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Original Research Article

# Comparative study of functional outcome in single plating and dual plating of unstable distal femur fractures

**Waulden DeMelo[1], Anish Vernekar[1]*, Ajmal Abdulla[1], Nehal Salgaokar[1], Gauresh Vargaonkar[1]**

[1] *Dept. of Orthopaedics, Goa Medical College, Goa, India*

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ABSTRACT

**Background and Objectives:** Fractures of the distal femur remain challenging to treat as satisfactory outcome demands anatomical articular reduction, rigid and stable internal fixation along with early range of motion. The purpose of our study is to evaluate the functional outcome in patients with unstable fractures of the distal femur treated with single versus dual plating.

**Materials and Methods**: The study was a prospective study of 40 patients. The study was a prospective study of 40 patients (30 male and 10 female) with unstable fractures of the distal femur admitted to Goa medical college between June 2019 to June 2021 treated with open reduction and internal fixation of the distal femur with locked plates. After admission patients were subjected to routine pre operative evaluation and x-rays along with CT scan with 3 D reconstruction. During surgery, after lateral plating patients were subjected to varus stress test on table. If found to be positive, medial plate was applied. Medial plating was also advocated if medial cortex was found to be deficient due to severe communition or bone loss. Patients were followed up for an average of 10 months and knee function was evaluated evaluated using Sanders Functional Evaluation Knee Score.

**Results:** Out of the 40 patients treated with plating, 24 were treated with single lateral plate and 16 were treated with medial as well as lateral plate. Out of the 16 treated with dual plating, 2 were open fractures treated by staged procedure (lateral plating and subsequent medial plating with iliac crest bone graft via a separate medial incision after a period of 10 weeks following primary surgery). 3 of the patients treated with single lateral plate showed a varus collapse upon weight bearing 12 weeks post op.

**Conclusion:** It was found that dual plating resulted in high union rates, early post op mobilisation due to more rigid fixation and less chances of varus collapse. However, overall when functional.



## 1. Introduction

Distal femur fractures account for six percent of all femur fractures. They can be observed in a trivial fall in older osteopenic persons, or they are commonly observed in high energy trauma in a younger age group as a result of motor vehicle accidents or falls from heights.

The development of contemporary orthopedics has had an impact on the evolving patterns in the surgical treatment of femur supracondylar fractures over time. Skeletal traction was the primary technique used in traditional procedures, which were augmented by manipulation of fragments and immobilization. Since then, treatment methods have improved; challenges were frequently encountered, such as:

1. Persistent angulatory deformities
2. Articular incongruity
3. Stiffness and

* *Corresponding author*.
*E-mail address*: vernekaranish2013@gmail.com (A. Vernekar).

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4. Delayed mobilization (especially in patients with multiple injuries)[1]

Irrespective of choice of fixation the following principles must be obeyed, which include:

1. Anatomical reduction of the distal femoral articular surface
2. Stable internal fixation
3. Minimal soft tissue stripping and
4. Early active mobilization.

## 2. Need for the Study

The aim of this research is to examine and assess the functional success and satisfied outcome of unstable distal femur fracture repair using single plating (lateral plating) and dual plating (lateral and medial plating). Few studies evaluating the effectiveness and outcomes of single versus dual plating in the management of supracondylar femur fractures have been published, despite the fact that fractures of the distal femur have been thoroughly researched and different treatment methods have been evaluated in terms of their efficacy and result. Patients with osteoporosis, fractures with metaphyseal comminution and a defective medial cortex, or those with a short articular segment are recommended to have locked implants.[2] Sander's et al[3] reported that medial augmented plate for unstable distal femur fractures can effectively reduce the loss of reduction and loosening of fixation caused by early post-operative activities. In a study by Pesceria et al, found non-union rates upto 12% in cases where medial bone defect was greater than 2 cm.[4] In 2016, Holzman et al[5] reported addition of medial locking plate to an in situ lateral locking plate results in good healing of distal femur nonunions. In 2018, Rongbin et al,[6] compared the medial assisted plate for comminuted metaphyseal distal femur fractures with lateral single implants suggested that it increases the fracture stability and improves the healing rate. This study aims at providing more clarity in the indications of the treatment method chosen in both groups and unveiling the risks, complications and outcomes using the Sander's Functional Evaluation Scoring System.

## 3. Aims and Objectives

1. To compare the clinical and functional outcomes between single and dual plating in unstable distal femur fractures.
2. To establish the best method of treatment for unstable distal femur fractures.
3. To determine the incidence of complications in single plating of unstable distal femur fractures.
4. To standardize the dual plating technique for unstable distal femur fractures.

## 4. Materials and Methods

We selected thirty patients of unstable distal femur fractures that were hospitalized between June 2019 and June 2021 to the Department of Orthopedics at Goa Medical College in Bambolim, Goa. This is a clinical study that is prospective. The Institutional Ethics Committee granted approval for the study. The patients were told of the study's purpose, the specifics of the treatment plan, any potential side effects, and the available options. Appropriate signed consent was obtained. Patients were chosen based on predefined inclusion and exclusion standards.

### *4.1. Inclusion criteria*

1. Age 20-60 years.
2. Muller Type A3, C1, C2 and C3 fractures.
3. Very low distal femur fractures.
4. Extensive metaphyseal comminution with more than 1cm medial cortical defect.

### *4.2. Exclusion criteria*

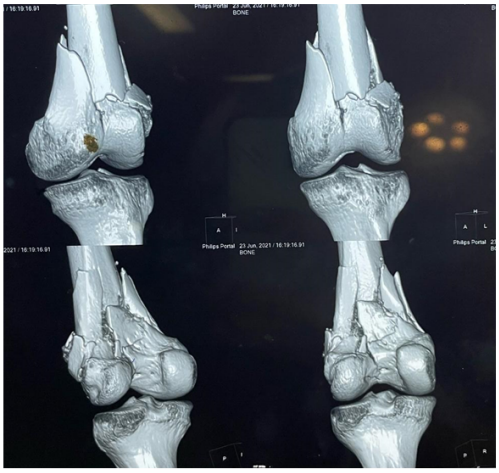
1. Skeletally immature individuals.
2. Muller Type A1, A2 and Type B fractures.
3. Grade IIIc open injuries (Gustilo – Anderson)
4. Associated with knee dislocation.
5. Pathological fractures.

## 5. Management

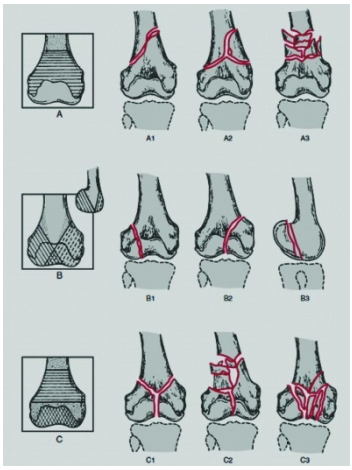
At first, the ATLS protocol helped to stabilize the patients, search for any comorbid conditions and related injuries. Meticulous documentation of the injury's etiology, history, and prior surgeries and treatments was done. With a posterior splint, the affected limb was momentarily stabilized. Verification of distal neurovascular status was done. If an open wound is present, it was debrided using local or spinal anesthetic and thoroughly cleaned with enough of normal saline. Following which the IV antibiotic loading dose was administered.

### *5.1. Radiological evaluation*

Anteroposterior and lateral views of the X-rayed thigh were obtained after applying mild traction to loosen up the fracture fragments. It offers an enhanced comprehension of fracture morphology. A distal femur CT scan with 3D reconstruction was also obtained.



Fracture stabilized with above knee slab. Open Injuries were graded according to Gustilo- Anderson Classification.



Fractures were classified according to Muller AO Classification system.[3]

### 5.2. AO classification system – Müller and associates

The "Schweizer Arbitsgemenischaft fur Oseosysthesesfragen" Group (SWISS AO), chaired by Müller at that time, in Davos, Switzerland proposed their classification system after exhaustively studying thousands of distal femur fractures. This system has been found to be easy to use and satisfies all the criteria for an ideal classification.[7]

In this classification, distal femur fractures are divided into 3 primary groups. Keeping in line with basic AO principles,

Type A fractures include extra-articular fractures and

Type B fractures are partial articular fractures, meaning parts of the articular surface remain in contact with the diaphysis of the femur.

Type C fractures include complete articular fractures with both condyles being detached from the diaphysis.

The fracture types are further subdivided describing the degree of comminution and other characteristics.

Type B fractures includes

B1 (sagittal, lateral condyle),

B2 (sagittal, medial condyle) and

B3 (frontal, Hoffa type).

Fracture type C is divided in

C1 (articular simple, metaphyseal simple),

C2 (articular simple, metaphyseal multifragmentary) and

C3 (multifragmentary)

The B3 type fracture – 'Hoffa's fracture'- has immense clinical significance in the final result following intervention and has been subdivided into three types.[8] This type of coronal fractures of the distal femur are further classified into: B3. 1 – Anterior and lateral flake fracture B3. 2 – Unicondylar Hoffa's fracture B3. 3 – Bicondylar Hoffa's fracture.

All fractures managed by either Single (Lateral) plating or Dual (Lateral and Medial) plating.

### 5.3. Position

Supine position on radio lucent table with sand bag under ipsilateral pelvis to facilitate internal rotation of limb. Knee flexed about 30 degree over a bolster under lower third of knee.

**Figure 1:** Position of patient

Pre-operative antibiotic given half an hour prior to incision. Painting and draping of operative site in the standard manner.

### 5.4. Approach

All patients were operated by either single lateral approach or a swashbuckler approach or a dual approach (lateral plus medial).

### 5.5. Implants

Laterally we used lateral distal femur locking compression plate. It has two 6.5mm locking holes and five 5 mm locking screws in condylar part. Combiholes in stem part.

### 5.6. Buttress plate

We had an aim to put at least 5 locking condylar screws in the articular block and 5 locking cortical screws in the shaft

**Figure 2:**

**Figure 3:** Distal femur locking compression plate and plates used in medial side

region. We aimed for a working length of plate at least 2.5 times of the fracture with screw density ratio of 0.4 to 0.5.

Medially we used mainly large fragment T buttress plate in 15 cases.

We aimed at least two cancellous screws in condylar region and 4 cortices of fixation in proximal end.

Always keep the medial plate shorter than the lateral plate to avoid a stress riser.

### *5.7. Surgical techniques*

To achieve precise anatomical reduction, the articular block was rebuilt first, and it was then reattached to the metaphysis. After carefully evaluating and reducing the fracture, the articular split is temporarily secured using pointed clamps, K wires, and lag screws. Any sagittal split of posterior condyles is reduced first, followed by coronal splits and intercondylar components.

**Figure 4:**

Osteochondral fragments were fixed with headless Herbert screws if > 1cm in size, if 5 to 10 mm sized fragments then they were fixed with K wires. It was inserted divergently upto purchasing far cortex and were cut flush with articular surfaces (Lost K wire technique). Small < 5mm fragments were excised.

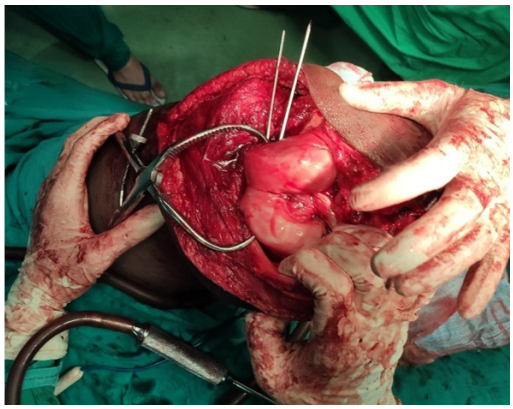


**Figure 5:**

Following articular surface repair, the block was secured with the shaft. In the event that metaphysis saw more comminution, the fracture site was bridged. The alignment and rotation of the length, coronal plane, and sagittal plane were meticulously evaluated and corrected. Excess soft tissue dissection and removing loose fragments from soft tissue attachments was avoided wherever possible. Care was taken to prevent injury to the collateral ligaments and meniscus. At times when required primary bone grafting procedure used an iliac crest or fibular strut graft was used if there was any bone loss or a medial cortical defect. The knee was flexed and extended two or three times after the

wound was closed. This procedure removed any soft tissue interposition between the bone and the implant or sutures that may have later resulted in post-operative pain.

### 5.8. Post-operative rehabilitation

Adequate rehabilitation following surgery is just as important as surgical care. It will make sure the knee joint's strength, range of motion, and functionality are all achieved and maintained to a satisfactory level. The rehabilitation regimen is customized for each patient and type of fracture. Stable stiff internal fixation is the primary requirement for an early and intensive rehabilitation program in cases of unstable distal femur fractures. Following surgery, the drain tube was withdrawn 48 hours later. The main objective during the early period (1-3 weeks) is full range of motion. The first day after surgery was when isometric exercises began. Active range-of-motion exercises were introduced after the seventh post-operative day, with a primary focus on patellar gliding, extension, and static quadriceps strengthening. The first week of continuous passive motion began. Better outcomes were after three days of use at a pace of one cycle per minute with 40 degrees of flexion. It reduces the risk of pulmonary embolism and deep vein thrombosis and increases the knee's early range of motion. It also relieves pain more quickly. It avoids joint stiffness, enhances cartilage nourishment, and reverses collagen loss. Walking without weight bearing for a week or two after which partial weight bearing (10 kg) was permitted if post-operative scans revealed bone healing. After the fracture had healed, around 10 to 12 weeks later, full weight bearing was permitted. The 14th post-operative day saw the removal of the sutures.

Follow up protocol: Every patient's post-operative x-ray of the thigh with knee anteroposterior and lateral view was taken immediately after surgery. Then followed up on 1st, 2nd, 4th, 6th, 8th and 12th weeks then every 3rd month. These radiological evaluations were used for fracture alignment, sagittal and coronal plane alignment, fixation stability and fracture healing assessment. Any loss of reduction, plate lift off, implant breakage were recorded. On every follow up patients evaluated for range of flexion, extension lag, amount of pain.

The functional outcome was evaluated using the Sander's Functional Evaluation Scoring System at the end of 3 months follow up. It has a total of 100 points.

By this score we evaluated range of flexion, extension lag, pain on weight bearing, angulation deformity, limb length shortening and walking and stair climbing ability and return to previous work status.

According to this patients final outcome functional status graded as excellent (36-40 points), good (26-35), fair (16-25) and poor (0-15) outcomes.

### 5.9. Outcome

1. **Excellent** 36-40 points
2. **Good** 26-35 points
3. **Fair** 16-25 points
4. **Poor** 0-15 points

### 5.10. Statistical analysis

Statistical analysis was done using IBM SPSS version 23 statistical software. P value $< 0.05$ was considered statistically significant.

## 6. Results

Total of 30 patients were selected according to inclusion and exclusion criteria. All are unstable complex distal femur fractures: 15 were treated with lateral plating alone and 15 were treated with lateral as well as a medial buttress plating.

The patients who underwent single plating has a lesser mean time of surgery 2±0.4226 hours compare to dual plating where mean time of surgery was 2.43±0.49 hours and lesser blood loss during surgery 540±110.4 ml in single plating and 580±111.4 ml in dual plating.

The patients who underwent dual plating had a higher mean sanders score 33.13±4.54 compared to single plating 25.33±6.48 and had a faster union 14.67±5.38 weeks and 15.47±5.63 weeks in single plating.

Out of the 30 patients 5 were female and 25 were male.

The patients were aged between 20 to 56 years and aged between 20-56 (mean 39.53±10.623) among those who underwent single plating and 22-56 (mean 36.873±9.125) among those who underwent dual plating. Hence, the patient's ages were approximately same.

Mode of Injury for distal femur fractures were mostly due to motor vehicular accidents (87%) compared to self-fall at home (13%).

Out of the 30 fractures 63% were closed and 36% were open fractures.

According to the Muller Classification, it was found that amongst the cases there were 14 C2 cases, 8 C1 cases, 5 C3 cases and 3 A3 cases.

The patients who underwent dual plating only 1 developed complications whereas 3 out of 15 developed complications after single plating. Complications included a varus collapse in cases with single plating that were not adequately buttressed with a medial plate. Other complications included non-union, knee stiffness and infection.

Out of the 30 patients 7 showed and excellent outcome according to Sanders score all of which were treated using dual plating, 16 showed a good outcome being equally shared amongst the dual and single plating groups, 5 had a fair and 2 had a poor outcome both belonging to the single plating group.

**Table 1:** Profile of cases studied

**A) Single plating**

| S. No. | Variable | Range | Mean | SD |
|---|---|---|---|---|
| 1 | Age | 20-56 | 39.53 | 10.623 |
| 2 | Duration of Surgery (hours) | 1 hour 30 minutes to 3 hours | 2 | 0.4226 |
| 3 | Blood Loss (ml) | 400-800 | 540 | 110.4 |
| 4 | Sanders Score | 13-32 | 25.33 | 6.48 |
| 5 | Time to Union (Weeks) | 8-32 | 15.47 | 5.63 |

**B) Dual plating**

| S. No. | Variable | Range | Mean | SD |
|---|---|---|---|---|
| 1 | Age | 22-56 | 36.87 | 9.125 |
| 2 | Duration of Surgery (hours) | 1 hour 30 minutes to 3 hours | 2.43 | 0.4925 |
| 3 | Blood Loss (ml) | 400-800 | 580 | 111.4 |
| 4 | Sanders Score | 26-38 | 33.13 | 4.54 |
| 5 | Time to Union (Weeks) | 8-24 | 14.67 | 5.38 |

**Table 2:** Age group and Sex cross distribution

| Sex | Age Group | | | Total |
|---|---|---|---|---|
| | Less than 30 | 30-50 | More than 50 | |
| Male | 6 | 18 | 1 | 25 |
| Female | 0 | 3 | 2 | 5 |
| **Total** | 6 | 21 | 3 | 30 |

**Table 3:** Mode of injury

| Mode | No. of cases | Percentage |
|---|---|---|
| MVA | 4 | 13% |
| Fall at home | 26 | 87% |
| **Total** | 30 | 100% |

**Table 4:** Grade of injury

| Grade | No. of Cases | Percentage |
|---|---|---|
| Closed | 19 | 63% |
| Type 1 open | 3 | 10% |
| Type 2 open | 4 | 13% |
| Type 3 open | 4 | 13% |
| **Total** | 30 | 100% |

**Table 5:** Type of fracture

| Classification | No. of cases | Percentage |
|---|---|---|
| A3 | 3 | 10% |
| C1 | 8 | 27% |
| C2 | 14 | 47% |
| C3 | 5 | 17% |
| Total | 30 | 100 |

**Table 6:** Complications

| Complications | Single Plating | Dual Plating |
|---|---|---|
| Yes | 3 | 1 |
| No | 12 | 14 |
| Total | 15 | 15 |

**Table 7:** Outcome

| Medial Plate Use | Outcome | | | | Total |
|---|---|---|---|---|---|
| | Excellent | Good | Fair | Poor | |
| Yes | 7 | 8 | 0 | 0 | 15 |
| No | 0 | 8 | 5 | 2 | 15 |
| Total | 7 | 16 | 5 | 2 | 30 |

Chi score = 14, Df = 3 and P = 0.003

The patients who underwent dual plating had a higher mean sanders score 33.13±4.54 compared to single plating 25.33±6.48 and had a faster union 14.67±5.38 weeks and 15.47±5.63 weeks in single plating.

There was no association found between dual and single plating in extension, pain, walking, climbing stairs and returning to work.

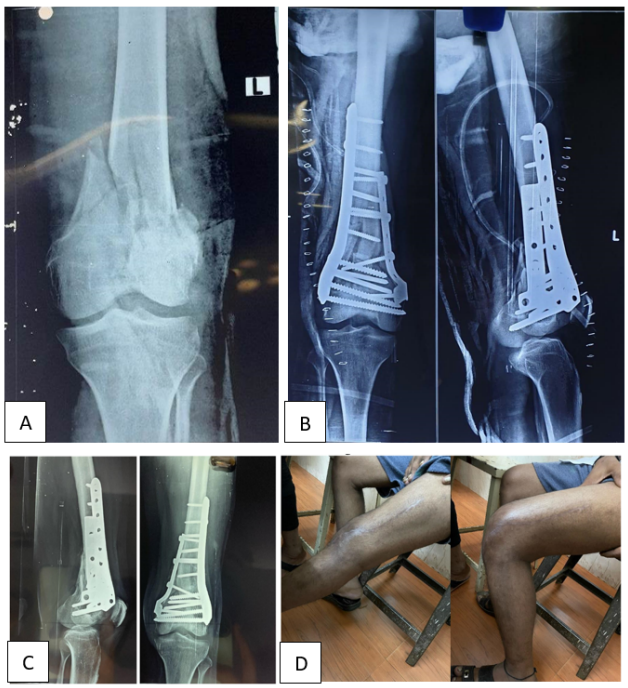



**Figure 6: Case 1**: 39M closed type C2 left side; **A)**: Preop X ray; **B)**: Postop X ray; **C):** 3 month follow up; **D):** Clinical images:

## 7. Discussion

Generally, the distal femur fractures are caused by high velocity injuries.

Though it commonly occurs in young adults between 15 to 40 years old, also increased incidence present in women more than 50 years who is osteoporotic.

In our study, out of the 30 patients 5 were female and 25 were male.

The patients were aged between 20 to 56 years and aged between 20-56 (mean 39.53±10.623) among those who underwent single plating and 22-56 (mean 36.873±9.125)

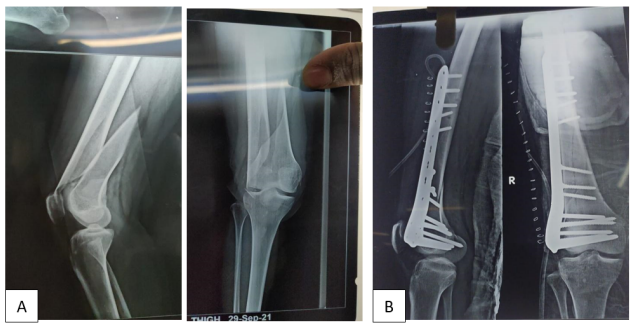



**Figure 7: Case 2**: 37 F closed type C1 right side; **A)**: Preop X ray; **B)**: Postop X ray

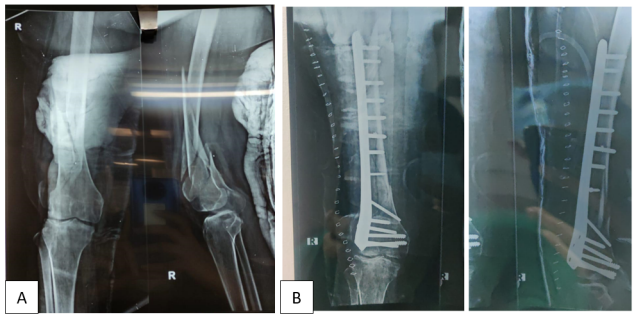



**Figure 8: Case 3:** 56F closed type c2 right side; **A)**: Preop X ray; **B)**: Postop X ray


**Figure 9:** Case 4: 22 M closed Ttype C1 right side; **A)**: Preop X ray; **B)**: Postop X ray; **C):** 6 weeks follow up; **D):** Clinical images:

**Table 8:** Relation with degree of flexion

| Medial Plate Use | Flexion | | | Total | |
|---|---|---|---|---|---|
| | Fair | Good | Excellent | | |
| Yes | 0 | 0 | 15 | 15 | Chi = 10.909 Df =1 and p = 0.004 |
| No | 2 | 6 | 7 | 15 | |
| Total | 2 | 6 | 22 | 30 | |

**Table 9:** Relation with deformity

| Medial Plate Use | Deformity | | | Total | |
|---|---|---|---|---|---|
| | Poor | Good | Excellent | | |
| Yes | 0 | 0 | 15 | 15 | CHI =12.857 Df =2 p = 0.002 |
| No | 2 | 7 | 6 | 15 | |
| Total | 2 | 7 | 21 | 30 | |

**Table 10:** Relation with shortening of the limb

| Medial Plate Use | Shortening of the limb | | | | Total | |
|---|---|---|---|---|---|---|
| | Poor | Fair | Good | Excellent | | |
| Yes | 0 | 0 | 0 | 15 | 15 | Chi =12.85 Df = 3 p = 0.005 |
| No | 2 | 5 | 2 | 6 | 15 | |
| Total | 2 | 5 | 2 | 21 | 30 | |

among those who underwent dual plating. Hence, the patient's ages were approximately same.[9,10]

The metaphyseal region is severely damaged by osteoporosis and strong impact force, which leads to considerable comminution and bone voids in the metadiaphyseal junction, most frequently in the anterior part. It greatly complicates reduction, especially if the fracture line extends intra-articularly. The knee is one among the body's main joints for bearing weight and has a larger articular contact area. Thus, early arthritic changes and knee stiffness result from any inappropriate reduction in articular surface. The posterior curved part of the condyle and the medial and lateral condyles, which are the building blocks of the distal femur, undergo comminution as an extensive cobweb-like fracture line. The individual articular block is forced into a displaced rotated position by the various muscle attachments to it.[11] During the reduction maneuver it is important to overcome the resistant muscle force. Because of the knee's valgus orientation, the compression side lies on the medial supracondylar ridge, making it susceptible to an axial force-induced wedge comminution fragment in the medial side. Even if the lateral column is rigidly fixed by locking implants, the loss of continuity in the medial cortex enhances the stress transfer over the column and leads to easy fatigue failure.Because of these critical challenges like comminution, medial cortical loss, intra articular extension, muscle force on fractured fragments and instability; unstable distal femur fractures become one of the more complicated trauma cases to operate on. 5-10% of open injuries add to the complexity.

Type A3, C1, C2, and C3 fractures—which are taken into consideration in our study—as unstable fractures among the Muller classification. These fractures require careful soft tissue management, appropriate reduction, accurate alignment, and implant selection that can tolerate these stresses and the right fixing technique. Without this expertise, fractures like this typically result in failure and consequences that give surgeons headaches and, more critically, cause patients' suffering, despair, and sadness. We should tackle these complicated fractures with a well-planned strategy because of the aforementioned issues that arise in unstable distal femur fractures. When choosing elements for fast healing and a good functional recovery, we should look for those that are modifiable based on patient benefit. At the time of injury and fracture fixation, risk factors such as advanced age, diabetes mellitus, obesity, and osteoporosis are beyond our control. The healing rate is slowed down by these metabolic variables. Open wounds and long-term smokers increase the healing time. Even though these are unanticipated obstacles during fracture healing, we can still alter other aspects, such as implant selection and surgical methods, to promote healing. The union rate and difficulties were significantly lower once locking condylar plates were created. Better stability in brittle bone is the aim of locking plates. Rather than forcing the plate against the bone, the screw is locked into the plate to provide primary support. Because of the anatomical design of the plates, it is used as a reduction mold to mold the bone to the plate.

Biomechanically speaking, locking plates are better than normal plates. Compared to other implants, this one has greater strength under axial compression, but less strength under torsion. Because the locking plates are not in direct touch with the bone, the periosteal blood flow can be

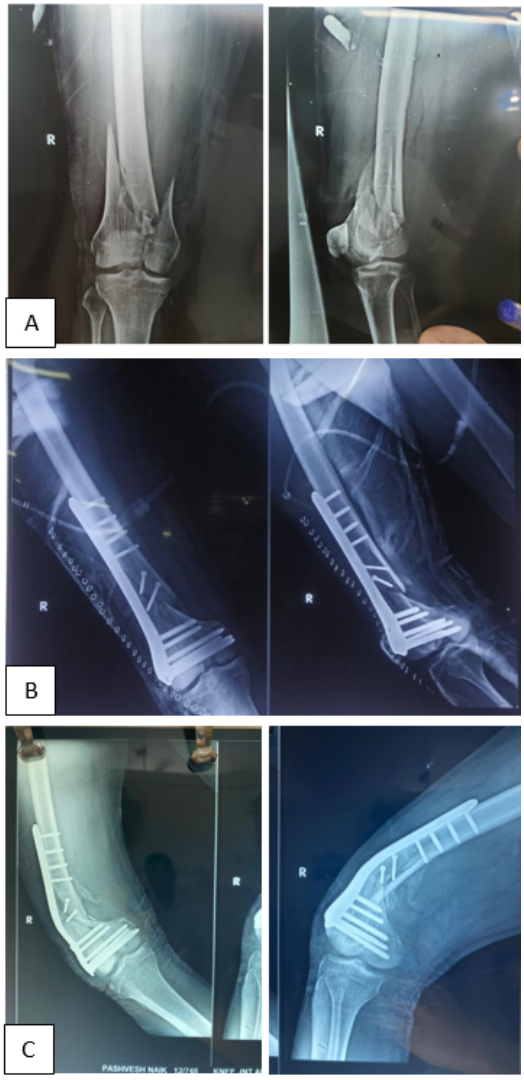



**Figure 10: Case 5:** 36 M type 2 open type C3 right side; **A)**: Preop X ray; **B)**: Postop X ray; **C):** 6 weeks follow up; Early weight bearing and failure to provide a medial buttress support led to a failure of the implant and varus collapse

preserved. Locking compression plates are therefore both physiologically compatible and biomechanically better. On the other hand, the MIPO approach is more technically challenging and results in a higher rate of malunion, malrotation, and secondary surgery due to the lack of direct visualization of the articular surface and metaphysis. The possibility of fixation failure in a single lateral plating indicates the insufficiency of this treatment in the case of an unstable distal femur fracture, aside from technical complications. As recommended by several biomechanical studies, we employed lateral plates in conjunction with medial enhanced plates to solve this issue.

According to a study published by Bologna, Claudio et al. and Kregor PJ in 2019 fixation using medial with lateral plates demonstrated higher rates of union and a lesser need for revision surgery compared to using just single plate in comminuted fractures of the distal femur.[12,13]

Siddhiqui YS et al, in a recent study in early 2021 proposed that a construct be created that is conducive to fracture healing while adhering to the principles of locked compression plate fixation and supplementation of the medial stability by appropriate medial reconstruction.[14,15]

Out of the 30 patients in our study, 7 had an excellent Sanders score and were treated with dual plating; 16 had a good outcome that was equally distributed between the dual and single plating groups; 5 had a fair outcome and 2 had a poor outcome, both of which were treated with single plating. Patients undergoing dual plating saw a faster union time of 14.67±5.38 weeks and 15.47±5.63 weeks in single plating, respectively, and a higher mean Sanders score of 33.13±4.54 compared to single plating's 25.33±6.48. The areas of degree of flexion, deformity repair, and post-operative limb shortening showed a significant improvement in Sander's score, which in turn led to a considerable improvement in Sander's overall score.

### *7.1. Our experience with double plating*

1. All fracture lines should be observed prior to surgery to know exact fracture morphology to make proper plan. Pre-operative X-ray can be taken with gentle traction to avoid overlapping of fragments. CT scan is must to rule out Hoffa's fractures and to view the fracture morphology.
2. In open injuries, initial thorough wash with profuse amount of saline is essential to reduce the infection. In Gr I, II, IIIa, early thorough wash, appropriate antibiotic and early internal fixation can be done. In most of Gr IIIB & Gr IIIc injures serial debridement and initial knee spanning temporary stabilization followed by delayed internal fixation once wound becomes clean usually one week later is usually done.
3. In unstable extensive comminuted metaphyseal and epiphyseal fractures and low lying fracture in distal femur and > 1cm cortical defect in medial side, double plating with medial assisted device is best decision to avoid complications and early return to activities.
4. Single swashbuckler approach with anterolateral skin incision is far enough to access both condylar reduction and plating. With obese and more proximal extension of comminution minimally invasive incision can be made in safe zone of 15 cm below lower edge of lesser trochanter to the adductor tubercle.
5. During reduction, we can choose the large condylar segment as the main segment, to which other fragments are matched and reduced.
6. Articular surface should be anatomically reduced. No step is accepted. If comminution in joint line present fully threaded cancellous screw was used to prevent

compression and narrowing the joint. Minimal gap can be accepted in comminution which becomes congruent later otherwise narrowing of joint makes incongruity and step in joint line which are unacceptable.

7. If comminution is present in metaphyseal region it should be bypassed by bridging technique. If we resect the comminuted part to dock the condyles to the shaft it results in shortening and translation of joint in relation to shaft.
8. If medial cortical defect > 1cm it should be bone grafted and medial plate serves as scaffold to the graft.
9. In condylar region mostly use solid screws rather than cannulated ones to reduce the frequency of screw breakage at screw plate junction.
10. Keeping a bolster under knee and provisional pin fixation, frequent check with C arm is needed to avoid coronal, sagittal and rotational malalignment. After provisional fixation check for patellar tracking which is affected in rotational malalignment.
11. Lateral plate is chosen by keeping at least five holes proximal to the fracture.
12. Lateral plate should be parallel to the lateral cortex in AP view and centered on femur diaphysis on lateral view. Epiphyseal screws are parallel to the joint line. Distal edge of plate should lie behind the base of trochlea and in front of the Blumensatt line.
13. If fracture is comminuted, locking screw placed near the fracture site to stabilize the fracture. In simple fracture place the locking screw away to the fracture leaving one hole on either side increases the elasticity of the construct and promotes the union..
14. The plate should be close to the bone within 2mm of distance provides better resistance to compression and torsional force. More than 5 mm increases the instability..
15. The plate must be parallel at 10 degree to the lateral cortex and condyle increases the strength to axial compression and cyclical loading.
16. Bicortical screw is better than unicortical one.
17. Medial plate fixed to bone with distally two screws and proximally two screws were adequate and in condylar region interdigitation of screws was better. It should be shorter than lateral plate by at least two cortices to reduce the stress fracture.
18. With double plating the quality of reduction is preserved and no re reduction needed and secondary surgery rate is decreased..
19. After closing soft tissue layers, we flex and extend the knee to full range to release any soft tissue interposition between sutures. It will reduce the post-operative pain and augments the range of motion..
20. In postoperative period early range of motion is encouraged. There is no place for cast or brace to compensate non-rigid fixation. So it needs rigid fixation of fractures.
21. There is no relation of dual plating with operative time, quadriceps scarring. Instead meticulous soft tissue handling increases the post-operative knee function and reduces the complication rate. Rigid fixation favours early post-operative rehabilitation.
22. Strength of our study is inclusion of only complex distal femur fractures.
    It is conducted in a single institution. The study was a prospective one and comparable to other standard international studies.
23. The main limitation of our study is small sample size though it is comparable with other such studies. Another limitation is short follow up period. The actual incidence of post-traumatic arthritis can be estimated only by a long term study.

## 8. Summary

The purpose of this study was to determine the most effective course of therapy for unstable distal femur fractures by comparing the clinical and functional outcomes between single and dual plating. Considering the above findings, it was discovered that dual plating produced better results in terms of degree of bending and deformity correction. It also produced equivalent results in terms of surgical time, blood loss, weight bearing, time of union, and return to normal activities. Furthermore, it was discovered that patients who underwent single plating surgery had a higher prevalence of problems such stiffness and varus collapse.

## 9. Conclusion

In conclusion, a medial buttress support will improve patient outcomes for patients treated with a single plating in cases of unstable distal femur fractures without lengthening the surgical procedure or increasing blood loss, making it a superior option for treating these fractures. The recommended method of fixation for unstable distal femur fractures is the use of biomechanical locking plates since they have dramatically decreased the rate of complications and increased fixation stability in unstable fractures of the distal femur.

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## 11. Conflict of Interest

None.

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## Author biography

**Waulden DeMelo,** Senior Resident

**Anish Vernekar,** Senior Resident

**Ajmal Abdulla,** Junior Resident

**Nehal Salgaokar,** Junior Resident

**Gauresh Vargaonkar,** Consultant

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