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Clinical, functional and radiological outcome of retrograde femoral nailing in femoral shaft fractures: an observational study

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ABSTRACT

Background: Femoral shaft fractures require prompt and effective management to prevent long-term disability. Retrograde intramedullary nailing (RIMN) offers a reliable alternative to antegrade nailing, particularly when proximal access is limited. This study evaluates the clinical, functional, and radiological outcomes of RIMN to inform optimal fracture management.
Methods: An ambispective observational study was conducted at the Asian Orthopaedic Institute, SIMS Hospital, Chennai, from February 2023 to February 2024. A total of 38 patients with femoral shaft fractures treated using RIMN were included. Functional outcomes were assessed using the lower extremity functional scale (LEFS), pain using the Visual Analogue Scale (VAS), and radiological outcomes based on time to union. All patients were operated on by the same surgeon and followed for six months postoperatively.
Results: The mean age was 42.3±0.9 years, with a female predominance (55%). Slip and fall was the most common cause (53%), and A1-type fractures were most frequent. The mean time to union was 14.5±4.4 weeks. LEFS scores improved from 23.76 to 63.29, VAS scores declined from 4.95 to 0.34, and knee ROM increased from 77.37° to 112.63° ($p<0.001$). One malunion was reported; no other complications occurred. No significant association was found between demographic variables and time to union.
Conclusion: RIMN is a safe and effective treatment for femoral shaft fractures, enabling early mobilization and favourable clinical outcomes.

Keywords: Femoral shaft fractures, Retrograde femoral nailing, Functional & radiological outcome

INTRODUCTION

A femur fracture is among the most frequently occurring fractures, and if not managed appropriately, it can result in severe long-term disability or even life-threatening complications.[1] Femoral shaft fractures are common orthopaedic injuries, typically caused by high-energy trauma, including motor vehicle collisions or falls from significant heights.[2] If not properly managed, these fractures can result in significant morbidity, highlighting the need for effective treatment strategies. Managing femur fractures often involves a multidisciplinary approach that considers underlying medical conditions while ensuring appropriate surgical stabilization, early mobilization, and rehabilitation. This comprehensive care strategy is essential for restoring functional mobility and promoting early independence.[3,4] A delay in appropriate surgical treatment is linked to a higher risk of complications and increased mortality rates.[5,6]

Intramedullary nailing (IMN) is now the standard treatment for femoral shaft fractures, boasting high union rates of approximately 97%. This technique offers several advantages, including minimally invasive application, stable fracture fixation, quicker procedural execution, and early patient mobilization, all of which contribute to improved recovery outcomes.[7,8]

However, factors such as nail design, the presence of grooves, the number and positioning of locking screws, the distance from the fracture site, and bone quality can significantly impact the implant's resistance to various mechanical forces.[9,10] Despite the benefits of intramedullary nailing (IMN), several challenges remain, including the risk of soft tissue damage, increased fluoroscopy exposure, extended operative duration, and difficulties in distal locking screw placement.[11,12]

Given the complexity of femoral shaft fractures and the need for optimal fixation methods, retrograde intramedullary nailing (RIMN) has emerged as a valuable alternative to antegrade nailing, particularly in cases where proximal femoral access is challenging or contraindicated. This technique offers several advantages, including preservation of the hip abductors, reduced risk of iatrogenic injury to the femoral head, and improved suitability for patients with multiple injuries or ipsilateral hip and knee pathologies.

However, its clinical efficacy must be evaluated in terms of functional recovery, complication rates, and radiological outcomes to determine its role in contemporary fracture management. Hence this study aimed to assess the clinical, functional, and radiological outcomes of retrograde femoral nailing in the treatment of femoral shaft fractures.

METHODS

This prospective observational study was conducted over a period of one year at the Asian Orthopaedic Institute, SIMS Hospitals. The study included patients diagnosed with femoral shaft fractures, selected using consecutive sampling, resulting in a total sample size of 38. Patients aged above 18 years, of either sex, with clinically and radiologically confirmed femoral shaft fractures were included. Open fractures classified as type I, II, IIIA, and IIIB according to the Gustilo-Anderson classification, patients fit for surgery, and those willing to participate were eligible for inclusion. Patients were excluded if they were below 18 years of age, unwilling to participate, unfit for surgery or anaesthesia, or had type IIIC compound femoral fractures.

All patients underwent surgery using the retrograde technique, with procedures performed by a single senior orthopaedic trauma surgeon. A Smith and Nephew retrograde nail was used in all cases, following the manufacturer's operative technique and using appropriate instruments. Postoperatively, patients were followed up at 2 weeks, 6 weeks, 3 months, and 6 months. At each follow-up, clinical and radiological assessments were conducted.

Radiological evaluation involved anteroposterior and lateral X-rays of the operated limb, while clinical assessments included evaluation of pain, range of motion, time to weight-bearing, and return to work. Pain was measured using the visual analogue scale (VAS), and functional outcomes were assessed subjectively using the lower extremity functional scale (LEFS).

Data were entered in Microsoft Excel and analysed using SPSS version 21.0. Descriptive statistics, including frequency and proportion for categorical variables and mean with standard deviation for quantitative variables, were used. Repeated Measures ANOVA was used to assess overall changes in outcome measures (such as VAS and LEFS scores) across multiple time points. Additionally, paired t-tests were performed for specific time-point comparisons. A p value of less than 0.005 was considered statistically significant.

RESULTS

Table 1 summarizes the demographic and clinical characteristics of the study participants. The majority of patients (36.8%) were aged between 61 and 80 years, followed by 31.6% in the 41–60 years age group, 21.1% in the 20–40 years group, and 10.5% were above 80 years. Female patients (55%) slightly outnumbered male patients (45%). Regarding the side of injury, fractures were distributed almost equally between the left (50%) and right (47%) femur, with one patient (3%) having bilateral fractures. Slip and fall was the most common mode of injury (53%), followed closely by road traffic accidents (47%). According to the AO fracture classification, 44.7% of patients had Type A1 fractures, 28.9% had Type A2, and 26.3% had Type A3 fractures.

Table 1: Demographic distribution among study participants.

Characteristics	Frequency	%
Age (in years)		
20-40	8	21.1
41-60	12	31.6
61-80	14	36.8
>80	4	10.5
Gender		
Male	17	45
Female	21	55
Side distribution		
Left	19	50
Right	18	47
Bilateral	1	3
Mode of injury		
Slip and fall	20	53
RTA	18	47
Type of fracture		
A1	17	44.7
A2	11	28.9
A3	10	26.3

In Table 2, the mean operative time among the study participants was 120.26 minutes with a standard deviation of 59.97 minutes, indicating variability in surgical duration. Similarly, the mean duration of hospital stay was 9.16 days with a standard deviation of 7.91 days.

Table 2: Mean operative time and duration of hospital stay among study participants.

Characteristics	Mean	Standard deviation
Operative time	120.26	59.966
Hospital stay	9.16	7.907

In Figure 1, the data illustrates the time of union among participants with a mean Time of Union of 14.53 weeks ±4.4. The majority of participants reaching union at various time intervals where, 20 participants achieved union within 12 weeks, 9 participants within 16 weeks, 6 participants within 20 weeks, and 2 participants within 24 weeks.

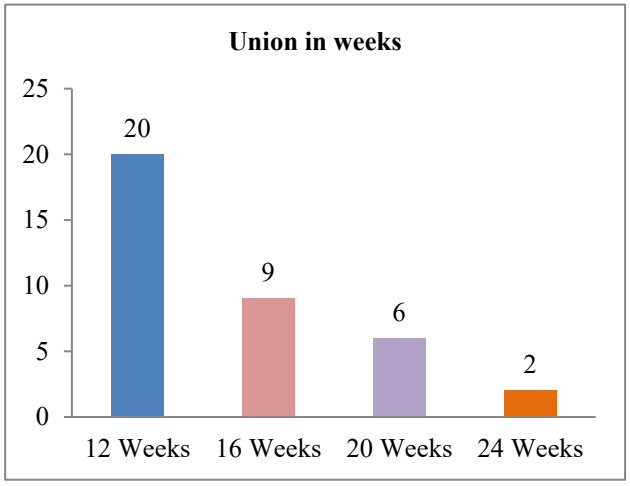

Figure 1: Distribution of time of union in weeks of study participants (n=37).

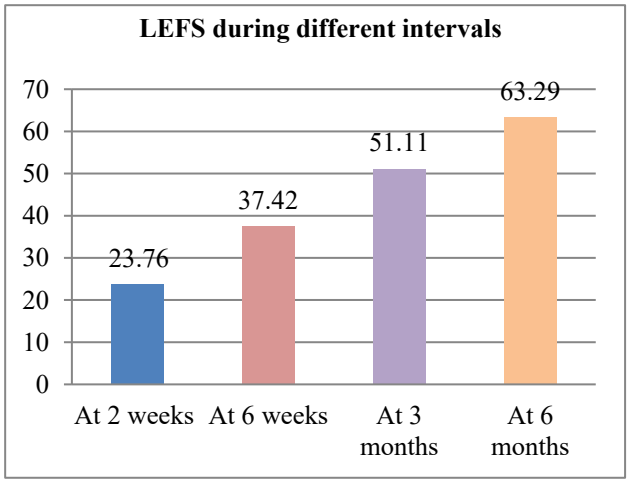

Figure 2: Mean LEFS during different intervals among study participants.

In Figure 2, the mean lower extremity functional scale (LEFS) scores at different time intervals indicate a progressive improvement in functional outcomes among the study participants. At 2 weeks, the mean LEFS was 23.76 (SD ±4.14), which increased to 37.42 (SD ±7.17) at 6 weeks. By 3 months, the mean score further improved to 51.11 (SD ±8.41), and at 6 months, it reached 63.29 (SD ±8.80).

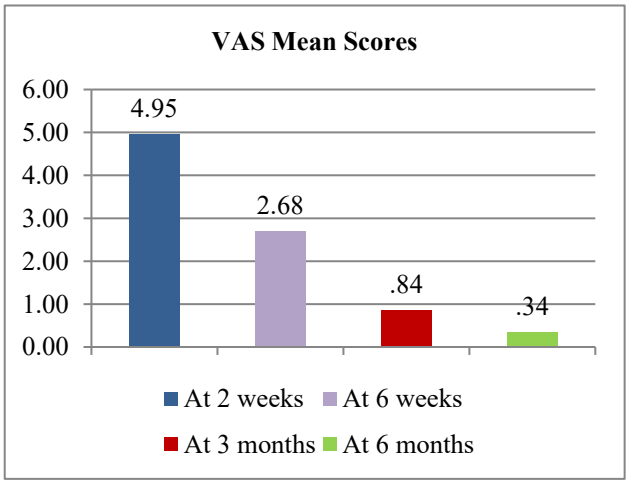

Figure 3: Mean VAS score during different intervals among study participants.

Table 3 compares the mean LEFS scores at different intervals using a paired t-test. At 2 weeks, the mean LEFS score was 23.76±4.14, which significantly increased to 37.42±7.16 at 6 weeks (t=19.987, p=0.000). Further improvement was observed at 3 months, with a mean score of 51.11±8.41 (t=21.171, p=0.000), and at 6 months, the mean score reached 63.29±8.80. The p values for all comparisons were less than 0.05, indicating statistically significant improvements in the LEFS scores at each interval.

In Figure 3, the mean visual analog scale (VAS) scores at different time intervals demonstrate a gradual reduction in pain among the study participants. At 2 weeks, the mean VAS score was 4.95 (SD±1.04), which decreased to 2.68 (SD±0.99) at 6 weeks. By 3 months, the mean score further declined to 0.84 (SD±0.82), and at 6 months, it reached 0.34 (SD±0.48). This steady decrease in pain levels over time suggests significant pain relief and recovery following retrograde femoral nailing.

Table 4 compares the mean VAS scores at different intervals using a paired t-test. At 2 weeks, the mean VAS score was 4.95±1.038, which significantly decreased to 2.68 ± 0.989 at 6 weeks (t = 19.282, p=0.000). The VAS score further decreased to 0.84 ± 0.823 at 3 months (t=4.482, p=0.000), and continued to decline to 0.34±0.481 at 6 months. The p values for all comparisons were less than 0.05, indicating statistically significant reductions in VAS scores at each interval.

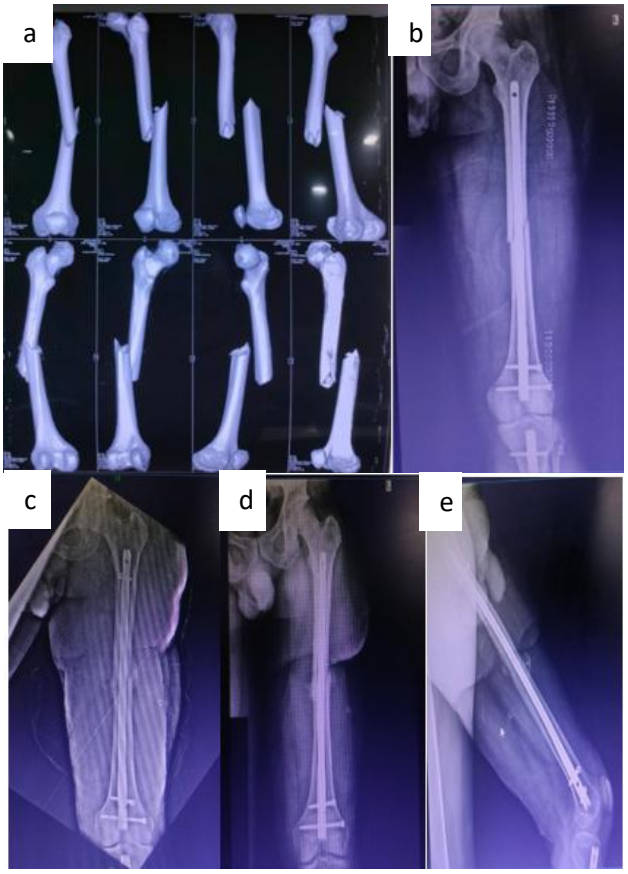

Figure 4: Pre & post operative images. (a) Pre-Op CT, (b) immediate post-op, (c) at 6 weeks, (d) at 3 months and (e) at 6 months.

In Table 5, the mean range of motion (ROM) scores at different time intervals indicate a progressive improvement in joint mobility among the study participants. At 6 weeks, the mean ROM was 77.37° (SD±18.26), which increased to 98.82° (SD±17.95) at 3 months. By 6 months, the ROM further improved to 112.63° (SD±16.43). This upward trend suggests a steady recovery in knee mobility following retrograde femoral nailing, with significant gains over time.

Table 6 presents the changes in LEFS, VAS, and ROM among study participants over the study period. The LEFS (lower extremity functional scale) showed a significant change, with a p value of <0.001, indicating a highly significant improvement in lower extremity function over time. The VAS (Visual Analogue Scale for pain) also demonstrated a significant reduction in pain levels, with a p value of <0.001, confirming that the observed changes were statistically significant. Similarly, the ROM (Range of Motion) exhibited notable improvement, with a p value of <0.001, highlighting a significant increase in joint mobility over the study period. In Figure 4a, the pre-operative CT scan reveals a comminuted proximal humerus fracture. Figure 4b shows the immediate post-operative radiograph with anatomical reduction and stable fixation with Smith and Nephew retrograde nail. Figures 4c, 4d, and 4e demonstrate serial follow-up images at 6 weeks, 3 months, and 6 months, respectively. At 6 weeks, early callus formation was noted; by 3 months, bridging callus indicated progressive healing; and by 6 months, complete union with restored cortical continuity was observed, with no evidence of implant-related complications.

Table 3: Comparison of mean LEFS Score at different intervals using paired t-test.

Time interval	No.	LEFS Score (Mean±SD)	't value'	P value
2 weeks	38	23.76±4.14	19.987	
6 weeks	38	37.42±7.16	df=37	0.000
3 months	38	51.11±8.41	21.171	
6 months	38	63.29±8.80	df=37	0.000

P value 0.000 <0.05 was taken as statistically significant

Table 4: Comparison of mean VAS Score at different intervals using paired t-test.

Time interval	No.	VAS Score (Mean±SD)	't value'	P value
2 weeks	38	4.95±1.038	19.282	
6 weeks	38	2.68±0.989	df=37	0.000
3 months	38	0.84±0.823	4.482	
6 months	38	0.34±0.481	df=37	0.000

0.00 <0.05 was taken as statistically significant

Table 5: Mean range of motion score during different intervals among study participants.

Time interval	Mean	Standard deviation
At 6 weeks	77.37	18.260
At 3 months	98.82	17.950
At 6 months	112.63	16.429

Table 6: Changes in LEFS, VAS and ROM during the study period among study participants.

Characteristics	Sum of squares	df	Mean Square	F	P value
LEFS	33262.789	3	11087.596	963.980	0.000
VAS	496.967	3	165.656	506.789	0.000
ROM	23995.175	2	11997.588	352.102	0.000

DISCUSSION

In the present study, the number of female participants was higher than males, whereas Khanzada et al reported more males. In the current study, the average age of fracture occurrence was 42.3±0.9 years, in contrast to 29.4 years as reported by Ostrum et al. Most participants had left-sided injuries, while study conducted by Khanzada et al observed more right-sided cases. Slip and fall was the most common mode of injury in this study, whereas their findings showed a different trend. However, the majority of patients had A1 type fractures in both studies, showing a similar pattern.[13,14]

The average time for union was 14.5 weeks, with only one case of non-union, compared to 20.3±2.13 weeks reported by Anaberu et al, and 24.2 weeks in a study by Salphale et al.[15,16] A meta-analysis by Dokostakis et al, reported a shorter union time in a group of 553 femoral fractures treated with a retrograde nail. Additionally, no complications were observed in this study, which is consistent with the findings of Cannada et al.

A study by Kim et al reported a union time of 17.4 weeks.[17-19] The mean knee range of motion was 112±16°C, consistent with the findings of Kim et al, who reported a mean knee ROM of 116°C, and Anaberu et al, who reported a mean knee ROM of greater than 111 degrees.[15,19] At 2 weeks, the mean lower extremity functional scale (LEFS) score was 23.76±4.14, and at 6 weeks, the mean score increased to 37.42±7.17.

The difference was statistically significant (<0.005), indicating a higher LEFS at 6 weeks compared to 2 weeks. At 3 months, the mean LEFS score was 51.11±8.41, and at 6 months, it further increased to 63.29±8.80. The difference was statistically significant (<0.005), showing a higher LEFS at 3 months compared to 6 months. Thus, there was a significant improvement in the LEFS from 2 weeks to 6 months, reflecting a good functional outcome. Additionally, the mean visual analogue scale (VAS) scores were recorded at 2 weeks, 6 weeks, 3 months, and 6 months. At 2 weeks, the VAS was 4.95±1.04, at 6 weeks it decreased to 2.68±0.99, at 3 months it was 0.84±0.82, and at 6 months it further decreased to 0.34±0.48. At 2 weeks, the mean VAS score was 4.95±1.04, and at 6 weeks, it was 2.68±0.99. The difference was statistically significant (<0.005), showing a lower VAS score at 6 weeks compared to 2 weeks. At 3 months, the mean VAS score was 0.84±0.82, and at 6 months, it was 0.34±0.48.

The difference was statistically significant (<0.005), indicating a lower VAS score at 6 months compared to 3 months. In the current study, the mean LEFS score steadily increased from the 2nd week to 6 months, demonstrating a continuous improvement in functional outcomes. Similarly, the mean VAS score showed a gradual decline over the same period, indicating a reduction in pain. Additionally, the mean knee range of motion improved progressively from the 3rd week to 6 months, reflecting enhanced joint mobility over time.

In this study, the time of union was not associated with any demographic characteristics, which is consistent with the findings of Shah et al.[20] The mean operative time was 120 minutes and average hospital stay was 9 days. The absence of complications in this study could be attributed to several factors, including meticulous surgical technique, proper patient selection, and adherence to postoperative protocols.

CONCLUSION

Retrograde intramedullary nailing (RIMN) is a safe and effective option for femoral shaft fractures, especially when proximal access is challenging. It offers advantages such as preserved hip abductor function, easier positioning, reduced operative time, and minimal blood loss. This study showed significant functional improvements, with higher LEFS scores, lower VAS scores, and better knee mobility over six months. Union times were consistent with literature, with no major complications. Demographic factors had no significant effect on healing, supporting RIMN as a reliable method for early mobilization and favorable outcomes.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Starr J, Tay YKD, Shane E. Current understanding of epidemiology, pathophysiology, and management of atypical femur fractures. Curr Osteop Rep. 2018;16(4):519–29.
2. Elsoe R, Ceccotti AA, Larsen P. Population-based epidemiology and incidence of distal femur fractures. Int Orthop. 2018;42(1):191–6.
3. Chang SM, Hou ZY, Hu SJ, Du SC. Intertrochanteric Femur Fracture Treatment in Asia: What We Know

and What the World Can Learn. Orthop Clin North Am. 2020;51(2):189–205.
4. Angelini A, Trovarelli G, Berizzi A, Pala E, Breda A, Maraldi M, et al. Treatment of pathologic fractures of the proximal femur. Injury. 2018;49(3):77–83.
5. Ehlinger M, Favreau H, Eichler D, Adam P, Bonnomet F. Early mechanical complications following fixation of proximal femur fractures: From prevention to treatment. Orthop Traumatol Surg Res. 2020;106(1):79–87.
6. Chen M, Li B, Liu H. V-blade tip needle scalpel reducing surgery time in ultrasonography-guided percutaneous A1 pulley release. Asian J Surg. 2024;10(24)1749-4.
7. Desta T, Lodamo T, Mulat H, Demissie DB, Ayalew K. Prevalence and associated factors of infection after intramedullary nailing of long bone fractures among patients attending St. Paul's Hospital Millennium Medical College, AaBET Hospital, Addis Ababa, Ethiopia. SAGE Open Med. 2023;11:205-9.
8. Odatuwa-Omagbemi DO. Open intramedullary nailing using 'Greens Instrumentation' in the treatment of femoral and tibial shaft fractures: a 5 years review of cases in a private health facility in the Niger Delta region of Nigeria. J Med Trop. 2020;22(2):115.
9. Cheng T, Xia RG, Dong SK, Yan XY, Luo CF. Interlocking Intramedullary Nailing Versus Locked Dual-Plating Fixation for Femoral Shaft Fractures in Patients with Multiple Injuries: A Retrospective Comparative Study. J Investig Surg Off J Acad Surg Res. 2019;32(3):245–54.
10. Wilson JL, Squires M, McHugh M, Ahn J, Perdue A, Hake M. The geriatric distal femur fracture: nail, plate or both. Eur J Orthop Surg Traumatol Orthop Traumatol. 2023;33(5):1485–93.
11. Wang Y, Kayastha Y, Cao Y, Guo Z, Yuan Y, Bi Y. Outcome of Humeral Shaft Fracture Treated with Intramedullary Nail and Plate Fixation. J Coll Physicians Surg--Pak. 2020;30(1):73–8.
12. Yamamoto N, Yamakawa Y, Inokuchi T, Iwamoto Y, Inoue T, Noda T, et al. Hip fractures following intramedullary nailing fixation for femoral fractures. Injury. 2022;53(3):1190–5.
13. Khanzada DMA, Lakho DMT, Memon DZ, Zeb DSA, Ahmed DB, Kumar DR. Functional outcome of distal femur fracture treated with retrograde nailing technique. J Islamabad Med Dent Coll. 2022;11(2):82–8.
14. Ostrum RF, DiCicco J, Lakatos R, Poka A. Retrograde intramedullary nailing of femoral diaphyseal fractures. J Orthop Trauma. 1998;12(7):464–8.
15. Anaberu P, Jeyaraman M, Chaudhari K, Selvaraj P. Prospective Study on Functional Outcome of Retrograde Femoral Nailing in Distal Third Femoral Fractures. J Clin Exp Orthop. 2019;5(2):688.
16. Davidson A, Houri SS, Cohen J, Feldman G, Mosheiff R, Liebergall M, et al. Initial definitive treatment of open femoral shaft fractures with retrograde nailing - is it safe. A retrospective analysis comparing antegrade to retrograde nailing. Injury. 2022;53(3):1231–6.
17. Salman LA, Al-Ani A, Radi MFA, Abudalou AF, Baroudi OM, Ajaj AA, et al. Open versus closed intramedullary nailing of femur shaft fractures in adults: a systematic review and meta-analysis. Int Orthop. 2023;47(12):3031–41.
18. Cannada LK, Taghizadeh S, Murali J, Obremskey WT, DeCook C, Bosse MJ. Retrograde intramedullary nailing in treatment of bilateral femur fractures. J Orthop Trauma. 2008;22(8):530–4.
19. Kim JW, Oh CW, Oh JK, Park KH, Kim HJ, Kim TS, et al. Treatment of infra-isthmal femoral fracture with an intramedullary nail: Is retrograde nailing a better option than antegrade nailing? Arch Orthop Trauma Surg. 2018;138(9):1241–7.
20. Shah S, Desai P, Mounasamy V. Retrograde nailing of femoral fractures: a retrospective study. Eur J Orthop Surg Traumatol Orthop Traumatol. 2015;25(6):1093–7.

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