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Original Research Article

FUNCTIONAL OUTCOME OF COMPLEX DISTAL FEMUR FRACTURES TREATED WITH DUAL PLATING USING THE MODIFIED SWASHBUCKLER APPROACH: A PROSPECTIVE STUDY

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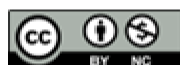


ABSTRACT

Background: Distal femur fractures involving the articular surface are complex injuries that demand precise reduction and stable fixation to achieve satisfactory functional outcomes.[1] These fractures are frequently associated with metaphyseal comminution, poor bone quality, and soft tissue compromise. Dual plating has emerged as a reliable fixation strategy for managing such complex fracture patterns by providing enhanced biomechanical stability.[2] **Aim:** To evaluate the functional outcome of complex distal femur fractures treated using dual plating techniques. **Materials and Methods:** This prospective study was conducted at the Department of Orthopaedics, Government Stanley Medical College, Chennai, from October 2023 to April 2025. Twenty patients aged between 20 and 60 years with AO Müller type C distal femur fractures were included. Patients were managed surgically using dual plating through either a modified swashbuckler approach or a dual-incision approach. Functional outcomes were assessed using the American Knee Society Score (AKSS), and radiological union was evaluated during serial follow-up. **Results:** Among the 20 patients, excellent functional outcomes were observed in 25%, good in 35%, fair in 25%, and poor in 15%. The mean time to radiological union was 20.4 weeks. Younger patients demonstrated better functional outcomes compared to older patients. The modified swashbuckler approach was associated with shorter operative time and superior functional results. Complications included infection in three patients and knee stiffness in three patients. No cases of malunion or implant failure were observed. **Conclusion:** Dual plating provides stable fixation and satisfactory functional outcomes in complex intra-articular distal femur fractures. The modified swashbuckler approach offers improved exposure, reduced operative time, and better early functional recovery. Careful surgical technique and structured rehabilitation are essential for optimal results.

INTRODUCTION

Distal femur fractures represent a challenging spectrum of injuries due to their proximity to the knee joint, frequent involvement of the articular surface, and association with metaphyseal comminution.[1] These fractures account for approximately 3–6% of all femoral fractures and exhibit a bimodal age distribution, occurring secondary to high- energy trauma in younger individuals and low-energy falls in elderly patients with osteoporotic bone.[2]
Earlier management strategies relied predominantly on conservative treatment, which often resulted in prolonged immobilization, knee stiffness, malunion, and poor functional outcomes3. With advancements in surgical techniques and implant design, operative fixation has become the standard of care for displaced and intra-articular distal femur fractures.[4]
The primary goals of surgical management include anatomical restoration of the articular surface, maintenance of limb alignment, length and rotation, and achievement of stable fixation that allows early mobilization of the knee joint.[5]
While lateral locking plates and retrograde intramedullary nails are commonly used, these methods may be insufficient in fractures with medial comminution, leading to varus collapse and implant failure.[6]

Dual plating techniques have been introduced to enhance stability by supporting both the medial and lateral columns of the distal femur.[7] In addition, adequate surgical exposure plays a critical role in achieving accurate articular reduction. The modified swashbuckler approach provides excellent visualization of the distal femur articular surface while minimizing soft tissue disruption.[8] This study evaluates the functional and radiological outcomes of distal femur fractures treated using dual plating techniques.

Aim of the study

To evaluate the functional outcome of complex distal femur fractures treated using dual plating techniques.

Objectives of the study

1. To assess the clinical, radiological, and functional outcomes of intra-articular distal femur fractures treated with bicolumnar plating.
2. To analyze the influence of age, sex, fracture pattern, and surgical approach on functional outcomes.
3. To document complications associated with dual plating in distal femur fractures.

MATERIALS AND METHODS

This was a prospective observational study conducted at the Department of Orthopaedics, Government Stanley Medical College, Chennai from October 2023 to April 2025. Twenty patients were included using consecutive sampling.

Inclusion Criteria

- Patients aged between 20 and 60 years
- Fractures less than two weeks old
- Gustilo–Anderson Grade I open fractures,[9]
- AO Müller type C1, C2, and C3 distal femur fractures

Exclusion Criteria

- Patients younger than 20 years or older than 60 years
- Gustilo–Anderson Grade II and III open fractures
- AO Müller type A and B distal femur fractures
- Associated neurovascular injury
- Pathological fractures, malignancy, osteoarthritis, or ipsilateral limb fractures

Preoperative Management

All patients underwent thorough clinical evaluation, including assessment of injury mechanism, comorbidities, and local soft tissue condition. Radiological evaluation included plain radiographs and computed tomography scans with three-dimensional reconstruction when required.[10] Temporary immobilization was provided using a splint. Baseline investigations were completed, and informed written consent was obtained. Surgery was performed under spinal or general anesthesia.

Surgical Technique

Fracture fixation was performed using dual plating, consisting of a lateral locking compression plate and a medial buttress or reconstruction plate. Depending on fracture configuration, either a modified swashbuckler approach or a dual-incision approach was used. Anatomical reduction of the articular surface was achieved before definitive fixation.[11]

Postoperative Protocol

Postoperatively, patients received intravenous antibiotics and analgesics. Limb elevation was maintained, and early knee range-of-motion exercises were initiated. Non-weight-bearing ambulation with walker support was started on the second postoperative day. Sutures were removed on the fourteenth postoperative day.

Follow-Up and Functional Assessment

Patients were followed at 3, 6, and 12 weeks, and subsequently at 6 months and one year. Radiological union was assessed using serial radiographs. Functional outcome was evaluated using the American Knee Society Score.[12]

RESULTS

Of the 20 patients, 13 were male and 7 were female. Five patients achieved excellent outcomes, seven had good outcomes, five had fair outcomes, and three had poor outcomes. Gender did not significantly influence functional outcome ($p > 0.05$).

All poor outcomes were observed in AO Müller type C3 fractures. Younger patients demonstrated significantly better functional outcomes compared to older patients. The modified swashbuckler approach was associated with shorter operative time and improved functional results.

The mean time to radiological union was 20.4 weeks. Complications included postoperative infection in three patients and knee stiffness in three patients. No cases of malunion, implant failure, or varus collapse were noted.

PREOP XRAY

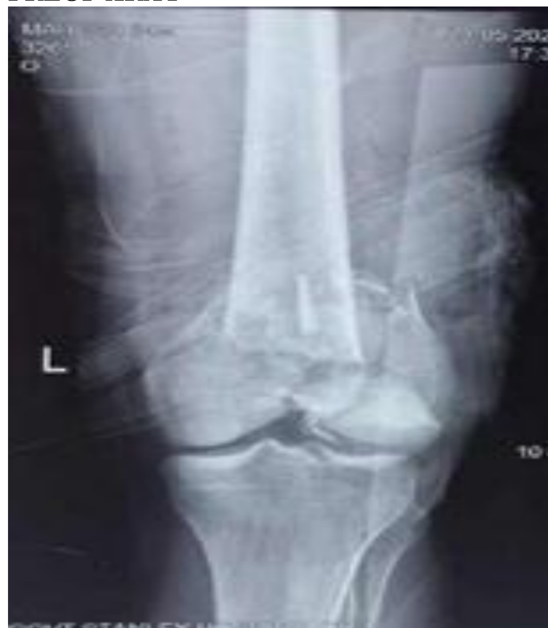


Figure 1

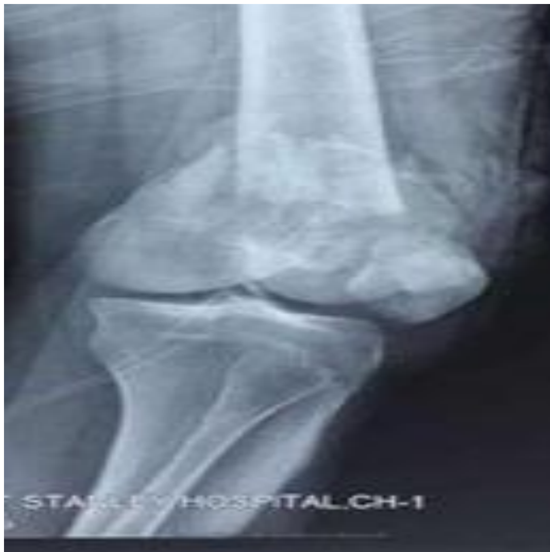


Figure 2

PREOP CT KNEE

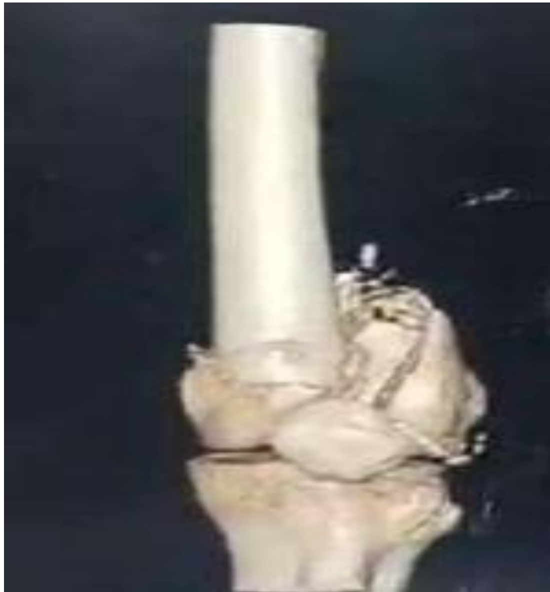


Figure 3

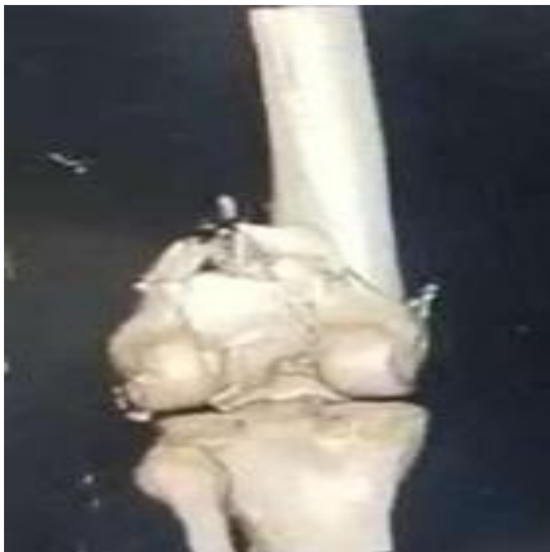
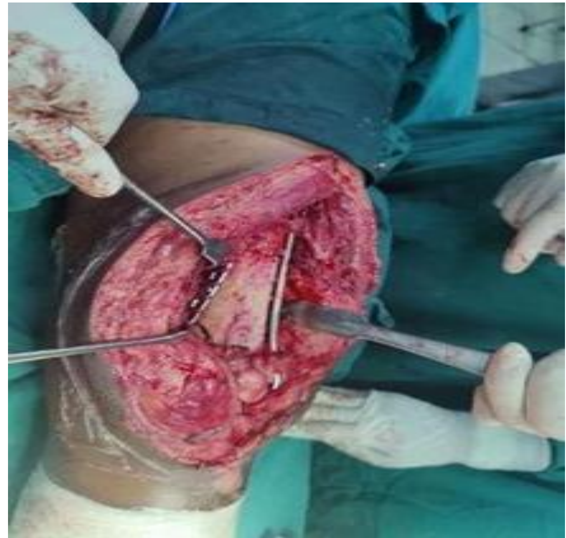


Figure 4

INTRAOP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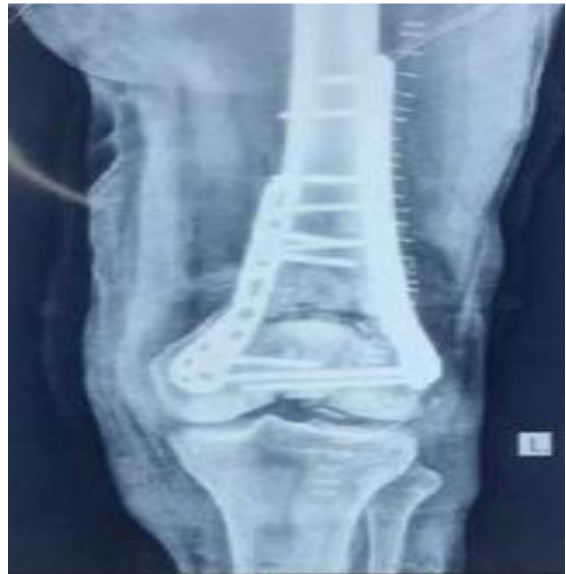
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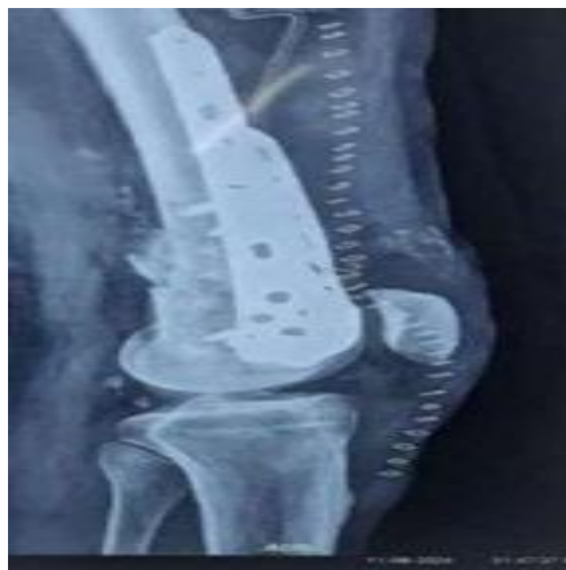
Figure 7

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ONE YEAR FOLLOWUP

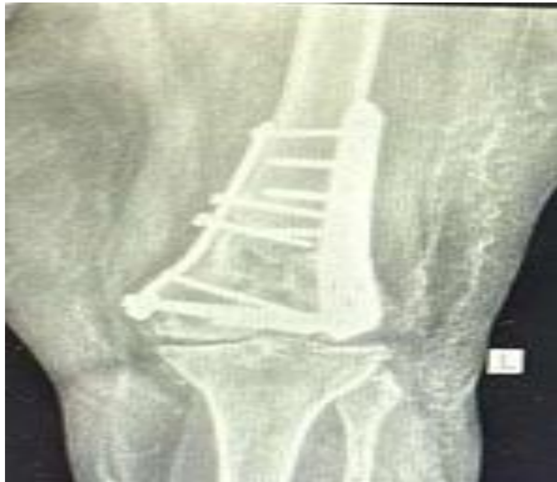

Figure 8

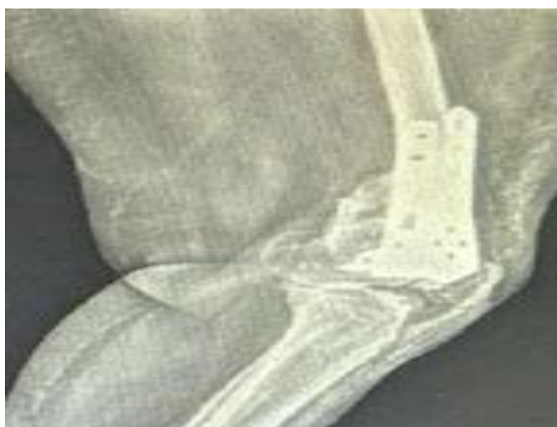

Figure 9

Figure 10

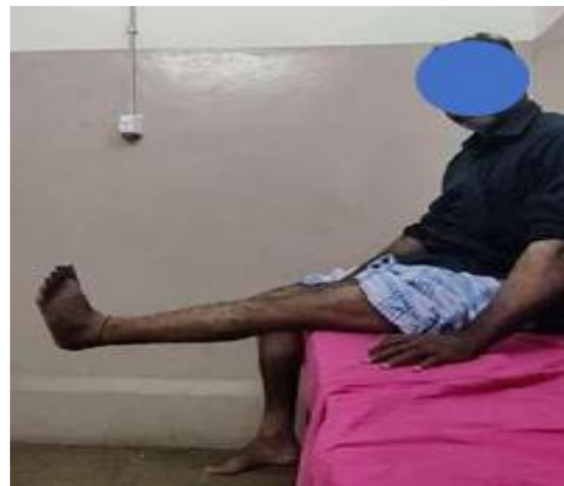

Figure 11

DISCUSSION

Achieving anatomical reduction and stable fixation is crucial in managing complex distal femur fractures to prevent long-term complications such as post-traumatic osteoarthritis[13]. Dual plating enhances construct stability, particularly in fractures with medial comminution, and reduces the risk of varus collapse.[14]

The modified swashbuckler approach offers improved visualization of the articular surface while minimizing quadriceps muscle damage, leading to better functional outcomes and reduced operative time.[8] Previous studies have demonstrated comparable or superior outcomes with dual plating when compared to single lateral plating techniques.[15-17]

The findings of the present study are consistent with existing literature, demonstrating satisfactory union rates and favorable functional outcomes with dual plating techniques.

Limitations of the study

- Small sample size
- Associated ligamentous injuries were not addressed during the initial surgery

CONCLUSION

Dual plating is an effective and reliable method for managing complex intra-articular distal femur fractures, providing stable fixation and satisfactory functional outcomes. The modified swashbuckler approach offers the advantages of better exposure, reduced operative time, and improved early functional recovery. Strict adherence to postoperative rehabilitation protocols is essential for optimal results.

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