Journal of Chemical Health Risks

www.jchr.org

JCHR (2025) 15(2), 970-982 | ISSN:2251-6727

Comparison between Intramedullary and Extramedullary Fixation in Subtrochanteric Fractures

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(Received: 16 January 2025 Revised: 20 Feburary 2025 Accepted: 31 March 2025)

KEYWORDS

Subtrochanteric, extra-medullary, intramedullary, significantly.

ABSTRACT:

Background: Subtrochanteric femur fractures occur below the lesser trochanter, involving high stress and rotational forces, leading to healing challenges. Treatment often requires internal fixation devices, either intramedullary (e.g., Y-nail, TFN) or extra-medullary (e.g., Dynamic Hip Screw). Intramedullary fixation offers faster surgery, less blood loss, and better early mobilization outcomes.

Materials and methods: A longitudinal study was conducted in 52 patients with non- pathological subtrochanteric femur fractures, excluding open and peri-prosthetic fractures. Patients were divided into intramedullary (27) and extramedullary (25) implant groups. Surgical procedures, including reaming and fixation, were followed by post-operative care, physiotherapy, and functional assessments using Harris Hip Score. Statistical analysis was performed using SPSS.

Results: The study involved 52 patients aged 20-82 years, with a mean age of 48.42 years. Most patients (44.23%) were between 40-60 years. Of the 52, 51.92% were male, and 46.15% had fractures due to RTAs. Intramedullary fixation showed significantly shorter surgery times and less blood loss compared to extramedullary fixation.

Discussion: Subtrochanteric femur fractures are challenging due to deforming forces and prolonged healing times. This study compared outcomes of intramedullary and extramedullary implant fixation. Of 52 patients, 51.92% were male, 53.85% had RTAs, and 44.22% had fractures classified as 3A or 2C. Intramedullary implants (PFN) had shorter surgery times, less blood loss, and a higher union rate (88.9%) compared to extramedullary implants (80%). Non-union occurred in 8 cases, with revision surgery recommended. Harris Hip Scores improved over time, with no significant differences between groups after 12 weeks.

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JCHR (2025) 15(2), 970-982 | ISSN:2251-6727

Conclusion: The intramedullary implant group had shorter surgery duration, and less blood loss compared to the extramedullary group, which had a higher incidence of implant failure. Both fixation methods are effective for subtrochanteric femur fractures, with choice depending on fracture type and surgeon preference.

INTRODUCTION

Sub trochanteric fractures of femur extend below lesser trochanter to 5 cm in the shaft of the femur distally presenting major displacement as sub trochanteric fractures despite their proximal or distal extension which occurs at the junction between the trabecular bone. The subtrochanteric region of femur is a high stress area, in addition rotational and bending forces also acting here, leading to higher chances of healing disturbances and deformities.[1-9] Precarious vascularization compared to the trans- trochanteric region, makes the consolidation of the fracture difficult and inherent instability render treatment options difficult.[10-15] Intramedullary and extra medullary internal fixation devices are now advocated for management of Subtrochanteric femur fractures.[16-18] As per Boyd and Griffin there are 1to 4 types , of which type 1-3 as per Fielding and Magliato,[19] Type 1-5 in Seinsheimer,[20] AO/ASIF[21] recommended Part A, B, C. Russel and Tayler classified Type1(A, B), Type2(A, B).[22-24] The indications for non-operative treatment of sub trochanteric femur fractures are extremely limited secondary to the deformity created, the instability of the fracture pattern, and the poor outcome associated with this treatment modality. Extra medulary implants includes - Dynamic Hip Screw, Dynamic Condylar Screw, 95 Degrees angled blade plate, Medoff axial compression screw and Proximal Femur LCP.[25-29] Intramedullary implants includes : Impaction (Y-nail, TFN), Dynamic compression (Gamma, IMHS), 2 screw dynamic compression (Reconstruction nail) and Linear compression integrated (InterTAN).[30] Intramedullary fixation might produce considerably fastens operation duration, less intraoperative blood loss, a shorter length of incision, and a shorter duration of stay compared to extra medullary fixation for sub trochanteric fractures.[31-35] According to Seinsheimer categorization, the majority of cases were type IIIA fractures. Follow up cases and evaluating them using Harris hip scoring system (Modified) result was satisfactory to outstanding.[36-37] Russell-T a y l o r classification was used to classify fractures. Patients treated with an INTERTAN nail had somewhat reduced pain during early postoperative mobilization[38]

MATERIALS AND METHODS

The study was conducted in orthopedic ward of Shri Sathya Sai Medical College and Research Institute, Ammapettai, Chengalpattu district, Chennai, Tamil nadu. A Longitudinal study in 52 patients (27-intramedullary implant group and 25 -extra medullary implant group) above 18-year age. Non pathological Subtrochantric fracture of Femur Open fractures and Peri prosthetic fractures patients are excluded.

Surgical procedure:

Prophylactic antibiotics were given to all patients 30 minutes before surgery, after spinal or general anesthesia, the patient was placed on the fracture table and patient's injured foot is padded, wrapped in a self-adherent dressing, and placed in traction boot. Contralateral leg placed in the lithotomy position, appropriately padded, and secured with the leg Holder. Fluoroscopic views were then obtained, and the fluoroscope enters the field between the patient's legs for an Antero-Posterior view of the Hip and femur. Sharp dissection was performed through the skin, subcutaneous tissue, and fascia. Blunt finger dissection was then carried down through the vastus lateralis to the proximal fragment. Great care was taken to avoid excessive stripping of soft tissues at the fracture site. After anatomical reduction of the fracture, entry point was made. Sharp dissection made through the fascia and a heavy curved scissor introduced to the level of the trochanter and spread open to provide a less impeded path for instrumentation. The guide pin was then perched just medial to the tip of greater trochanter on the anterior-posterior view and centered on the lateral view. The guidewire was advanced to the level of the lesser trochanter.

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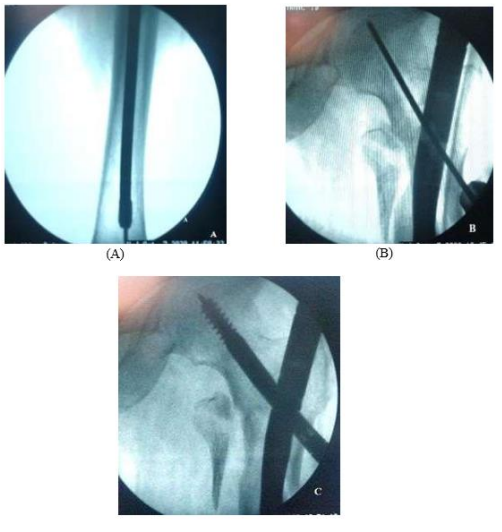
[A] **[B]**

(A) Preoperative Xray (B) Entry point and Excess to Medullary canal made Cannulated Awl used over the guidewire to make the entry point and to gain

access to the Intramedullary canal. Both the guide pin and awl were removed and a ball-

tipped guidewire advanced to the level of the fracture. Anatomic reduction maintained with the help of clamps; the guidewire then advanced to the level of the distal most shaft of femur. A lateral view of the knee is checked to determine the position of the ball tip relative to the anterior cortex of the femur and serial reaming done.



(A) Reaming of Femoral Medullary canal

(B) Guidewire insertion

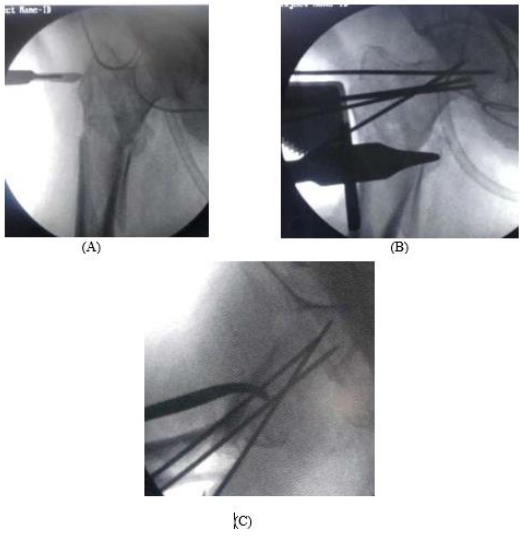
(C)Lag screw in Femoral Head

AP view of the hip was obtained to assess appropriate depth of nail insertion and to ensure that the locking screws are entering the nail at the appropriate position relative to the femoral head and neck. Rotation and length were assessed before locking the nail. The

wounds were copiously irrigated and closed in layers.

Extra medullary plate fixation

The patients placed supine on a fracture table with the affected leg padded in a traction boot and the contralateral leg padded in a lithotomy position. This position ensures adequate fluoroscopic imaging in the antero-posterior and lateral planes. A direct lateral approach was made over the flare of the trochanter, deepened through the skin, subcutaneous tissue, and fascia lata. The vastus lateralis was elevated in a sub muscular fashion from its origin on the vastus ridge and the lateral shaft of femur. Manipulation of the proximal and distal fragments performed using clamps, joysticks, circumferential clamping techniques. The proximal fixation placed accurately into the femoral head, for example, when using a dynamic hip screw, a dynamic condylar Screw, or a locking proximal femoral plate.



(A) Preoperative X-ray

(B) Guide Wire insertion AP view

(C) Lateral View

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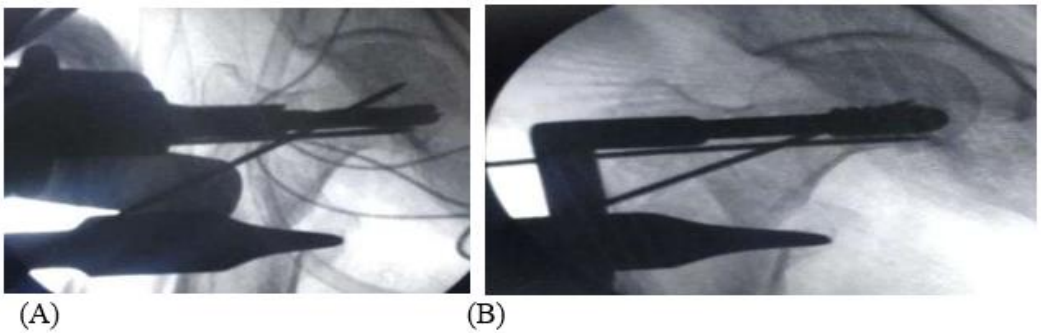
The plate on the proximal fragment then reduced to the shaft. Side plate screws are placed in the usual fashion in compression mode. The relationship of the tip of the trochanter and the center of the femoral head carefully scrutinized to avoid any varus deformity.



(A) (B)

(A) Reaming of Femoral Head

(B) Lag screw insertion

After the plating got done, the wound thoroughly irrigated and closed in layers with a suction drain. The patient placed in a loose compressive dressing. Post operatively patients were managed with IV third generation cephalosporin and aminoglycosides for 5 days. Oral antibiotics started from 6th day post operatively. Parenteral analgesics were given for the first 2 days depending upon the tolerance level of pain by the patient. Drain was removed on 2nd post-operative day in extra medullary implant fixation cases where negative suction drain was used. Static quadriceps strengthening exercises and physiotherapy started on post operative day 1. Regular aseptic dressing was done. Half sutures removed on 12th and full on 14th postoperative day. Radiological evaluation was done on 4th and 8th week and subsequently every month until evidence of union or declared as non-union. On each follow up the Functional assessment as per HHS (at 4 weeks, 12

weeks,24 weeks), Radiological union and Complications were assessed. Weight bearing and rehabilitation of the patients were decided based on fracture pattern, bone quality, radiological evidence of callus formation and union.

Rate of bone union was assessed as per criteria of Bridging of callus at 3 cortices, Obliteration of fracture line, Absence of displacement of fracture segments and Absence of implant loosening.

Patients were assessed based on the following criteria:

- Demographic analysis of the patient includes age and sex of patient.
- Mode of Injury
- All the fractures were categorized as per Seinsheimer classification20 based on fracture pattern.
- Duration of surgery was calculated from incision to closure of wound.
- Intraoperative blood loss was measured with the help of gauze and sponges. Post- operative blood loss was measured in suction drain (in extra medullary implant group) or change in weight of dressings when drain not functional or not used.
- Outcome of Fracture union as per x-ray based evidence of callus formation and non- union, patient evaluated when there was no evidence of fracture healing present both clinically and radiologically on all follow-ups.
- Preoperative x-ray of the patient was taken and type of fracture was assessed. Immediate post-operative x-ray was taken, further x-rays were taken at 4thweek, 8th week and monthly interval thereafter and union was assessed.
- Range of Motion was assessed as degree of flexion from the fully extended limb which was measured by using goniometer. Range of motion was assessed at first, third and
- sixth month.
- Functional assessment was done using Harris Hip Score 38,39 at 4, 12 and 24 weeks.

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Statistical analysis: The data from the present study was systematically collected, compiled and statistically analyzed using software IBM SPSS version 26 to draw relevant conclusions. Level of significance was determined as its p value with $p<0.05$.

RESULTS

In the present study maximum age taken was 82 years and minimum was 20 years with mean age of 48.42 years. Mean age in intramedullary and extra medullary fixation being 49.67 years and 47.08 years respectively. Most of the patients in present study population fall in the age group of 40-60(44.23%) years.

In present study, 27(51.92%) out of 52 were males and 25(48.08%) out of 52 patients were females.

28 (53.85%) patients out of 52 had RTA and 24 (46.15%) had history of fall.

Most of patients were 3A= 12(23.07%) and 2C= 11(21.15%)

Right side involved in 27 (51.92%) and left side involved in 25 (48.08%) among the study groups.

Proximal Femoral LCP was used in 40%, Dynamic Condylar Screw in 28%, Blade plate in 20 % and Dynamic Hip Screw in 12% of the cases.

Proximal Femoral Nail was used in 21/27 (77.7%) of the patients and gamma nail in 6/27 (22.3%) of the patients.

28 (52.84%) of patients out of 52 had RTA and 10 (35.71%) of the total patients with RTA had associated injuries.

Significantly lesser duration of surgery in intramedullary implant group of 84.07 mins as compared to 101.4 minutes in extra medullary implant group.

Significantly lower total blood loss in intramedullary group of 177.96 ml as compared to

302.2 ml in extra medullary group.

At 28 weeks union was present in 24(88.9%) cases in intramedullary group and 20(80%) patients in extra medullary group. The difference is statistically insignificant with

p value of 0.374

Mean time of union in intramedullary group was 20.33 weeks and extra medullary group was 18.68 weeks and the difference is statistically insignificant.

19(70.3%) patients in intramedullary and 17(68%) patients in extra medullary groups had good to excellent HHS at 24 weeks.

A total of 3 superficial infections, 8 non-union with 5 implant failure and 2 cases of knee stiffness was present.

In the present study the maximum age was 82 years, and minimum age was 20 years with a mean age of 48.42 years. Mean age in intramedullary and extra medullary and age groups being 49.67 years and 47.08 years respectively. Most of the patients in the present study population fall in the age group of 40-60(44.23%) years.

RESULTS:

Age distribution of Patients

Characteristic	**Intramedullary implant (n=27)**		**Extra medullary implant (n=25)**	
	n	**%**	**f**	**%**
Age (years)				
<40	9	33.3	10	40
40-60	12	44.4	11	44
>60	6	22.2	4	16
Mean	49.67		47.08	

Mode of Injury

Variables	**Intramedullary implant (n=27)**		**Extra medullary implant (n=25)**	
Mode of Injury	**n**	**%**	**n**	**%**
FALL	13	48.15	11	44
RSA	14	51.85	14	56

Fracture type according to Seinsheimer Classification[20]

Variables	**Intramedullary implant (n=27)**	**Extra medullary implant (n=25)**

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Classification (Seinsheimer)	n	%	n	%
2A	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

Table: Side involved in study group

Variables	Intramedullary implant (n=27)		Extra medullary implant (n=25)	
Side	n	%	n	%
Left	10	37.0	15	60.0
Right	17	63.0	10	40.0

Table : Implant used in Extra medullary group (n=25)

S. No.	Implant used	n	%
1.	BLADE PLATE	5	20.0
2.	DCS	7	28.0
3.	DHS	3	12.0
4.	PFLCP	10	40.0

Table : Implants used in Extra medullary group (n=27)

S.no.	Implant type	n	%
1	PFN	21	77.7
2	Gamma	6	22.3

Table : Associated Injury among Groups

Associated injuries	Intramedullary Implant (n=27)		Extra medullary Implant (n=25)	
	n	%	n	%
Contralateral femur fracture	3	11.11	0	0
Head injury	3	11.11	0	0
Fracture Clavicle	0	0	1	4.0
Fracture both bone leg(ipsilateral)	0	0	2	8.0
Abdominal injury	0	0	1	4.0

Table: Duration of Surgery (n=52)

S. No.	Group	Mean	SD	t--value	p value
1.	Intramedullary implant	84.07	15.066	3.897	.001*
2.	Extra medullary implant	101.40	16.988		

* significant at 0.05 level.

Table: Radiological assessment for callus formation/Union (n=52)

Weeks	Radiological status fo union	Intramedullary implant (n=27)		Extra medullary implant (n=25)	
		n	%	n	%
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	Absent	21	77.8	20	80.0
	Present	6	22.2	5	20.0

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20th week	Absent	15	55.6	9	40.0
	Present	12	44.4	16	60.0
24th week	Absent	9	33.3	5	12.0
	Present	18	66.7	20	88.0
28th week	Absent	3	11.1	5	20
	Present	24	88.9	20	80

Table: Blood Loss during Surgery (n=52)

S. No.	Group	Mean (ml)	SD	t--value	p value
1.	Intramedullary implant	177.96	36.775	8.253	.001*
2.	Extra medullary implant	302.20	68.284		

Table: Harris Hip Score[38,39](n=52)

Weeks	Implant Group	Harris Hip Score								
		Poor		Fair		Good		Excellent		Mean ± SD
		n	%	n	%	n	%	n	%	
4th week	Intramedullary	27	100	--	--	-	--	-	--	28.26±9.264
	Extramedullary	25	100	•	--	-	--	--	--	11.80±3.841
12th week	Intramedullary	24	88.9	1	3.7	-	--	2	7.4	57.44±14.407
	Extramedullary	23	92.0	1	4.0	-	--	1	4.0	53.52±15.956
24th week	Intramedullary	8	29.6	--	--	9	33.3	10	37.0	80.78±13.551
	Extramedullary	5	20.0	3	12.0	8	32.0	9	36.0	81.64±11.715

Table: Complications

Complications	Intramedullary implant (n=27)		Extra medullary implant (n=25)	
	n	%	n	%
Infection(superficial)	1	3.7	2	8
Infection(deep)	0	0	0	0
Neurovascular injury	0	0	0	0
Nonunion	3	11.1	5	20
Implant failure wit varus collapse	1	3.7	4	16
Knee stiffness	2	7.2	0	0
Hip stiffness	0	0	0	0

Table: Mean time of Union (n=52)

S. No.	Group	Mean	SD	t--value	P value
1.	Intramedullary implant	20.33	4.517	-1.518	0.135
2.	Extra medullary implant	18.68	3.138		

INTRAMEDULLARY GROUP

PRE OP

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POST OP (POD 0)

24 WEEKS POST SURGERY

EXTRA MEDULLARY GROUP

12 WEEKS POST SURGERY

PRE OP

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POST OP

POD 0

12 WEEKS POST SURGERY

24 WEEKS POST SURGERY

DISCUSSION

In subtrochanteric femur fractures deforming forces are difficult to curtail and these fractures take more time to unite. Hence, it is a challenging case for treating orthopedic Surgeons. Choosing the best implant is controversial.

In present study attempt was made to compare the outcome of sub trochanteric fractures treated with intramedullary and extra medullary implant fixation.

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 now a days. A similar study by Streubel et al.40 showed an almost equal incidence in both sexes. Though a study conducted by Lee et al.41 shows a male pre ponderance with 21 men out of 26 total cases.

A major proportion of the study group, 28 out of 52 patients (53.85%) had RTA while 24 patients (46.15%) had history of fall. Similar results were shown by Rao et al.42 with road traffic accidents in 60 % of cases and 40% of cases following accidental fall.

As per Seinsheimer classification, most of the patients in the present study were classified into 3A and 2C i.e. 23/52 (44.22%) cases followed by types 2B, 3B and 4 with 7 (13.46%)

cases in each group.

The right side was involved in 27 cases, making 51.92 % of cases and left side accounted for 25 cases making 48.08 % of total cases i.e. almost equal involvement of both sides.

In the 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 extra medullary 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 (depending on the surgeon) were preferred and for fractures with breach/ comminution in the lateral cortex PFLCP was preferred.

The mean duration of surgery in intramedullary group in present study was 84.07 minutes, similar result was given in a study by Ekstrom et al.43 which showed 56.6 minutes. The mean duration of surgery in extra medullary group in present study was 101.4 minutes,

Similar results were given by Celebi et al.[44] which showed a mean duration of 110 minutes

and Pai et al.[45] which showed a mean duration of surgery to be 100 minutes. The difference in the mean duration of surgery in both the group in present study is statistically significant.

In present study mean total blood loss in extra medullary implant group was 302.2mL 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 extra

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medullary implant groups.

There were 3 cases of superficial infection (2 in extra medullary group and 1 in intramedullary group). All of them were managed with I.V. antibiotics.

The mean time of union in intramedullary implant group is 20.33 weeks. Other studies showing mean time of union:[46-49]

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 extra medullary implant group was 18.68 weeks. Other studies showing mean time of union.[50,51]

Mean time of union in intramedullary implant group was 20.33 weeks which was relatively more as compared to extra medullary 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.[52,53]

Rate of union in extra medullary group is 80%. Other studies showing union rates:[54]

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

In the present study a total of 8 cases developed non-union and they were advised revision- surgery with bone grafting at 28 weeks post-surgery. 3 cases in intramedullary group and 5 cases in extra medullary group were in non-union. Out of the 3 cases in intramedullary group, one also had implant failure (3.7%). Similar results were shown by a study by Kanthimathi et al.[55] where the rate of implant breakage in PFN was 4% and a study by Streubel et al.[56] with 5% non-union.

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.[57]

Two patients were non-union with the implant being stable, were taken up for revision surgery. Out of 5 cases of non-union in extra medullary group, one of them had non-union with stable implant in situ. Two patients were non-compliant and started weight bearing

without being advised. In a study by Asif et al.58 the union rate was found to be 92%, 3(12%) patients developed bending or breakage of proximal screws and in 3 (12%) cases varus deformity was observed.

Harris Hip Score was significantly low in the extra medullary implant group at the end of 4 weeks, this was due to delayed weight bearing in the extra medullary group but there was no significant difference in the two groups at 12 and 24 weeks post-surgery38,39. 70.3% of patients in intramedullary group and 68% of patients in extra medullary group had good to excellent Harris Hip Score at 24 weeks post-surgery in a study by Kumar et al.59 was seen in 77.5% of patients. There were no cases of hip stiffness.

CONCLUSION

It is observed that the duration of surgery and amount of blood loss in intramedullary implant group was significantly lower as compared to extra medullary implant group. The extra medullary implant group had higher incidence of implant failure, though there were no major differences in the functional outcomes and union rates. In conclusion, both intramedullary and extra medullary implant fixation are effective treatment options in the management of sub trochanteric femur fractures and implant of choice depends on the fracture type and surgeon preference.

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