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Original Research Article

TO COMPARE THE OUTCOME OF INTRAMEDULLARY VERSUS EXTRAMEDULLARY FIXATION IN SUBTROCHANTERIC FEMUR FRACTURES

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ABSTRACT

Background: Subtrochanteric femur fractures are complex injuries often associated with high-energy trauma and osteoporotic changes. Surgical fixation using either intramedullary or extramedullary implants remains the mainstay of treatment, but the optimal choice between the two techniques continues to be debated. The aim is to compare the clinical and radiological outcomes of intramedullary versus extramedullary implant fixation in patients with subtrochanteric femur fractures.

Materials and Methods: This longitudinal, prospective study was conducted at the Department of Orthopaedics, Sri Guru Ram Das (SGRD) Tertiary Care Hospital, Amritsar. A total of 60 patients were initially enrolled through purposive sampling, out of which 52 completed follow-up and were included in the final analysis. Patients were alternately allocated into two groups: Group A (27 patients) underwent intramedullary fixation, and Group B (25 patients) underwent extramedullary fixation. Clinical and radiological parameters including duration of surgery, intraoperative blood loss, time to union, Harris Hip Score (HHS), and complication rates were assessed. Statistical analysis was performed using IBM SPSS version 26.0, with a p-value < 0.05 considered significant.

Results: The mean age of patients was slightly higher in the intramedullary group (49.67 years) compared to the extramedullary group (47.08 years). The duration of surgery and intraoperative blood loss were significantly lower in the intramedullary group (p = 0.001 for both). The mean time to radiological union was similar between the groups (20.33 weeks vs. 18.68 weeks; p = 0.135). At 24 weeks, both groups demonstrated comparable functional outcomes with mean HHS of 80.78 (intramedullary) and 81.64 (extramedullary). Radiological union rates and complication profiles, including rates of infection, non-union, and implant failure, showed no statistically significant difference between the two groups.

Conclusion: Both intramedullary and extramedullary fixation methods are effective in the treatment of subtrochanteric femur fractures. The choice of implant should be guided by fracture pattern, patient profile, and surgeon experience, as both techniques provide comparable functional and radiological outcomes.

Keywords: Subtrochanteric femur fracture, intramedullary fixation, extramedullary fixation, Harris Hip Score, radiological union.

INTRODUCTION

Subtrochanteric fractures of femur can be described as those occurring below the lesser trochanter to 5 cm distally in the shaft of the femur.[1] Fracture patterns presenting major displacement in this area are considered sub trochanteric fractures despite their proximal or distal extension.[2] They occur at the

junction between the trabecular bone and the cortical bone where the mechanical stresses are highest in the femur and constitute about 10 to 34 percent of all hip fractures.[3] The overall incidence rate of fractures of the proximal femur is found to be approximately 230 per 100,000 patients with approximately 5-10% of these fracture occurring in the ST region. Estimated to be approximately 15-20/100,000. They occur after high-energy trauma mostly in younger patients, as osteoporotic fractures in the elderly and as bisphosphonate-associated atypical fractures. One study delineated that approximately two-thirds of all ST fractures occur in patients older than 50 years of age with another 25% occurring in patients aged 17-50. Due to high stress concentration as well as bending and rotational forces, this region has thick cortical bone with less vascularity, which leads to relatively increased chances for healing disturbances and deformity. Due to predominance of cortical bone, this region presents a more precarious vascularization than the trans-trochanteric region, which makes the consolidation of the fracture difficult. The inherent instability of these fractures and the enormous muscle forces acting across the fracture fragments, render most treatment options difficult.[4] It is difficult to treat these fractures conservatively and surgical management is the current standard of care. A medial buttress is important to minimise the implant stress and the fatigue failure but when comminution is severe, as is often the case, this cannot be achieved. Conservative treatment gives only satisfactory results in 56 %of patients compared to 70- 80% for operative methods.[5] Intramedullary and extramedullary internal fixation devices are now advocated for the management of subtrochanteric femur fractures. Intramedullary fixation has been gaining popularity for the past decades due to its unique advantage- short force arm which can better distribute the stress compared to extramedullary fixation. Previously non-surgical treatment of these fractures was associated not only with significant shortening and malrotation but also with the morbidity and mortality of prolonged immobilization. There is a high incidence of complications like nonunion, delayed union, implant failure, delay in weight bearing, loss of alignment, coxa vara, shortening and rotational deformity.[6] Due to better understanding of biology, reduction techniques and biomechanically improved implants, we have been able to address these fractures with relative consistency.

MATERIALS AND METHODS

This longitudinal, prospective study was conducted in the Department of Orthopaedics at Sri Guru Ram Das (SGRD) Tertiary Care Hospital, Amritsar. The study aimed to compare the clinical and radiological outcomes of intramedullary versus extramedullary implant fixation in subtrochanteric femur fractures. A total of 60 patients were initially enrolled in the study using a purposive sampling technique. During the follow-up period, eight patients were lost to follow-up (two due to mortality and six owing to COVID-19-related reasons), leaving 52 patients for final analysis. These were divided into two groups:

Group A (Intramedullary Implant Fixation): 27 patients

Group B (Extramedullary Implant Fixation): 25 patients

Patients were allocated alternately into the two groups based on their order of admission—odd-numbered cases received intramedullary fixation, while even-numbered cases received extramedullary fixation.

The inclusion criteria for this study were clearly defined to ensure uniformity in patient selection. Patients aged 18 years and above, with radiologically confirmed subtrochanteric femur fractures, were considered eligible for enrollment. Only those patients with non-pathological fractures and who provided written informed consent were included in the study. The exclusion criteria aimed to eliminate cases that could confound the outcomes. Patients presenting with open fractures graded as II or III based on the Gustilo and Anderson classification, as well as those with periprosthetic fractures, were excluded from the study.

Methodology: The methodology included a detailed assessment of several clinical and radiological parameters. Demographic data such as age and gender were recorded for both groups. The mode of injury—such as falls or road traffic accidents—was documented for each patient. Fractures were classified radiographically according to the Seinsheimer classification. The duration of surgery was timed from skin incision to wound closure using a digital timer. Intraoperative blood loss was estimated by gauze weighing and sponge count, while postoperative blood loss was measured through suction drain output in the extramedullary group or by assessing the weight of soaked dressings when drains were not used. Fracture outcomes were assessed based on union—defined as bridging callus formation in at least three out of four cortices on orthogonal radiographs—and non-union, indicated by the absence of clinical and radiological healing signs across follow-up visits. Radiological evaluation included standard anteroposterior and lateral radiographs taken preoperatively, immediately postoperatively, and at 4-week, 8-week, and monthly intervals thereafter until union. The range of motion (ROM) of the hip joint was measured using a universal goniometer at the 1st, 3rd, and 6th months postoperatively, focusing on the degree of flexion from full extension. Functional outcomes were assessed using the Harris Hip Score (HHS) at 4, 12, and 24 weeks to evaluate patient recovery.

Statistical Analysis: The collected data were compiled and statistically analyzed using IBM SPSS Statistics version 26.0. The Chi-square test was employed to assess categorical variables and determine the homogeneity between the intramedullary and extramedullary groups. For

continuous variables, particularly the comparison of mean Harris Hip Scores between the two groups, an independent samples t-test was applied. A p-value of less than 0.05 was considered indicative of statistical significance throughout the analysis.

RESULTS

Table 1: Comparison of Demographic and Clinical Characteristics Between Intramedullary and Extramedullary Implant Groups (N = 52)

Characteristic	Category	Intramedullary Implant (n = 27)	%	Extramedullary Implant (n = 25)	%
Age Distribution	< 40 years	9	33.3%	10	40.0%
	40–60 years	12	44.4%	11	44.0%
	> 60 years	6	22.2%	4	16.0%
	Mean Age (years)	49.67		47.08	
Gender Distribution	Male	14	51.9%	11	44.0%
	Female	13	48.1%	14	56.0%
Mode of Injury	Fall	13	48.15%	11	44.0%
	RTA	14	51.85%	14	56.0%
Fracture Type (Seinsheimer)	2A	0	0.0%	4	16.0%
	2B	3	11.1%	4	16.0%
	2C	2	7.4%	9	36.0%
	3A	10	37.0%	2	8.0%
	3B	5	18.5%	2	8.0%
	3C	2	7.4%	1	4.0%
	4	3	11.1%	4	16.0%
	5	2	7.4%	3	12.0%
Side Involved	Left	10	37.0%	15	60.0%
	Right	17	63.0%	10	40.0%

[Table 1] shows that the majority of patients in both groups were aged between 40–60 years, with a slightly higher mean age in the intramedullary group (49.67 years) compared to the extramedullary group (47.08 years). Gender distribution was nearly balanced, with 51.92% males and 48.08% females overall. Regarding the mode of injury, 53.85% of the total patients sustained fractures due to road traffic accidents (RTA), while 46.15% suffered from falls. According to the Seinsheimer classification, the most common fracture types were 3A (23.07%) and 2C (21.15%). Side involvement was nearly equal, with the right side involved in 51.92% and the left side in 48.08% of cases.

Table 2: Types of Implants Used in Intramedullary and Extramedullary Groups

Implant Type	Intramedullary Group (n = 27)	%	Extramedullary Group (n = 25)	%
PFN	21	77.7%	–	–
Gamma Nail	6	22.3%	–	–
PFLCP	–	–	10	40.0%
DCS	–	–	7	28.0%
Blade Plate	–	–	5	20.0%
DHS	–	–	3	12.0%

[Table 2] shows that in the intramedullary implant group, PFN was the most commonly used implant, utilized in 77.7% of cases, followed by Gamma nail in 22.3% of patients. In the extramedullary group, PFLCP was the most frequently used implant (40%), followed by DCS (28%), Blade plate (20%), and DHS (12%).

Table 3: Distribution of Associated Injuries Among Study Groups

Associated Injuries	Intramedullary Implant (n = 27)	%	Extramedullary Implant (n = 25)	%
Contralateral Femur Fracture	3	11.11%	0	0.0%
Head Injury	3	11.11%	0	0.0%
Fracture Clavicle	0	0.0%	1	4.0%
Fracture Both Bone Leg (Ipsilateral)	0	0.0%	2	8.0%
Abdominal Injury	0	0.0%	1	4.0%

[Table 3] shows that associated injuries were more commonly observed in the intramedullary group, where 11.11% of patients had contralateral femur fractures and 11.11% had head injuries. In contrast, the extramedullary group presented with a lower incidence of associated injuries, including fracture clavicle (4.0%), fracture both bone leg (8.0%), and abdominal injury (4.0%). Out of 52 patients, 28 (52.84%) had road traffic accidents (RSA), and 10 (35.71%) of those with RSA had associated injuries.

Table 4: Comparison of Surgical Duration, Blood Loss, and Time to Union Between Study Groups

Parameter	Group	Mean	SD	Mean Difference (MD)	t-value	df	p-value
Duration of Surgery (min)	Intramedullary Implant	84.07	15.07	17.33	3.897	50	0.001*
	Extramedullary Implant	101.40	16.99				
Blood Loss (ml)	Intramedullary Implant	177.96	36.78	124.24	8.253	50	0.001*
	Extramedullary Implant	302.20	68.28				
Time to Union (weeks)	Intramedullary Implant	20.33	4.52	1.65	-1.518	50	0.135
	Extramedullary Implant	18.68	3.14				

[Table 4] shows that the duration of surgery was significantly shorter in the intramedullary implant group (84.07 ± 15.07 minutes) compared to the extramedullary group (101.40 ± 16.99 minutes), with a p-value of 0.001, indicating statistical significance. Similarly, the intraoperative blood loss was significantly lower in the intramedullary group (177.96 ± 36.78 ml) versus the extramedullary group (302.20 ± 68.28 ml), also with a p-value of 0.001. However, the mean time to radiological union was 20.33 ± 4.52 weeks in the intramedullary group and 18.68 ± 3.14 weeks in the extramedullary group, with a p-value of 0.135, suggesting that this difference was not statistically significant.

Table 5: Radiological Assessment for Callus Formation/Union at Different Follow-Up Weeks

Follow-Up Week	Radiological Status	Intramedullary Implant (n = 27)	%	Extramedullary Implant (n = 25)	%
4th Week	Absent	27	100.0%	25	100.0%
8th Week	Absent	27	100.0%	25	100.0%
12th Week	Absent	27	100.0%	25	100.0%
16th Week	Present	6	22.2%	5	20.0%
	Absent	21	77.8%	20	80.0%
20th Week	Present	12	44.4%	16	60.0%
	Absent	15	55.6%	9	40.0%
24th Week	Present	18	66.7%	20	88.0%
	Absent	9	33.3%	5	12.0%
28th Week	Present	24	88.9%	20	80.0%
	Absent	3	11.1%	5	20.0%

[Table 5] shows the progression of radiological union in both groups. No signs of union were observed up to the 12th week in either group. By the 16th week, callus formation was seen in 22.2% of intramedullary and 20.0% of extramedullary cases. This increased by the 20th week to 44.4% and 60.0% respectively. At 24 weeks, 66.7% of the intramedullary group and 88.0% of the extramedullary group showed union. By the 28th week, union was observed in 88.9% of the intramedullary group and 80.0% of the extramedullary group. However, the difference in union rates between the groups was statistically insignificant (p = 0.374).

Table 6: Harris Hip Score (HHS) Evaluation at Different Follow-Up Weeks

Follow-Up Week	Group	Poor (f)	%	Fair (f)	%	Good (f)	%	Excellent (f)	%	Mean ± SD
4th Week	Intramedullary	27	100.0%	0	0.0%	0	0.0%	0	0.0%	28.26 ± 9.26
	Extramedullary	25	100.0%	0	0.0%	0	0.0%	0	0.0%	11.80 ± 3.84
12th Week	Intramedullary	24	88.9%	1	3.7%	0	0.0%	2	7.4%	57.44 ± 14.41
	Extramedullary	23	92.0%	1	4.0%	0	0.0%	1	4.0%	53.52 ± 15.96
24th Week	Intramedullary	0	0.0%	0	0.0%	9	33.3%	10	37.0%	80.78 ± 13.55
	Extramedullary	0	0.0%	3	12.0%	8	32.0%	9	36.0%	81.64 ± 11.72

[Table 6] shows the progression in functional recovery based on the Harris Hip Score (HHS). At the 4th week, all patients in both groups had poor scores, with mean scores of 28.26 (intramedullary) and 11.80 (extramedullary). By the 12th week, functional improvement was noted with 2 patients (7.4%) in the intramedullary group and 1 patient (4.0%) in the extramedullary group achieving an excellent outcome. At the 24th week, a notable rise in function was observed, with 19 patients (70.3%) in the intramedullary group and 17 patients (68.0%) in the extramedullary group attaining good to excellent outcomes. The mean HHS at 24 weeks was 80.78 ± 13.55 in the intramedullary group and 81.64 ± 11.72 in the extramedullary group, showing comparable functional recovery between the two groups.

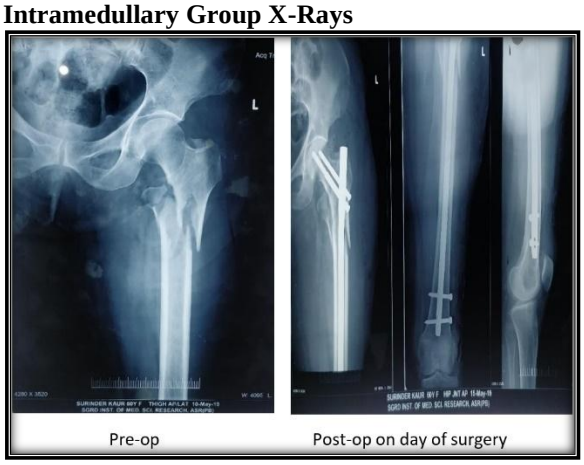
Table 7: Postoperative Complications Observed Among Study Groups

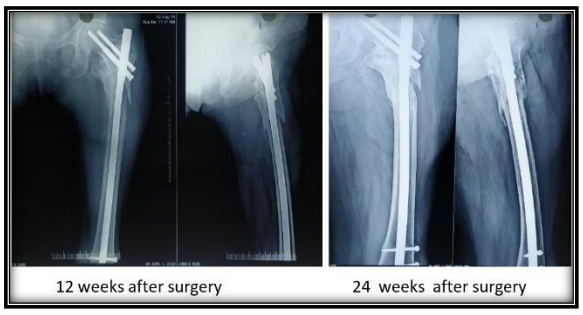
Complication	Intramedullary Implant (n = 27)	%	Extramedullary Implant (n = 25)	%
Infection (Superficial)	1	3.7%	2	8.0%
Infection (Deep)	0	0.0%	0	0.0%
Neurovascular Injury	0	0.0%	0	0.0%
Non-union	3	11.1%	5	20.0%

Implant Failure with Varus Collapse	1	3.7%	4	16.0%
Knee Stiffness	2	7.2%	0	0.0%
Hip Stiffness	0	0.0%	0	0.0%

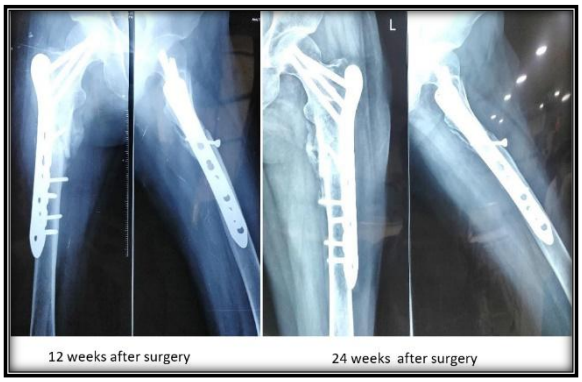
Table 7 shows the distribution of complications between the two study groups. A total of 3 superficial infections were recorded (1 in intramedullary and 2 in extramedullary groups). Non-union was observed in 8 patients—3 in the intramedullary group (11.1%) and 5 in the extramedullary group (20.0%). Implant failure with varus collapse occurred in 1 intramedullary case (3.7%) and 4 extramedullary cases (16.0%). Knee stiffness was reported in 2 patients (7.2%) in the intramedullary group, whereas no cases of deep infection, neurovascular injury, or hip stiffness were observed in either group.

Intramedullary Group X-Rays





Extramedullary Group X-Rays



DISCUSSION

Most of the patients were in 40–60 years of age group i.e. 23 out of 52 (44.23%) with mean age of 48.42 years. More incidence in this age group can be explained as this is an active age group and more of RSA are associated with this group. A similar study conducted by Jiang et al.[7] where the average age of patients was 53 years.

In present study, 27 out of 52 patients (51.92%) were females and 25 patients (48.18%) were males, which is almost equal incidence which can be explained due to more of females being involved in driving 2-wheelers and going for jobs nowadays. A similar study by Streubel et al.[8] showed an almost equal incidence in both sexes.

A major proportion of the study group—28 out of 52 patients (53.85%)—had RSA while 24 patients (46.15%) had history of fall. Similar results were shown by Rao et al.[9] with road traffic accidents in 60% of cases and 40% of cases following accidental fall.

In intramedullary implant group, fixation in 21 out of 27 patients (77.7%) was done using PFN and Gamma nail was used in 6 patients (22.3%). In extramedullary implant group, fixation in 10 out of 25 patients (40%) was done using PFLCP, 7 patients (28%) using DCS, 5 patients (20%) using blade plate, and 3 patients (12%) using DHS. For fractures at the level of lesser trochanter and distal extension, DCS/Blade plate (surgeon dependent) were preferred and for fractures with breach/comminution in the lateral cortex, PFLCP was preferred.

Mean duration of surgery in intramedullary group in present study was 84.07 minutes. Similar result was given in a study by Sadowski et al,[10] which showed 82 minutes while study by Ekstrom et al,[11] showed 56.6 minutes.

In present study, mean total blood loss in extramedullary implant group was 302.2 mL and in intramedullary group was 177.96 mL, which is statistically significant. Blood transfusion was required in 11 out of 27 (40.74%) cases in intramedullary and 16 out of 25 (64%) cases in

extramedullary implant groups. A large proportion of patients in both groups were transfused and the difference is statistically insignificant in both the groups, so the need for blood transfusion was more related to the long bone fracture.[12]

The mean time of union in intramedullary implant group is 20.33 weeks. Other studies showing mean time of union: Yadikar et al – 16 weeks.[13]

The mean time of union in intramedullary implant group was 20.3 weeks which is on the higher side as compared to other studies.

Mean time of union in extramedullary implant group was 18.68 weeks. Other studies showing mean time of union: Oh et al – 22 weeks.[14]

Mean time of union in intramedullary implant group was 20.33 weeks which was comparatively more as compared to extramedullary implant group of 18.68 weeks but the difference was statistically insignificant.

Rate of union in intramedullary group is 88.9%. Other studies showing union rates: Banan et al – 85%, Wang et al – 96%.[15,16]

Rate of union in extramedullary group is 80%. Other studies showing union rates: Floyd et al – 78%.[17]

Rate of union was more in intramedullary group with 88.9% as compared to 80% of extramedullary group, though the difference was statistically insignificant.

In present study, a total of 8 cases were in non-union and they were advised re-surgery with bone grafting at 28 weeks post-surgery. Three cases in intramedullary group and five cases in extramedullary group were in non-union. Out of the three cases in intramedullary group, one also had implant failure (3.7%). Similar results were shown by a study by Kanthimathi et al,[20] where the rate of implant breakage in PFN was 4% and a study by Streubel et al,[21] with 5% non-union. The cause for non-union in these patients could be due to inability to achieve posteromedial cortical continuity, lack of an accurate reduction, excessive distraction at the fracture site, and inherent nature of the fracture pattern to go for non-union. Non-union could be avoided if a proper reduction of the fracture fragments and primary bone grafting was done.

Ekstrom et al,[22] in their study analysing the results of intramedullary fixation in the treatment of subtrochanteric fractures observed that in those cases with acceptable reduction, the rate of reoperation was 23%, whereas those with good reduction, no patients were reoperated. The aim should be to restore the cervico-diaphyseal angle, in addition to the correction of rotation and flexion of the proximal fragment with methods that cause minimal biological damage.

In four of our cases with intramedullary nailing, cerclage wiring was done and one of them was in non-union. Thus, 75% of our patients with cerclage wiring had union. Codesido et al. emphasized the importance of cerclage wiring and all cases in his study showed complete union.[23]

Two patients who were in non-union with the implant being stable were taken up for revision surgery. Out of five cases of non-union in extramedullary group, one of them had non-union with stable implant in situ. The patient is still on follow-up and is advised bone grafting. Patient is doing guarded weight bearing. Four patients (16%) had implant failure. Three of them had undergone revision surgery. We observed that the cause of failure in present study patients was due to mechanical stress at the plate screw interface caused due to early weight bearing on the affected leg before bone healing had been completed. Two patients were non-compliant and started weight bearing without being advised. In a study by Asif et al,[18] union rate was found to be 92%, 3 (12%) patients developed bending or breakage of proximal screws, and 3 (12%) cases of varus collapse were observed. They observed that the failure was due to early weight bearing before callus formation, and they observed that in all the failure cases there was a lack of posteromedial continuity and patients were unreliable and non-compliant with weight bearing.

Harris Hip Score was significantly low in the extramedullary implant group at the end of 4 weeks; this was due to delayed weight bearing in the extramedullary group but there was no significant difference in the two groups at 12 and 24 weeks post-surgery. 70.3% of patients in intramedullary group and 68% of patients in extramedullary group had good to excellent Harris Hip Score at 24 weeks post-surgery. Study by Chalise et al,[24] observed that 88% of cases had a good to excellent Harris Hip Score whereas in a study by Kumar et al,[19] a good to excellent Harris Hip Score was seen in 77.5% of patients. Knee stiffness was present in 2 intramedullary cases, which was temporary and with the help of physiotherapy both the patients recovered. Knee stiffness developed due to reluctance of the old patients to make movements at knee, probably due to distal locking screws. There were no cases of hip stiffness.

CONCLUSION

In conclusion both intramedullary and extramedullary implant fixation are effective treatment options in the management of subtrochanteric femur fractures and implant of choice depends on the fracture type and surgeon preference.

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