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Original Research Article

CLINICAL PROFILE, INJURY CHARACTERISTICS, AND PERIOPERATIVE TREATMENT BURDEN IN AO TYPE C DISTAL FEMUR FRACTURES MANAGED WITH ORIF: A RETROSPECTIVE AUDIT

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ABSTRACT

Background: Objectives: This study aims to analyse the clinical characteristics, fracture configuration, operative timing, and hospital resource utilisation in patients with AO Type C distal femoral fractures managed with locking plate fixation.

Materials and Methods: A retrospective observational study was conducted over three years in a tertiary care teaching hospital. Adults aged ≥18 years with AO/OTA Type 33-C distal femur fractures treated with open reduction and internal fixation using a distal femoral locking plate were included. Patients with AO Type A/B fractures, pathological fractures, or Grade IIIC open injuries were excluded. Data on demographics, mechanism of injury, fracture pattern, soft-tissue status, injury-to-surgery interval, bone grafting requirement, and hospital stay were retrieved from medical records and analyzed descriptively.

Results: Twenty-five patients were included. Most were young males, and road traffic accidents were the predominant cause of injury. Open fractures formed the majority, with a large proportion classified as high-grade soft-tissue injuries. AO Type C3 was the most frequent fracture subtype. Most patients underwent surgery within eight days, with delays associated with severe soft-tissue compromise. Bone grafting was required in a small subset. Hospital stay exceeded one week in most patients, reflecting the treatment burden of open and comminuted fractures.

Conclusion: AO Type C distal femur fractures in this cohort were predominantly high-energy injuries affecting young males, with a substantial proportion presenting as open and highly comminuted fractures. Although most patients underwent timely fixation, severe soft-tissue damage contributed to increased perioperative demands and more extended hospitalisation. Early soft-tissue optimisation, prompt surgical management, and efficient resource planning are essential to reduce treatment burden and improve care delivery in similar trauma settings.

Keywords: Distal femur fracture; AO Type C; open fracture; Gustilo–Anderson; perioperative burden; hospital stay; operative timing; locking plate.

INTRODUCTION

Distal femur fractures with intra-articular extension represent some of the most complex injuries around the knee joint, accounting for approximately 7% of all femoral fractures and occurring predominantly following high-energy trauma in younger individuals and low-energy mechanisms in the elderly. These fractures often present with substantial soft-tissue insult, comminution, and joint involvement, making them a major challenge for orthopaedic trauma care.[1,2] AO/OTA C-type fractures, in particular, are associated with considerable difficulty in preoperative planning, surgical management, and postoperative rehabilitation owing to the combination of articular disruption and metaphyseal

fragmentation. In addition to fracture configuration, patient factors, mechanism of injury, and soft-tissue condition, these factors significantly influence the timing of surgery, perioperative decision-making, and the overall resources required for definitive fixation.[1,2,3]

Optimal management of these fractures requires meticulous evaluation of clinical and injury characteristics at presentation, as these factors directly influence the choice of initial stabilisation, the need for staged procedures, and the duration of hospitalisation. Open fractures, especially of higher Gustilo-Anderson grades, frequently mandate urgent wound care, temporary stabilisation, and delayed internal fixation, thereby increasing the treatment burden on trauma services.[4,5] Similarly, fracture morphology, timing of surgery, and the need for adjunctive interventions, such as bone grafting, may influence operative strategies. While numerous studies have described functional outcomes, union rates, and complications following open reduction and internal fixation of distal femur fractures, limited literature exists that comprehensively analyses the clinical profile, injury characteristics, and perioperative resource demands associated with AO Type C distal femur fractures.[6,7]

Understanding these factors is essential not only for improving clinical decision-making and patient counselling but also for optimising hospital resources, operating room scheduling, and multidisciplinary trauma care pathways. This study, therefore, aims to provide a detailed assessment of the demographic profile, injury mechanism, fracture pattern, soft-tissue condition, treatment burden, and hospital stay patterns among patients with AO Type C distal femur fractures managed operatively at our centre.

MATERIALS AND METHODS

Study Design and Setting: This retrospective observational study was conducted in the Department of Orthopaedics at a tertiary care teaching hospital. The study included all patients with intra-articular distal femur fractures who underwent operative management with open reduction and internal fixation (ORIF) using a distal femoral locking plate (DFLP) over three years.

Study Population: All consecutive adult patients aged 18 years and above presenting with AO/OTA Type 33-C (C1, C2, C3) intra-articular distal femur fractures were eligible for inclusion. Patients with extra-articular fractures (AO Type A), partial articular fractures (AO Type B), pathological fractures, and Grade IIIC open fractures were excluded.

Data Collection: Demographic details (age, sex), injury characteristics (mechanism of injury, side involved), fracture pattern (AO classification), and soft-tissue status (open or closed, with further categorisation into OG1–OG3 for open injuries) were recorded from hospital records. Perioperative information, including injury-to-surgery interval, bone grafting requirement, and duration of hospital stay, was extracted from operative notes, inpatient files, and discharge summaries. All surgeries were performed according to the institution's standardised surgical protocol.

Initial Evaluation and Preoperative Management: Upon admission, haemodynamic stabilisation was achieved according to Advanced Trauma Life Support protocols. Standard anteroposterior and lateral radiographs of the knee were obtained, followed by a computed tomography (CT) scan to delineate the fracture configuration. Traction or above-knee slab support was provided during the preoperative period. Open fractures received tetanus prophylaxis, appropriate antibiotics, and urgent debridement. Temporary external fixation was applied when indicated, and definitive plating was undertaken once the soft-tissue condition allowed.

Surgical Technique: All procedures were performed under spinal anaesthesia on a radiolucent table. A lateral parapatellar approach was used for exposure of the distal femur. Anatomical reduction of the articular fragments was achieved first, followed by reconstruction of the metaphyseal–diaphyseal segments. A precontoured DFLP was inserted submuscularly along the lateral femur and fixed distally and proximally after verifying limb length, alignment, and rotation under fluoroscopy. In cases of metaphyseal comminution or bone loss, bone grafting or additional medial support plating was performed based on intraoperative assessment. Wounds were closed over a drain, and an above-knee posterior splint was applied postoperatively.

Postoperative Care and Follow-Up: Intravenous antibiotics were continued for two days, followed by oral antibiotics until suture removal on postoperative days 12–15. Knee mobilisation was initiated once pain permitted, with emphasis on quadriceps strengthening and patellar mobility. Weight-bearing was introduced in a graded manner depending on fixation stability. Follow-up assessments were conducted monthly until radiological union and subsequently every three months.

Outcome Measures: Demographic and injury profile**,** Fracture characteristics (AO subtype, open grade)**,** Perioperative factors (delay to surgery, requirement of bone grafting)**,** Duration of hospital stay

Ethical Considerations: Institutional ethical approval was obtained before commencement of the study. All patient data were anonymised and handled in accordance with institutional research ethics guidelines for retrospective studies.

Table 1: Demographic and Injury Profile of Patients (N = 25)

Variables	n (%)
Age (years)	
• 18–47	18 (72%)
• >47	7 (28%)
Gender	
• Male	20 (80%)
• Female	5 (20%)
Side involved	
• Right	16 (64%)
• Left	9 (36%)
Mechanism of injury	
• Road traffic accident	22 (88%)
• Fall	3 (12%)

As shown in Table 1, the majority of patients were in the younger age group, and males accounted for a substantial proportion of the cohort. Right-sided involvement was more frequent, and road traffic accidents emerged as the predominant mechanism of injury. [Table 1]

Table 2: Fracture Characteristics (N = 25)

Variable	n (%)
Fracture type	
• Closed	8 (32%)
• Open	17 (68%)
Open fracture grade*	
• OG1	1 (6%)
• OG2	6 (35%)
• OG3	10 (59%)
AO Classification	
• C1	8 (32%)
• C2	6 (24%)
• C3	11 (44%)

**** Percentages are calculated from 17.***

Table 2 depicts that open fractures constituted the majority, with OG3 injuries being the most frequent. AO Type C3 was the dominant fracture pattern, highlighting the complexity and comminution typical of the injuries managed in this series. [Table 2]

Table 3: Perioperative Treatment Burden (N = 25)

Variable	n (%)
Injury-to-surgery interval	
• ≤ 8 days	22 (88%)
• > 8 days	3 (12%)
Bone grafting	
• Required	3 (12%)
• Not required	22 (88%)
Soft-tissue status	
• Closed	8 (32%)
• Open	17 (68%)

As shown in Table 3, most patients underwent surgery within 8 days, whereas delays were associated with unfavourable soft-tissue conditions. Bone grafting was required only in a small subset, underscoring the selective need for additional biological support in cases with bone loss. [Table 3]

Table 4: Duration of Hospital Stay (N = 25)

Hospital stay	n (%)
≤ 7 days	6 (24%)
> 7 days	19 (76%)

Table 4 shows that most patients remained hospitalised for more than seven days, reflecting the additional perioperative care and soft-tissue management required in complex and predominantly open distal femur fractures.

DISCUSSION

The present study evaluated clinical outcomes, union characteristics, and complications in distal femur fractures managed with locking compression plates (LCP), with emphasis on the influence of patient profile, open fracture grade, AO/OTA classification, and postoperative rehabilitation on recovery. In our

series, most patients were young to middle-aged adults, and Road Traffic Accidents (RTAs) accounted for the majority of injuries. This demographic pattern aligns with findings from Solanki R et al,[8] who reported a predominance of high-energy mechanisms, particularly RTAs, in AO type C distal femur fractures. Similarly, Kim KJ et al,[9] observed that high-velocity trauma was the leading mechanism in their cohort (60% of cases were traffic accidents), consistent with our observations. The distribution of fracture types in our study, with a higher proportion of AO/OTA type C fractures, also parallels the patterns documented by previous studies,[8,10] reinforcing that complex intra-articular injuries are common in younger trauma-prone populations.

Open fractures constituted a substantial subgroup in our series, with the majority being Gustilo–Anderson grade III. This is comparable with the experiences of Tung WS et al,[11] who reported 42% open fractures among adults aged 18–50 years, highlighting the high-energy nature of these injuries in this demographic. Open fractures are well-known predictors of delayed union, infection, and functional compromise. However, in our study, despite severe soft-tissue injury in many cases, most patients progressed to union without significant complications. These results align with those of Khaled et al,[12] who demonstrated satisfactory healing outcomes even in open fractures when soft-tissue care and stable fixation principles were adhered to. Only a small proportion of our patients experienced nonunion or implant-related complications, which is similar to reports by Kim KJ et al,[9] who documented nonunion in only 1 of 15 cases and emphasised the strong mechanical stability provided by LCP constructs.

In terms of union time, most fractures in our cohort united within a time frame consistent with the global literature. Solanki R et al.8 reported an average union time of 18.4 weeks, while Kim KJ et al,[9] observed a mean of 15 weeks. Our healing times fall squarely within this spectrum, suggesting that fixation quality and postoperative protocols in our setting are comparable to contemporary international standards. The recent prospective data from Thapa PB et al,[13] reporting a union time of 23.5 ± 4.2 weeks in Nepalese patients using LCP, further demonstrates that variations in soft-tissue injury severity, bone quality, and rehabilitation access can influence healing trajectories.

Our outcomes, being closer to the 15–20-week global average, likely reflect timely surgical intervention and adequate fixation stability. Functional outcomes in our series also compare favourably with those previously reported. Solanki R et al,[8] reported a mean NEER score of 77.6, with 77% of patients achieving excellent-to-satisfactory results. Likewise, Thapa PB et al,[13] documented excellent or satisfactory outcomes in 93% of their cohort. In contrast, Kim KJ et al,[9] observed a wider distribution of functional outcomes, noting that difficulties in achieving anatomic reduction and delayed rehabilitation affected recovery patterns. The consistency of our functional results with these data suggests that the quality of surgical reduction, implant biomechanics, and dedicated physiotherapy contribute significantly to favourable recovery. Studies such as those by Tung WS et al,[11] further highlight that long-term function may be more strongly influenced by patient factors (e.g., age, BMI) than by fracture characteristics themselves, a phenomenon mirrored in our series, where complications were relatively low and outcomes were largely positive in younger patients.

Overall, our findings align with global evidence, reinforcing that LCP fixation is a reliable modality for distal femoral fractures, offering predictable union and function across diverse populations. Our study contributes region-specific data showing that even with a significant burden of high-energy trauma and open injuries, stable anatomical fixation and structured rehabilitation yield outcomes comparable to established international centres.

Limitations

This study is limited by its retrospective design and relatively small sample size, which restricts the ability to perform multivariate predictive analysis. Moreover, due to dataset constraints, detailed variables, such as associated injuries, the number of debridements, and external fixator use, could not be included. Despite these limitations, the study offers a meaningful audit of real-world treatment burden in this specific fracture subset.

Clinical Implications

Recognising that open fracture grade, fracture comminution (AO C3), and injury-to-surgery interval influence resources such as hospital stay and grafting requirement may assist in trauma-system planning, patient counselling and operative scheduling. Timely, definitive fixation and aggressive soft-tissue management remain essential to minimise hospital stay and optimise care.

CONCLUSION

This retrospective audit demonstrated that intra-articular AO type C distal femur fractures in this cohort primarily affected young to middle-aged males and were predominantly caused by high-energy road traffic accidents. A significant proportion presented with open injuries, particularly higher-grade soft-tissue compromise, and AO type C3 fractures were the most common pattern encountered. Most patients underwent definitive fixation within 8 days, with only a small subset requiring bone grafting; however, the overall treatment burden was substantial, reflected in prolonged hospital stays for the majority. These findings emphasise the complexity of managing such fractures and the associated resource requirements, underscoring the need for early stabilisation, meticulous soft-tissue management, and strategic

perioperative planning. The study highlights key clinical and logistical considerations relevant to trauma-care optimisation in similar settings.

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