

**ORIGINAL RESEARCH**

# To investigate the efficacy of dual plate fixation in treating fractures of the distal femur

<sup>1</sup>Dr. Maninder Singh, <sup>2</sup>Dr. Surya Partap, <sup>3</sup>Dr. Dixit Bansal, <sup>4</sup>Dr. Vikas Sood

<sup>1</sup>Associate Professor, <sup>2,4</sup>Junior Resident, <sup>3</sup>Senior Resident, Department of Orthopaedics, GMC Amritsar, Punjab, India

**Corresponding Author**

Dr. Vikas Sood

Junior Resident, Department of Orthopaedics, GMC Amritsar, Punjab, India

**Email:** [Vikassood066@Gmail.Com](mailto:Vikassood066@Gmail.Com)

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**ABSTRACT**

**Aim:** To investigate the efficacy of Dual Plate Fixation in treating fractures of the distal femur. **Material and Methods:** This research included a cohort of 50 individuals who were diagnosed with distal femoral fractures. Dual plate fixation was used to handle all patients. This research comprised individuals who were skeletally mature and had distal femoral fractures categorized as type A3 or C3 based on the AO/OTA classification. The research eliminated individuals who were skeletally immature, had open fractures, periprosthetic supracondylar femur fractures, or pathological fractures. Pain was managed with appropriate medications. The patient will have a lengthy leg splint and was given low molecular weight heparin (Enoxaparin 40 IU) to prevent deep vein thrombosis (DVT). The heparin was halted 12-24 hours before surgery and restarted 12 hours after surgery. **Results:** The average duration of the operation, which was 95.4 minutes with a standard deviation of 20.3 minutes. The mean intraoperative blood loss was 350 ml with a standard deviation of 75 ml. Five patients (10%) needed blood transfusions during surgery. 3 patients (6%) had Postoperative infection rates, whereas 2 patients (4%) had deep vein thrombosis (DVT). Patients were treated using non-weight-bearing for a period of 6 to 8 weeks until radiographic evidence of bone healing was seen. All patients (100%) received intravenous analgesics for 2 days after the operation as part of pain treatment. All patients (100%) received daily administration of low molecular weight heparin (Clexan - enoxaparin sodium) for 6 weeks as a prophylactic for deep vein thrombosis (DVT). All patients (100%) received postoperative broad-spectrum antibiotics. The average duration for union formation, which was 12.4 weeks with a standard deviation of 3.2. By the 3-month mark, 84% of the 42 patients had indications of union, a figure that rose to 100% after 6 months. The average Neer's score for functional outcome was 85.6 ( $\pm$  10.2), and the average Oxford Knee Score (OKS) was 40.5 ( $\pm$  7.3). **Conclusion:** The findings of this research indicate that using dual plate fixation for distal femoral fractures has favorable results in terms of the rates of bone healing, restoration of function, and occurrence of complications. The results align with previous research, confirming that dual plate fixation is a dependable surgical approach for treating distal femoral fractures.

**Keywords:** Dual Plate Fixation, Fractures, Distal femur

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**INTRODUCTION**

Distal femoral fractures, which make up about 4% to 6% of all femoral fractures, pose considerable difficulties in orthopedic trauma treatment because of their intricate nature and the crucial role of the distal femur in knee joint function and total limb mechanics. These fractures often happen as a result of severe trauma in younger persons or minor falls in older people with osteoporotic bones.<sup>1,2</sup>

Conventional approaches for treating distal femoral fractures include the use of intramedullary nailing and single lateral plating. Nevertheless, these methods may sometimes be insufficient in ensuring the

required level of steadiness, particularly in instances with fragmented fractures, osteoporosis, or significant injury to the soft tissues. Dual plate fixation has been a helpful approach in addressing these issues, since it provides improved mechanical stability and leads to better functional results.<sup>3,4</sup>

Dual plate fixation is a surgical technique that includes the placement of two plates, usually one on the outer side and one on the inner side of the thigh bone, in order to provide strong and secure attachment. This technique uniformly distributes the mechanical strain over the fracture site, therefore decreasing the chances of implant failure and non-

union. Research has shown that the use of dual plating may enhance the mechanical stability of a biological system and facilitate prompt mobility, which is essential for the recuperation of patients and the reduction of problems such as joint rigidity and muscle wasting.<sup>5</sup>

Zlowodzki et al.'s research has shown that dual plating is better than single lateral plating in terms of mechanical stability and healing rates for comminuted distal femoral fractures.<sup>1</sup> In addition, Ricci et al. found that the use of dual plating greatly decreased the occurrence of varus collapse and implant failure in individuals with osteoporotic bone.<sup>6</sup> The clinical studies and meta-analyses have confirmed these results, further supporting the therapeutic advantages of using dual plate fixation for distal femoral fractures.<sup>7-9</sup>

Although dual plate fixation offers benefits, it is not devoid of obstacles. To avoid problems like as infection and non-union, the procedure requires meticulous control of soft tissues.<sup>10</sup> Furthermore, the surgical proficiency and extended duration of surgery linked to the use of two plates need careful and precise surgical preparation and implementation. However, the enhanced functional results and reduced occurrence of complications make twin plate fixation a very appealing choice for treating intricate distal femoral fractures.

## MATERIAL AND METHODS

This research was done in the Orthopedic Surgery Department at our institution using a prospective analytic approach. The research acquired permission from the institutional ethics committee, and all subjects provided informed consent. This research included a cohort of 50 individuals who were diagnosed with distal femoral fractures. Dual plate fixation was used to handle all patients. This research comprised individuals who were skeletally mature and had distal femoral fractures categorized as type A3 or C3 based on the AO/OTA classification. The research eliminated individuals who were skeletally immature, had open fractures, periprosthetic supracondylar femur fractures, or pathological fractures. Patients who met the specified criteria for inclusion were admitted from the emergency department. The preoperative care adhered to the advanced trauma life support protocol and included the following: comprehensive history gathering and clinical examination, radiological evaluation consisting of pelvic AP view, femur AP and lateral views, and knee AP and lateral views. Required laboratory tests include a complete blood count (CBC), liver and renal function tests, bleeding profile, random blood sugar, electrocardiogram (ECG), and echocardiogram if necessary. Pain will be managed with appropriate medications. The patient was a lengthy leg splint and was given low molecular weight heparin (Enoxaparin 40 IU) to prevent deep vein thrombosis (DVT). The

heparin will be halted 12-24 hours before surgery and restarted 12 hours after surgery.

## METHODOLOGY

The procedures were conducted using either spinal/epidural or general anesthesia, with the patient lying on a radiolucent orthopedic table and under the guidance of fluoroscopy.

**Surgical Methodology:** The patient was lying on their back in a supine position, and their knee was bent at a 90° angle using the median parapatellar approach. A linear incision was made along the length of the patella. The dissection was performed in the space between the vastus medialis (VM) and rectus femoris muscles. The patella was laterally displaced, and the knee was flexed to a 90° angle to facilitate exposure. The fracture segments were completely visible, and tiny condylar pieces were aligned using pointed bone reduction clamps. Anatomical congruity restoration was achieved using preliminary wires and cannulated interfragmentary screws with a diameter of 4 mm. The procedure for definitive fixation included the use of countersunk cancellous screws measuring either 4 or 6.5 mm, together with a distal femoral locking plate placed on the lateral condyle surface. This was guided by preoperative CT images that were reconstructed in 3D.

**The lateral approach:** The lateral approach included making a skin incision starting at the middle-lateral part of the femoral shaft near Gerdy's tubercle, and curving towards the proximal direction. The iliotibial band was cut following the direction of the muscle fibers. The muscle fibers of the vastus lateralis were raised from the lateral intermuscular septum in a direction from the far end to the near end. The vastus lateralis muscle was pulled towards the front and middle, and the perforating vessels were tied off. The muscle was excised from the outer surface of the femur while preserving the periosteum.

**Medial Approach:** The skin is incised along the adductor magnus tendon. The adductor tubercle and tendon were recognized. The Sartorius muscle was moved backwards to provide better visibility. The adductor magnus tendon was pulled back towards the rear, while the vastus medialis was pulled forward to reveal the femur.

**Management and monitoring of patients after surgery and subsequent check-ups:** Administration of intravenous analgesics for a duration of 2 days after a surgical procedure to control pain. Administration of enoxaparin sodium, a low molecular weight heparin, at a dosage of 40 mg per day for a duration of 6 weeks to prevent deep vein thrombosis. Additionally, the use of broad-spectrum antibiotics after surgery. The patient will need to avoid putting any weight on the affected area for a period of 6 to 8 weeks, until X-ray

images show that the bones have healed together. After that, the patient will have follow-up appointments for 6 months, during which X-rays will be taken at 3 and 6 months to monitor progress. In addition to the X-rays, the patient's condition will be assessed using functional scores and further X-ray images.

**Evaluation criteria:** Primary outcomes include functional result measured using Neer' s score and operative time. Assessment of union using X-ray and time required for union. Secondary outcomes include measures of intraoperative blood loss, intraoperative blood transfusion, infection rates, and the incidence of deep vein thrombosis (DVT).

**Recovery and rehabilitation after surgery:** Early postoperative rehabilitation and subsequent monitoring of function and discomfort using the Oxford Knee Score (OKS) are essential. Patients completed the OKS, a 12-item patient-reported outcome measure, without any assistance from the clinical staff. The assessment tool is specifically intended to evaluate the results of knee therapies. It is recognized for its straightforwardness, ability to be replicated, and its ability to detect even small but significant changes that are relevant in a clinical setting.

## RESULTS

Table 1 displays the inclusion of 50 patients in the study, with an average age of 45.6 years ( $\pm 12.3$ ). The sample size included 32 male and 18 female. The fracture types in the study were categorized as type A3 in 28 patients and type C3 in 22 patients, based on the AO/OTA classification.

Table 2 demonstrates that in terms of anesthesia, 28 patients (56%) had spinal or epidural anesthesia, whereas 22 patients (44%) got general anesthesia. The surgical method was as follows: 52% of the patients had a median parapatellar approach, 30% underwent a lateral approach, and 18% underwent a medial approach.

whereas 22 patients (44%) got general anesthesia. The surgical method was as follows: 52% of the patients had a median parapatellar approach, 30% underwent a lateral approach, and 18% underwent a medial approach.

Table 3 displays the average duration of the operation, which was 95.4 minutes with a standard deviation of 20.3 minutes. The mean intraoperative blood loss was 350 ml with a standard deviation of 75 ml. Five patients (10%) needed blood transfusions during surgery.

Table 4 indicates that 3 patients (6%) had Postoperative infection rates, whereas 2 patients (4%) had deep vein thrombosis (DVT). Patients were treated using non-weight-bearing for a period of 6 to 8 weeks until radiographic evidence of bone healing was seen. All patients (100%) received intravenous analgesics for 2 days after the operation as part of pain treatment. All patients (100%) received daily administration of low molecular weight heparin (Clexan - enoxaparin sodium) for 6 weeks as a prophylactic for deep vein thrombosis (DVT). All patients (100%) received postoperative broad-spectrum antibiotics.

Table 5 displays the average duration for union formation, which was 12.4 weeks with a standard deviation of 3.2. By the 3-month mark, 84% of the 42 patients had indications of union, a figure that rose to 100% after 6 months.

Table 6 displays the average Neer' s score for functional outcome as 85.6 ( $\pm 10.2$ ), and the average Oxford Knee Score (OKS) as 40.5 ( $\pm 7.3$ ).

Table 7 presents the following complications: nonunion occurred in 2 patients (4%), malunion in 1 patient (2%), knee discomfort in 5 patients (10%), infection in 3 patients (6%), and deep vein thrombosis (DVT) in 2 patients (4%).

**Table: 1 Demographic Data**

Parameter	Value
Number of patients	50
Age (years, mean $\pm$ SD)	45.6 $\pm$ 12.3
Gender (M/F)	32/18
Fracture Type (A3/C3)	28/22

**Table: 2 Operative Data**

Parameter	Number of Patients (%)
Anesthesia Type	
- Spinal/Epidural	28 (56%)
- General	22 (44%)
Surgical Approach	
- Median Parapatellar	26 (52%)
- Lateral	15 (30%)
- Medial	9 (18%)

**Table: 3 Intraoperative Data**

Parameter	Mean $\pm$ SD
Operative Time (minutes)	95.4 $\pm$ 20.3
Intraoperative Blood Loss (ml)	350 $\pm$ 75
Intraoperative Blood Transfusion	5 (10%)

**Table: 4 Postoperative Outcomes**

Parameter	Number of Patients (%)
Infection Rates	3 (6%)
Incidence of DVT	2 (4%)
Non-weight bearing (weeks)	6-8
Pain Management	
- IV Analgesics (2 days)	50 (100%)
DVT Prophylaxis (6 weeks)	50 (100%)
Antibiotics	50 (100%)

**Table: 5 Follow-up and Union Data**

Parameter	Mean $\pm$ SD
Time to Union (weeks)	12.4 $\pm$ 3.2
Union at 3 months	42 (84%)
Union at 6 months	50 (100%)

**Table: 6 Functional Outcomes**

Parameter	Mean $\pm$ SD
Neer's Score	85.6 $\pm$ 10.2
Oxford Knee Score (OKS)	40.5 $\pm$ 7.3

**Table: 7 Complications**

Complication	Number of Patients (%)
Nonunion	2 (4%)
Malunion	1 (2%)
Knee Pain	5 (10%)
Infection	3 (6%)
DVT	2 (4%)

## DISCUSSION

The prevalence of osteoporotic fractures has been rising with the aging population, presenting a complex therapeutic challenge. Insufficient fixation or extended immobilization during surgical therapy may lead to fixation failure, improper or incomplete bone healing, restricted joint movement, and other serious medical problems, including blood clot formation or lung-related issues. Both stiff fixation and early rehabilitation are crucial for a prompt recovery of preoperative ambulatory function and level of daily activity, despite the bone fragility associated with osteoporotic fractures.<sup>11</sup> The demographic features of the patients in this research are consistent with those found in prior investigations on distal femoral fractures. The mean age of 45.6 years aligns with the results of Zlowodzki et al.'s (2006) study, which reported a similar mean age of about 47 years in a comparable population.<sup>1</sup> The higher representation of males (64%) is consistent with earlier studies, including Martinet et al. (2000), which reported a male-to-female ratio of about 2:1.<sup>2</sup> The selection of anesthesia (56% spinal/epidural and 44% general) adheres to established norms in orthopedic surgery,

where regional anesthesia is often favored for its advantages in mitigating postoperative pain and complications. The distribution of surgical techniques indicates a predilection for the median parapatellar approach (52%), which is often used because of its direct accessibility to the fracture site. This is similar to the distribution of approaches seen in studies conducted by Giannoudis et al. (2015), when the parapatellar method was used in around 50% of instances.<sup>12</sup> The average operation time of 95.4 minutes is within the range of 90-110 minutes described by Hierholzer et al. (2011) for the dual plate fixation of distal femoral fractures.<sup>13</sup> The mean intraoperative blood loss of 350 ml is similarly similar to the findings published in comparable research, such as the study conducted by Oh et al. (2015), which saw average blood losses ranging from 300 to 400 ml.<sup>14</sup> The incidence of intraoperative blood transfusion in 10% of patients is somewhat lower than the 15% reported in certain publications, suggesting the possible effectiveness of blood management measures in this particular research. Im, et al (2001) were also found similar blood loss in their study.<sup>15</sup>

The postoperative infection rates of 6% and the incidence of deep vein thrombosis (DVT) of 4% are within the anticipated range for orthopedic surgeries that include internal fixation. In the literature, infection rates are frequently reported to be between 5-8%, while DVT rates are usually around 3-5%. The implementation of non-weight bearing for a duration of 6-8 weeks is in accordance with the most up-to-date and effective methods to promote optimal healing and union of the fracture. Metsemakers et al. (2015) and Warwick et al. (2013) were also found similar complication in their study.<sup>16,17</sup> The average duration till union of 12.4 weeks and a 100% union rate at 6 months suggest that the surgical and postoperative care were effective. These results are advantageous in comparison to the findings of Henderson et al. (2011), which indicated a mean duration of 14 weeks for bone union and a union rate of 95% at 6 months.<sup>18</sup>

The functional results, shown by a mean Neer's score of 85.6 and an Oxford Knee Score (OKS) of 40.5, demonstrate a favorable level of recovery and functioning after the surgical procedure. The scores obtained in this study are similar to those published by Higgins et al. (2007). Higgins et al. discovered that the mean Neer's scores ranged from 80-85 and the OKS ranged from 38-42 in patients who had identical operations.<sup>19</sup>

The incidence rates identified in this research, which include nonunion (4%), malunion (2%), knee discomfort (10%), infection (6%), and deep vein thrombosis (4%), align with the rates described in existing literature. The rates of nonunion and malunion are within the standard range of 2-5% and 1-3%, respectively, as shown by Ricci et al. (2009). The knee discomfort rate of 10% is somewhat elevated, which may be ascribed to individual disparities in pain perception and recuperation.<sup>6</sup>

## CONCLUSION

In summary, the findings of this research indicate that using dual plate fixation for distal femoral fractures has favorable results in terms of the rates of bone healing, restoration of function, and occurrence of complications. The results align with previous research, confirming that dual plate fixation is a dependable surgical approach for treating distal femoral fractures.

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