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Case Report

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From collapse to consolidation: salvage of lateral plate failure in a medial-deficient distal femur fracture

Suyog Wagh*, Aibin B. Michael, Tushar Ramteke, Pradeep Nair, Arvind Goregaonkar

Department of Orthopaedics, Lokmanya Tilak Municipal Medical College and General Hospital, Sion, Mumbai, Maharashtra, India

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***Correspondence:**
Dr. Suyog Wagh,
E-mail: suyogwagh6159@gmail.com

ABSTRACT

Distal femur fractures with medial metaphyseal deficiency pose significant biomechanical challenges, and lateral plating alone may be insufficient to resist varus forces. We reported the case of a 40-year-old male who sustained a distal femur extra-articular fracture with substantial medial cortical bone loss. Initial fixation with a lateral locking plate and cancellous graft failed due to early, unadvised weight bearing, resulting in varus collapse and plate deformation within one week. Revision surgery included removal of failed implants, debridement, and application of a longer lateral locking plate, combined with reconstruction of the medial column using an autologous fibular strut graft inserted intramedullary. A contoured medial plate was added to create a dual-plating construct. Postoperative rehabilitation followed a protected, staged weight-bearing protocol. Radiographs at 3 months demonstrated bridging callus, and by one year the patient achieved painless independent ambulation with maintained alignment and no implant-related complications. This case illustrates the mechanical vulnerability of lateral-only constructs in medial-deficient distal femur fractures and highlights the benefits of dual plating with structural grafting in both primary and salvage settings. Augmenting the medial column improves load sharing, reduces varus stress on the lateral plate, and enhances construct stability. Early recognition of at-risk patterns, appropriate implant selection, and cautious rehabilitation are critical to preventing fixation failure. Timely revision using dual plating and graft support can successfully salvage early collapse and restore function.

Keywords: Distal femur fracture, Medial column deficiency, Dual plating, Fibular strut graft, Fixation failure salvage

INTRODUCTION

Distal femur fractures constitute a challenging subgroup of femoral injuries, comprising approximately 4-6 % of femoral fractures. They are associated with high complication rates-malunion, nonunion, fixation failure, and knee stiffness, especially in comminuted or metaphyseal bone loss patterns. The metaphyseal flare, short distal fragment, and sometimes poor bone stock near the condyles all pose difficulties in achieving stable fixation. In particular, when the medial column is deficient (either due to comminution, defect, or bone loss), a lateral plate alone must resist large bending and varus loads, increasing the risk of varus collapse and plate fatigue failure.

Over the last decade, there has been growing recognition that dual plating, i.e., supplemental medial column support, can enhance construct stability in distal femur fractures at high risk of mechanical failure. Biomechanical studies have repeatedly shown that dual plating yields higher axial stiffness, improved torsional stability, less displacement under load, and reduced incidence of failure compared to lateral only constructs.[1] Anatomical and vascular studies also suggest that medial distal femoral plating is safe with careful technique, given the distance of

the femoral artery from the medial femoral cortex in the distal femur segments.[2]

In cases of metaphyseal voids or medial defects, structural augmentation using fibular strut grafts (autograft or allograft) has been described. The strut graft helps to restore medial column continuity, provide a scaffold for load sharing, fill defect space, and allow better screw purchase. A small series of distal femur fractures treated with fibular strut allograft plus dual locking plates reported union in all patients (mean ~12.6 weeks) without implant failure or wound complications.[3]

Despite increasing adoption, dual plating is not universally used prophylactically, and the optimal timing, plate configuration, plate length, screw strategy, and weight bearing protocols remain matters of active discussion in the orthopedic trauma literature. This case report described a 40-year-old patient with a distal femur extra articular fracture with medial bone loss, whose initial lateral plating failed early, and was salvaged by revision to a long lateral plate, fibular strut graft, and medial plating, with eventual union and good function at one year. We draw lessons on construct planning, rehabilitation protocols, and pitfalls encountered, grounded in the current literature.

CASE REPORT

A 40-year-old male with no significant comorbidities sustained a closed right distal femur fracture in a fall from height. Radiographs demonstrated an extra articular distal femur fracture with significant medial metaphyseal cortical bone loss, creating a defect in the medial column. The distal fragment was sufficiently sized for fixation, and there was no intra articular extension, vascular injury, or soft tissue compromise. (Figure 1).

In the index surgery, open reduction and internal fixation was performed using a lateral locking plate applied in bridge mode. The medial defect was managed with cancellous graft only (Figure 2). The surgeon judged the reduction acceptable in coronal and sagittal planes and advised the patient to not weight bear until told to do so.

However, the patient did not comply with the protocol and started weight bearing immediately. By the end of first week, the patient complained of deformed leg, increasing pain, and radiographs revealed varus collapse of the distal fragment and bending of the lateral plate, signs of mechanical failure (Figure 3). There was no clinical sign of infection: the wound was clean, inflammatory markers (ESR, CRP) were normal, and no drainage or systemic symptoms were present.

Given the early failure, the patient underwent revision surgery. Failed implants were removed, and the fracture edges were debrided. A longer locking plate was selected for the lateral side, extending proximally to increase fixation span. To reconstruct the medial column, an autologous nonvascularized fibular strut graft (harvested from the ipsilateral fibula) was inserted into the medulla, bridging the defect (Figure 4). A contoured medial plate was then applied, converting the construct to dual plating (medial+lateral). Screw placement was optimized, with maximal use of locking screws, and care was taken to avoid conflicts between plating trajectories. Reduction was confirmed under fluoroscopy, with neutral to slight valgus alignment and rotational matching (Figure 5). Closure was done in layers.

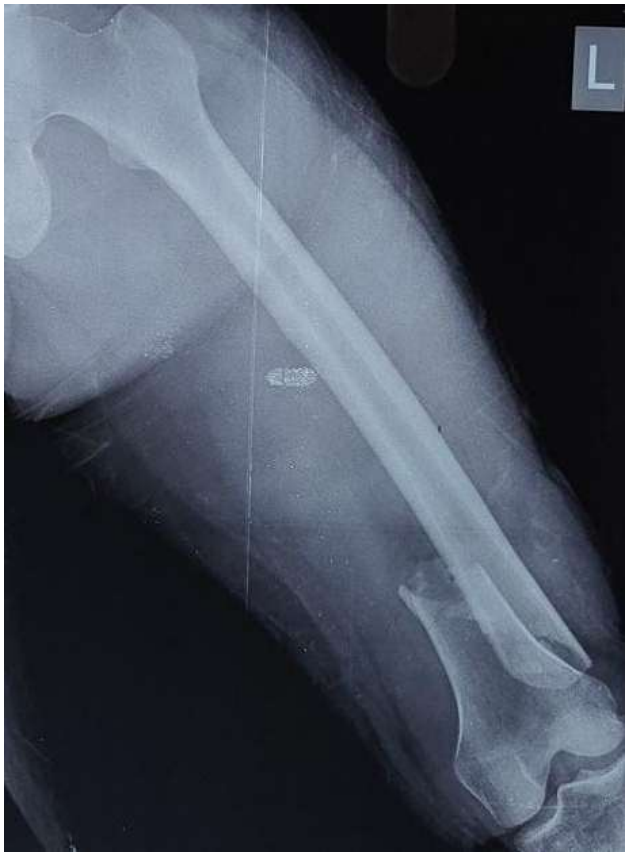

Figure 1: Pre-operative X-ray.

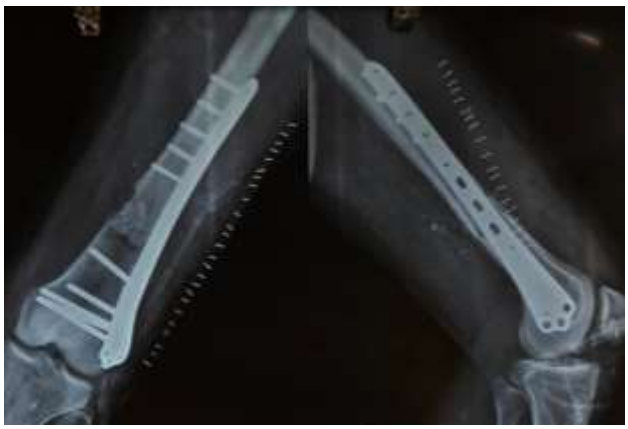

Figure 2: X-ray after index surgery.

Postoperatively, physiotherapy (passive knee motion, isometric quadriceps activation) commenced as per pain tolerance. However, for mechanical protection, the limb

was maintained nil weight bearing for the first three weeks. At three weeks, minimal toe touch loading was permitted. At six weeks, partial weight bearing (crutch assisted) was introduced gradually under close radiographic surveillance. Full weight bearing was allowed at twelve weeks once early callus and stability were confirmed. Periodic radiographs were obtained.

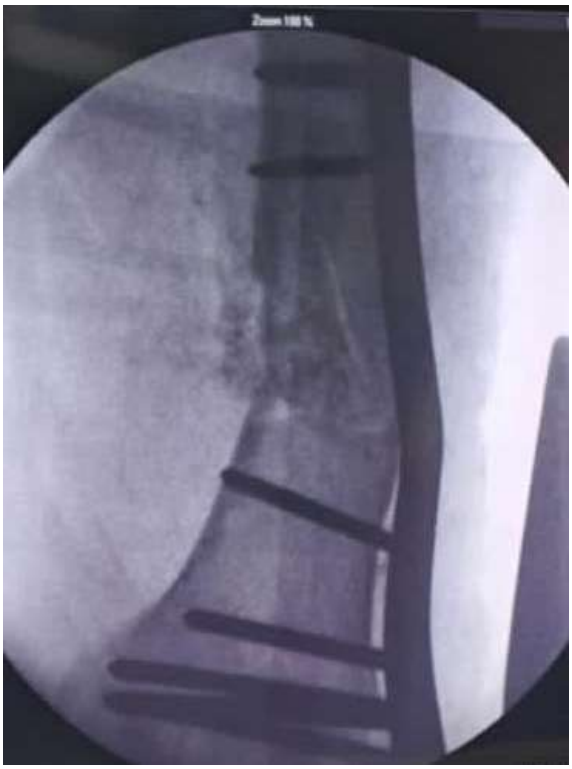

Figure 3: Varus failure.

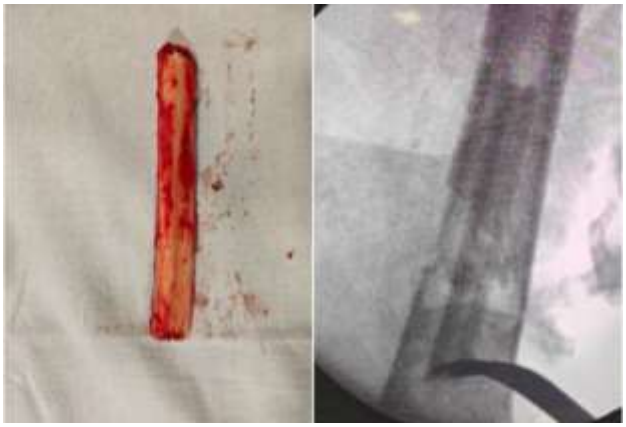

Figure 4: Fibula strut graft harvested and positioned inside medulla.

By 3 months, bridging callus was visible on multiple cortices (Figure 6). Over the ensuing months, the patient progressed in muscle strength and mobility. At one year, he walked independently without pain, had returned to all of his activities of daily living. Clinically the alignment was maintained and there were no signs of infection or failure.

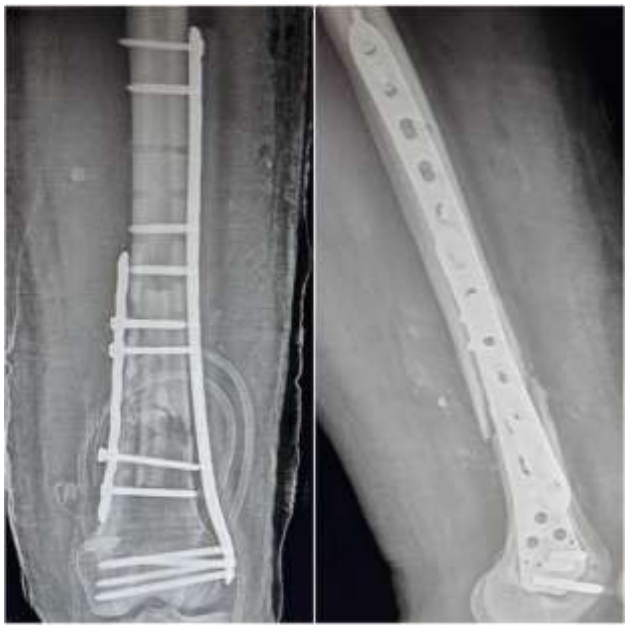

Figure 5: Immediate post-operative X-ray after revision surgery.

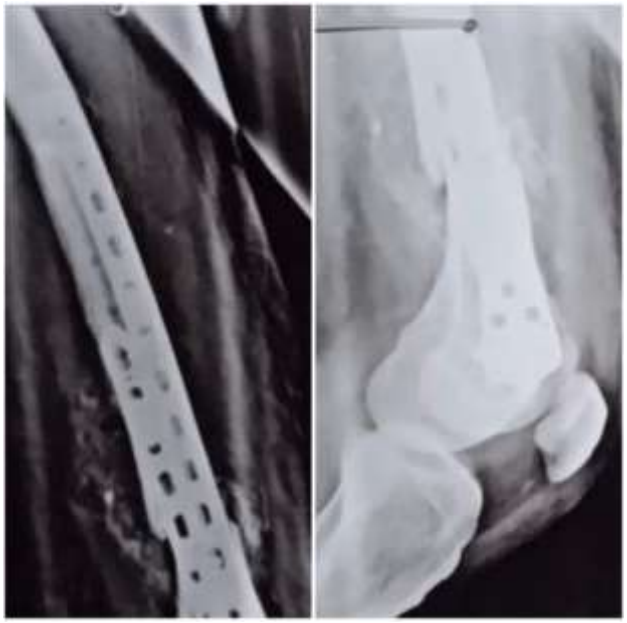

Figure 6: Radiograph at 3 months follow up.

DISCUSSION

The failure in the initial fixation underscores how a lateral only construct in a distal femur fracture with medial bone loss is biomechanically vulnerable. Without a medial support column, the lateral plate must resist all bending and torsional forces, functioning as a beam spanning the defect. When reduction is imperfect or slight varus persists, the load on the plate increases further. Under cyclic loading, especially with early weight bearing, the plate may bend, screws may loosen, and progressive collapse may ensue. This scenario is especially likely when the implant is short, proximal fixation is suboptimal,

or the screw hole ratio is high, concentrating stress on individual components.

Biomechanical investigations have shown that dual plating constructs outperform single lateral plates in terms of axial and torsional stiffness, resistance to displacement, and thresholds of failure under cyclic loading.[1,2] The medial plate acts effectively as a buttress, sharing load, reducing bending moments on the lateral implant, and stabilizing the construct against varus collapse. Anatomical studies support that medial plating in the distal femur is safe with careful surgical technique, avoiding vascular compromise, and respecting soft tissues.[2] In fact, some cadaveric vascular studies show that addition of a medial plate does not significantly worsen vascular risk compared to lateral plating alone.[4]

Clinically, systematic reviews of distal femur fractures treated with dual plating report relatively low rates of nonunion and reoperation (4-8.5 %) and favorable functional outcomes when compared to historical series of lateral-only constructs.[3,5] In meta-analyses, dual plating is associated with faster union, although with somewhat longer operative times, and with no statistically significant increase in complication rates compared to single plating[3]. Many authors advocate dual plating in the presence of medial column defects, compromised bone quality, or other mechanical risk factors.[3,4]

In salvage settings such as this, revision with dual plating and structural grafting can restore alignment, improve mechanical stability, and facilitate union without resorting to more radical interventions such as distal femoral replacement. In our patient, the fibular strut graft bridged the medial void, provided structural support, and improved screw purchase in the medial column. Without graft support, a medial plate alone may hinge on a thin cortical shell and risk screw pullout or micromotion.

Rehabilitation strategy is equally critical. Early loading prior to biologic consolidation may overload the construct, especially in the vulnerable early healing period. In our patient, delaying weight bearing for three weeks allowed early callus formation in a relatively protected environment. Gradual progression to partial and then full weight bearing under radiographic guidance balanced the competing demands of mechanical protection and stimulatory loading for bone healing.

The technical choices in this case-longer plate length, optimized screw density, dual plating, structural grafting, and staged weight-bearing-collectively mitigated the risks inherent to the fracture pattern. Nevertheless, dual plating carries disadvantages: increased surgical time, further dissection, potential soft tissue compromise, and elevated infection risk. Surgeons must judiciously weigh these against expected benefits and plan trajectories to avoid screw interferences. Still, in fractures at high risk of varus collapse due to medial deficiency, the complexity is often justified.

This report was limited by being a single-case description and lacking quantitative biomechanical data or a comparative COHORT. However, the favourable clinical and radiographic outcome supports the biomechanical and clinical principles currently discussed in the literature.

CONCLUSION

This case reinforces that distal femur fractures with medial column deficiency are at elevated risk of fixation failure when managed with lateral plating alone. Mechanical demands in such fracture patterns often exceed the capacity of a solitary lateral plate, especially under early loading or slight malalignment. In such scenarios, surgeons should proactively consider augmenting the medial column via dual plating or structural grafting. In the event of early collapse or hardware failure, a timely revision using a longer lateral plate, supplemental medial plating, and graft support can salvage the construct, promote union, and restore function. Meticulous attention to construct design, screw strategy, alignment, and graduated weight bearing is essential to prevent recurrent failure.

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