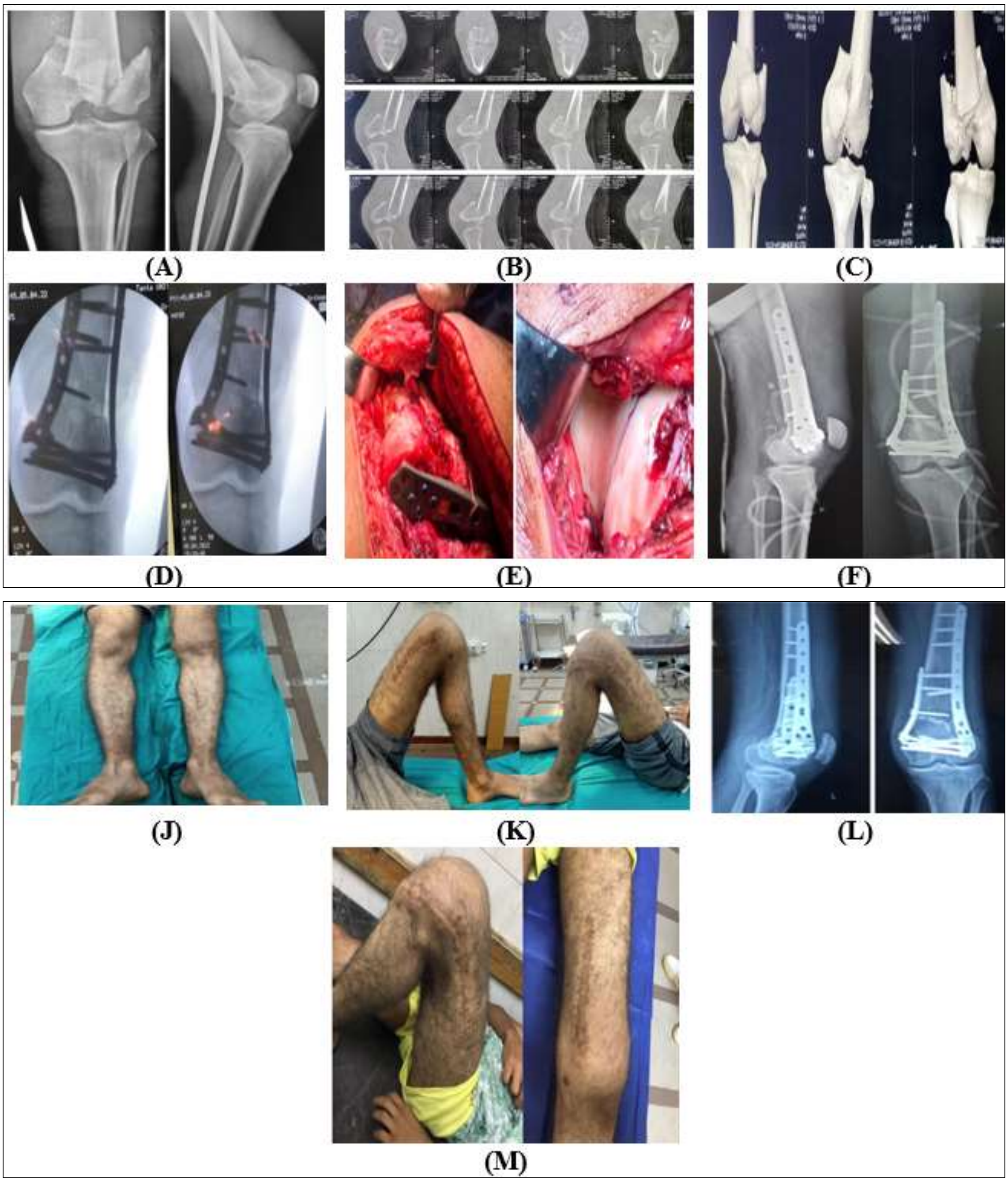


**Fig 3:** (A) X-ray on knee joint showing distal femur fracture with intercondylar extension,(B, C) Preoperative CT imaging of knee joint showing distal femur fracture Class (C2.2) according to the AO/OTA classification, (D) Intra-operative imaging on knee joint showing reduction of distal femur fracture and fixation by double plating, (E) Intra-operative picture showing reduction of distal femur fracture and fixation by double plating, (F) Immediate post-operative X-ray, Follow-up after (G, H) 3 months, (I, J, K) 6 months showing fracture union, (L, M) after 12 months

**Case 1:** was explained in this figure. Figure 3.

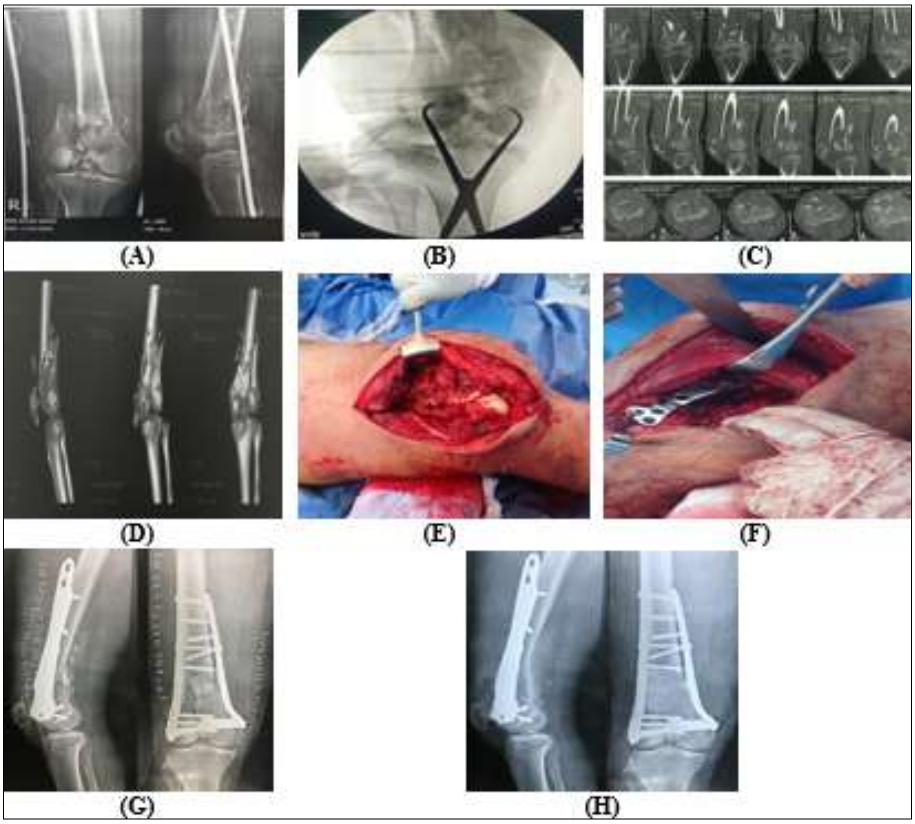


**Fig 4:** (A) X-ray on knee joint showing distal femur fracture with intercondylar extension,(B) Intra-operative imaging on knee joint showing reduction of distal femur fracture, (C, D) Preoperative CT imaging of knee joint showing distal femur fracture Class (C3.2) according to the AO/OTA classification, Intra-operative pictures showing (D) lateral and medial approaches of distal femur fracture, (E) fixation of distal femur fracture by medial plate, (F) Immediate post-operative X-ray, (G) Follow-up after 6 months showing fracture union

## Discussion

Regarding mode of trauma, 18 (85.71%) of the studied patients underwent high energy trauma, and the other 3 (14.29%) patients underwent low energy trauma. Of the patients whose fracture types were recorded, 8 (38.1%) had open fractures and 13 (61.9%) had closed fractures. According to research by Kandel *et al.* [13] low energy trauma accounted for 25% of all traumas, whereas high energy trauma accounted for 75%.

In terms of fracture classification, 7 patients (33.33%) were classified as A3, 9 patients (42.86%) as C2, and 5 patients (23.81%) as C3. Regarding the fracture classification in the studied patients, 7 (33.33%) patients had A3 classification, 9 (42.86%) patients had C2 classification, and 5 (23.81%) patients had C3 classification.

Radiological score and Functional score were significantly lower in A3 and C3 compared to C2. Seven fractures were categorized as AO/OTA 33-C2, seven as AO/OTA 33-C3, and seven as periprosthetic, according to Bologna *et al.* [14] out of the total number of patients, 83 had either dual plating or single plate fixation.

The average operating duration for the patients included in this research was 154.4±8.01 minutes, with a range of 140 to 167 minutes. The patients that were evaluated had a post-operative stay that was an average of 2.1±0.83 days long and may be anywhere from 1 to 3 days. Kandel *et al.* [13] determined that the typical duration of the procedure was 162 ±26 minutes. The average length of time spent in the hospital after surgery was 3 days, with a 1-day variation. The average duration for union was 16±2 weeks. In their investigation, Zhang *et al.*[15] found that the average operating time for groups using two plates was 104 minutes.

The time it took for the patients in the study to reach union varied between 4 and 8 months, with an average of 5.52 ± 1.24 months. Compared to the non-infected group, the infection group had a noticeably longer union time. The use of double plating and bone grafting resulted in a healing rate of 100% in cases of atrophic distal femur non-union with bone defect and non-union of femoral supracondylar, subtrochanteric, and shaft fractures, as reported by Lu *et al.* [16] and Mardani-Kivi *et al.* [17].

Time to weight bearing with dual plating was found to be 7.90 weeks according to Bologna *et al.* [14]. The dual plating group had an average time to union of 7 weeks (6.25-7.0) weeks. In a study conducted by Mohammed Abd El-Noor Saad *et al.* [18] the average duration was 8.00±1.63, spanning from 6w to 10w.

In terms of complications, 3 patients (14.29% of the total) had delayed union, 3 patients (14.29% of the total) had infection, 4 patients (19.05%) had knee stiffness, and 11 patients (52.38% of the total) had no difficulties at all.

Four patients had knee stiffness. Three of these cases had associated fractures. One had fracture of first lumbar vertebra and bilateral calcaneus fractures treated all conservatively. Open reduction and plating was used to treat the ipsilateral broken tibia in the second patient. In the third example, the tibia bones were repaired by interlocking nails after ipsilateral fractures of both legs. Those people got physical treatment to help their knees move more freely two cases had superficial infections on the lateral wound treated all by surgical debridement of the wound and application of local antibiotics. One case suffered deep infection on the medial wound extended to the plate treated by surgical debridement and plate removal.

The infection group had substantially worse radiological and functional scores than the non-infected group. There was a statistically significant difference in stiffness between the infection and non-infection groups. Three cases showed delayed union at 6 months of follow up all improved only by medical treatment and encouraging of weight bearing. Only 16.7% were infected, as pointed out by Kandel *et al*. [13] out of 80, no failures or revisions were recorded. No revision arthroplasty or secondary surgeries were discovered by Lim *et al*. [19].

Two patients in the dual plating group exhibited modest anterolateral heterotopic ossification, although none of them needed further surgery at 12 or 13 months, according to Bologna *et al*. [14].

The total number of problems in group II was 30%, according to Mohammed Abd El-Noor Saad *et al*. [18]. There were no problems for seven patients (70%) and two patients (10%) had delayed union and one patient (10%) suffered infection. In a comprehensive analysis of 141 individuals, Lodde *et al*.[20] found that 35% of those patients had complications. Compared to IM, which had a complication rate of 40% (34 difficulties in 84 instances), double plating had a complication rate of 28% (16 complications in 57 cases). There were 26 occurrences of pulmonary problems in the IM group (31% of the total) and 10 cases in the double-plating group (18% of the total).

Finally, functional score showed negative correlation with age, smoking, DM, time of union, infection and stiffness. Radiological score had negative correlation with age, smoking, DM, time of union, infection and stiffness. On multiple regression analysis, age, DM, time of union, and delayed union were significant predictors of complications.

On Multiple regression analysis, other variables (HTN, operative time, type of fracture) were insignificant predictors of complications. Both the functional and radiological scores increased statistically over time; the functional score improved at 6 and 12 months vs. 3 months, while the radiological score improved at 12 months vs. 6 months.

There were significant negative correlations between age ($r = -0.922$, $p< 0.001$) and post-operative hospital stay ($r = -0.654$, $p< 0.001$) in relation to the Oxford knee score, according to Kandel *et al*. [13]. Additionally, individuals with high energy trauma had a significantly higher score (40±5) compared to those with low energy trauma (33±3), with a p-value of 0.001. When it came to the Oxford knee score, however, there were no discernible variations according to either gender or smoking status. According to Mohammed Abd El-Noor Saad *et al*. [18] the knee society score with partial and full weight bearing was negatively correlated with age.

Limitations of the study included that the sample size was relatively small. The study was in a single center. The follow up of patients was limited for relatively short period. So, we recommended providing larger sample size with multicenter cooperation, wide variety of injuries to validate our results, and further research is recommended to generalize our results.

## Conclusion

Double plating of comminuted unstable distal femur fractures showed promising results for fracture treatment with faster healing, improved function, early rehabilitation and reduced complications. Patients experienced shorter surgery and hospital stays, achieved better function and bone healing scores at 6 and 12 months, and faced lower risks of infection, stiffness, and delayed union compared to other methods. While factors like age, diabetes, and smoking may impact healing time. Double plating emerged as an effective option with significant benefits for patients with comminuted unstable distal femur fractures.

**Financial support and sponsorship:** Nil.

**Conflict of Interest:** Nil.

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**How to Cite This Article**
Kassab ME, El-Tabakh MR, Megahed AEAE, Ayoub MA. Outcome of dual plating in comminuted unstable distal femur fractures. International Journal of Orthopaedics Sciences. 2024;10(2):265-272.