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Case Series

Functional recovery and quality of life after surgical fixation of segmental femoral shaft fractures: a case series from India

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ABSTRACT

Segmental femoral shaft fractures, which are often a result of high-energy trauma, pose significant challenges in management and rehabilitation. This case series presents twelve male patients (mean age 40 years, range 28-52) with segmental femoral shaft fractures treated between October 2022 and March 2023 at tertiary care centers in Tamil Nadu, India. Surgical fixation methods included intramedullary interlocking nails (58.3%), locking plates (25%), and other constructs (16.7%), with all patients undergoing open reduction. Functional recovery and quality of life were assessed using WOMAC, EQ-5D-3L, and SMFA scores at 1, 3, and 6 months postoperatively. Significant improvements were observed across all measures, with mean WOMAC scores decreasing from 55.6 (±6.5) to 18.2 (±5.9), EQ-5D-3L scores improving from 0.62 (±0.10) to 0.91 (±0.06), and SMFA dysfunction index decreasing from 41.4 (±5.3) to 12.6 (±3.9) over six months. Radiological union was achieved in 33.3% of cases at 3 months and in all remaining eleven patients (one lost to mortality from associated injuries) by 6 months, with a mean union time of 23.7 weeks. This case series demonstrates that appropriate surgical fixation of segmental femoral shaft fractures can yield favorable functional outcomes and quality of life improvements, with complete radiological union achievable within six months in this challenging fracture pattern.

Keywords: Femoral shaft fractures, Functional recovery, Intramedullary nailing, Locking plates, Segmental fractures

INTRODUCTION

Segmental femoral shaft fractures are complex injuries often resulting from high-energy trauma, typically seen in young males between the second and fourth decades of life.[1] These fractures are frequently associated with extensive soft tissue damage and additional traumas, such as craniocerebral, chest, or abdominal injuries.[2] From presentation to postoperative rehabilitation, managing these fractures presents various challenges.[3] Initial assessment should rule out vascular, head, chest, or abdominal injuries, and ensure hemostatic control. Surgery timing, implant choice, and reduction sequence are crucial.[4,5] Intraoperatively, the reduction method must be adapted to the fracture's displacement while preserving surrounding soft tissues to prevent further damage and promote healing.[6] Complications like delayed union, malunion, nonunion, infections, pulmonary embolism, compartment syndrome, fat embolism, and joint stiffness may arise despite stable fixation.[7] These complications can lead to increased revision rates and hinder recovery.[8-11] Therefore, managing segmental fractures requires careful preoperative planning, addressing potential complications, and overcoming intraoperative challenges.[12]

CASE SERIES

From October 2022 to March 2023, 12 male patients with segmental femoral shaft fractures presented to our institutions in Tamil Nadu, India. The mean age was 40

years (range: 28-52 years). 50% (6 patients) were manual laborers, 33.3% (4 patients) were drivers, 8.3% (1 patient) was a street food vendor, and 8.3% (1 patient) was unemployed. All fractures resulted from high-energy trauma, primarily road traffic accidents.

Associated injuries were present in 16.7% of cases: one patient (8.3%) had other fractures, and one patient (8.3%) had abdominal trauma who later succumbed to these injuries. 66.6% (8 patients) were closed and 33.3% (4 patients) were open. Details of patient demographics, fracture characteristics, surgical treatment, and functional outcomes are shown in Table 1.

All patients presented with pain, swelling, and inability to bear weight following high-energy trauma. Initial management included a thorough clinical assessment, radiographic evaluation, and ruling out of associated life-threatening injuries. Surgery was performed within 24 hours of injury in 91.6% (11 patients) of cases, with one patient (8.3%) receiving surgery after 24 hours due to delayed presentation.

Despite initial attempts to employ closed reduction techniques, open reduction was ultimately necessary for all patients due to the complexity of fracture reduction and to minimize the risk of additional soft tissue damage. Various implants were used for fixation based on fracture pattern, bone quality, and surgeon preference: 58.3% (7 patients) received intramedullary interlocking nails (Figure 1), 8.3% (1 patient) received a long proximal femoral nail A2 (Figure 2), 25% (3 patients) were treated with locking plates, and 8.3% (1 patient) had a locking plate followed by a nail-plate construct after a fall.

Postoperative management included standardized rehabilitation protocols, pain management, and thromboprophylaxis. Patients were followed up at 1, 3, and 6 months postoperatively.

Functional outcomes were assessed using the Western Ontario and McMaster Universities Arthritis Index (WOMAC) questionnaire for pain, stiffness, and physical function, the EuroQol 5-Dimension 3-Level (EQ-5D-3L) for health-related quality of life, and the short musculoskeletal function assessment (SMFA) for musculoskeletal function.[13-15]

The mean WOMAC score showed significant improvement, decreasing from 55.6 (±6.5) at 1 month to 32.8 (±7.1) at 3 months, and further to 18.2 (±5.9) at 6 months ($p<0.001$). Quality of life, assessed using EQ-5D-3L, improved from a mean score of 0.62 (±0.10) at 1 month to 0.78 (±0.08) at 3 months, and 0.91 (±0.06) at 6 months ($p<0.001$).

Musculoskeletal function, measured by the SMFA dysfunction index, improved from 41.4 (±5.3) at 1 month to 26.2 (±4.8) at 3 months, and 12.6 (±3.9) at 6 months ($p<0.001$). Similarly, the SMFA bother index decreased from 36.8 (±4.7) at 1 month to 22.4 (±4.3) at 3 months, and 10.2 (±3.2) at 6 months ($p<0.001$).

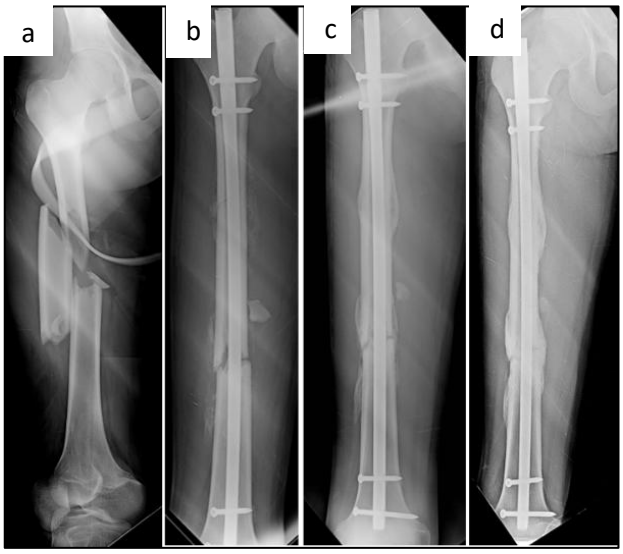

Figure 1: Radiographs demonstrating fracture union, with plain anteroposterior X-rays of the femur (a) at the time of presentation, (b) at 1 month, (c) at 3 months, and (d) at 6 months post-operatively. The fracture was stabilized using an intramedullary interlocking nail (IMIL).

Figure 2: Radiographs demonstrating fracture healing and implant positioning, with plain anteroposterior X-rays of the pelvis with both hips (a) at the time of injury, (b) at 1 month, (c) at 3 months, and (d) at 6 months post-operatively, and femur X-rays (e) at the time of presentation, (f) at 1 month, (g) at 3 months, and (h) at 6 months post-operatively. The fracture was stabilized using a long proximal femoral nail (PFN). Progressive callus formation and fracture union are evident over the follow-up period.

Radiological assessment was done using anteroposterior and lateral views of the femur at each follow-up visit. Radiological union was observed in 33.3% of cases at the 3-month follow-up, and all patients who completed the study (11 patients) achieved union by 6 months without requiring additional interventions. The average time to union was 23.7 weeks (range: 22-24 weeks).

One patient succumbed to associated abdominal injuries during the follow-up period. No other mortality was reported. None of the patients developed implant failure, non-union, malunion, or infection during the follow-up period. Functional outcomes at 6 months indicated that all patients who completed follow-up had returned to their daily activities with minimal to no pain and significantly improved quality of life. The patients are currently being followed up as per our institutional protocol to assess long-term outcomes and detect any late complications.

Table 1: Case series summary-Table depicting patient demographics, pathology, surgical management, and outcomes following surgical fixation of segmental femoral shaft fractures.

Patient	Age	Occupation	Fracture type	Associated injury	Fixation method	WOMAC Score (1 month/3 months/ 6 months)	EQ-5D-3L (1 month/3 months/6 months)	SMFA Dysfunction Index (1 month/3 months/6 months)	Union Time (weeks)
1	28	Driver	Open	None	IMIL nail	49/24/10	0.75/0.85/1.00	35/19/8	24
2	32	Laborer	Closed	None	IMIL nail	53/30/16	0.65/0.80/0.92	40/25/12	24
3	35	Driver	Closed	None	IMIL nail	52/31/18	0.60/0.75/0.90	39/24/11	23
4	38	Laborer	Open	None	Long PFNA2	65/40/28	0.48/0.65/0.85	49/31/20	24
5	40	Vendor	Closed	None	IMIL nail	55/33/18	0.60/0.80/0.92	42/26/12	23
6	42	Driver	Open	Other Fractures	IMIL nail	58/35/20	0.58/0.75/0.88	43/28/14	24
7	44	Laborer	Closed	None	Locking plate	54/32/17	0.62/0.78/0.90	41/25/12	24
8	45	Unemployed	Closed	None	IMIL nail	50/26/12	0.70/0.82/0.95	38/23/10	22
9	48	Laborer	Closed	None	Locking plate	57/36/22	0.56/0.74/0.88	44/29/15	24
10	50	Driver	Closed	None	IMIL nail	54/32/16	0.62/0.80/0.92	40/24/11	23
11	52	Laborer	Open	None	Locking plate	65/38/24	0.50/0.70/0.86	48/30/18	24
12*	42	Laborer	Closed	Abdominal trauma	Locking plate+nail	54/-/-	0.60/-/-	40/-/-	-

IMIL=Intramedullary Interlocking; PFNA2 = Proximal Femoral Nail Antirotation-2, *Patient 12 did not complete follow-up as he succumbed to his abdominal injuries.

DISCUSSION

Segmental femoral shaft fractures, caused by high-energy trauma, present challenges from stabilization to rehabilitation. Our study showed a male predominance (100%), consistent with previous research, Dave et al reported 73.3%, Liu et al, 71.7%, and Wu et al a 3:1 male-to-female ratio. Road traffic accidents were the primary injury mechanism, common across all reviewed studies.[3,6,12]

The mean age of our patients was 40 years, slightly older than those of Dave et al (35.85 years) and Liu et al (37.8 years).[3,6] Wu et al, reported a wider age range of 19–81 years. Occupationally, manual laborers comprised 50% of our patients, with drivers accounting for 33.3%, and street food vendors and unemployed each representing 8.3%, which was not reported in other studies.[3,6,12] Associated injuries in our cohort included fractures (8.3%) and abdominal trauma (8.3%). Liu et al reported a wider range of injuries, while Dave et al and Wu et al did not specify.[3,6,12] In our study, 66.6% of fractures were closed, and 33.3% open, similar to Dave et al (76.7% closed, 23.3% open) and Liu et al (72.2% closed, 27.8% open).[3,6] All patients in this case series required open reduction. Dave et al, reported 22% with open nailing, while Liu et al used a combined plating and nailing approach.[3,6] Implant choices in our study were based on fracture patterns and surgeon preference: 58.3% intramedullary interlocking nails, 8.3% long proximal femoral nail A2, 25% locking plates, and 8.3% had a locking plate followed by a nail-plate construct after a fall.

Functional outcomes, assessed using WOMAC, EQ-5D-3L, and SMFA scores, showed significant improvements over 6 months. WOMAC scores decreased from 55.6 to 18.2, EQ-5D-3L improved from 0.62 to 0.91, and SMFA indices reflected enhanced musculoskeletal function and quality of life ($p < 0.001$). Dave et al used Harris hip and knee society scores, reporting 54% with excellent outcomes, while Liu et al and Wu et al did not evaluate functional recovery.[6] Notably, ours was the only study in the literature review to assess functional outcomes following segmental femur fractures involving the shaft.

Radiological union was observed in 33.3% of patients at 3 months and 100% at 6 months, with an average time to union of 23.7 weeks. No interventions were required. Dave et al reported an 82% union rate at 4 months, with non-unions managed by dynamization and cancellous bone

grafting.[6] Liu et al, had a shorter healing time (18.9 weeks) due to their use of nail-plate constructs. Wu et al had a 78.6% union rate, with 21.4% requiring dynamization or bone grafting.[3,12] Cho et al, studying fragmentary segmental fractures, reported higher non-union rates (27%) due to severe soft tissue damage and alignment issues.[7] Our superior union rates might be attributed to careful soft tissue handling, stable fixation techniques, and appropriate post-operative protocols.

The early surgical intervention in 91.6% of our cases, combined with our choice of implants and surgical technique, may have contributed to the favorable outcomes observed in our study. These results suggest that a standardized approach to timing, implant selection, and surgical technique could optimize outcomes in segmental femoral fractures. Furthermore, our comprehensive functional assessment provides valuable insights into the recovery timeline, which can help in patient counseling and rehabilitation planning.

The study's primary limitation is its small sample size and single-center design, affecting generalizability. Variations in fracture patterns, implant choices, and the short follow-up period also limit the analysis. Larger cohorts and longer follow-up periods would provide more robust insights.

CONCLUSION

Optimized treatment of segmental femoral shaft fractures depends on proper timing, implant selection, and surgical technique, which when paired with standardized postoperative care and rehabilitation, significantly enhance functional recovery and quality of life. While these fractures present challenges in reduction that may necessitate open reduction, individualized implant selection and multidisciplinary management can effectively achieve radiological union within six months, demonstrating the value of a tailored treatment approach.

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REFERENCES

1. Babalola OM, Ibraheem GH, Ahmed BA. Open intramedullary nailing for segmental long bone fractures: an effective alternative in a resource-restricted environment. Niger J Surg. 2016;22(2):90-5.
2. Kempf I, Grosse A, Beck G. Closed locked intramedullary nailing: its application to comminuted fractures of the femur. J Bone Joint Surg Am. 1985;67(5):709-20.
3. Liu H, Wu J, Lin D. Results of combining intramedullary nailing and plate fixation for treating segmental femoral fractures. ANZ J Surg. 2023;11:15050.
4. Winquist RA, Hansen ST, Clawson DK. Closed intramedullary nailing of femoral fractures: a report of five hundred and twenty cases. J Bone Joint Surg Am. 1984;66(4):529-39.
5. Millar MJ, Brown SB, Irish SE. Nail fit: does nail diameter to canal ratio predict the need for exchange nailing in the setting of aseptic, hypertrophic femoral nonunions. J Orthop Trauma. 2018;32(5):245-50.
6. Dave DS, Patel HN, Ashwin KK. Study of results of intramedullary nailing in segmental fracture femur. Natl J Clin Orthop. 2020;4(1):42-5.
7. Cho WT, Jang JH, Park SR. Radiographic outcomes and non-union factor analysis in fragmentary segmental femoral shaft fractures (AO/OTA 32C3) treated with reamed antegrade nailing. Sci Rep. 2024;14(1):8364.
8. Quan K, Xu Q, Zhu M, Liu X, Dai M. Analysis of risk factors for non-union after surgery for limb fractures: a case-control study of 669 subjects. Front Surg. 2021;8:754150.
9. Pihlajamaki HK, Salminen ST, Bostman OM. The treatment of nonunions following intramedullary nailing of femoral shaft fractures. J Orthop Trauma. 2002;16(7):394-402.
10. Zura R, Xiong Z, Einhorn T. Epidemiology of fracture non-union in 18 human bones. JAMA Surg. 2016;151(11):162775.
11. Jensen SS, Fenton P, Moroney P. Risk factors for nonunion following surgically managed, traumatic, diaphyseal fractures: a systematic review and meta-analysis. EFORT Open Rev. 2022;7(1):516-25.
12. Wu CC, Chen WJ. Healing of 56 segmental femoral shaft fractures after locked nailing: poor results of dynamization. Acta Orthop Scand. 1997;68(6):537-40.
13. Bellamy N, Buchanan WW, Goldsmith CH, Campbell J, Stitt LW. Validation study of WOMAC: a health status instrument for measuring clinically important patient relevant outcomes to antirheumatic drug therapy in patients with osteoarthritis of the hip or knee. J Rheumatol. 1988;15(12):1833-40.
14. Rabin R, de Charro F. EQ-5D: a measure of health status from the EuroQol Group. Ann Med. 2001;33(5):337-43.
15. Swiontkowski MF, Engelberg R, Martin DP, Agel J. Short musculoskeletal function assessment questionnaire: validity, reliability, and responsiveness. J Bone Joint Surg Am. 1999;81(9):1245-60.

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