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Comparative study of Harris Hip Score in Proximal Femoral Nail with Augmentation and Proximal Femoral Nail without Augmentation in Unstable Intertrochanteric Femur Fracture treated in Adults

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Abstract

Various modalities of treatment of intertrochanteric are available which includes extramedullary devices like DHS and intramedullary nails like PFN, PFNA, TFN, GAMMA nail. Present study was aimed to compare Harris hip score in proximal femoral nail with augmentation and proximal femoral nail without augmentation in unstable intertrochanteric femur fracture treated in adults at a tertiary hospital. Material and Methods: Present study was single-center, prospective, comparative study, conducted in patients > 20 years age, either gender, admitted with unstable inter-trochanteric femur fractures amenable to osteo- synthesis by Proximal Femoral Nailing, Patients allocated as Patients operated with proximal femoral nail with augmentation using SS wire - Group A & Patients operated with proximal
femoral nail - Group B . Results: Age, gender, mode of trauma & co-morbidities were comparable among both groups. In group A, patient had Harris hip score of 0 on day of trauma, mean score of 69.57 ± 4.78 on 1st month , mean score of 75.71 ± 4.63 on 3rd month and mean score of 85.85 ± 2.87 on 6th month with F-value of 2076.13 and P-value of less than 0.0001.. In group B, patient had Harris hip score of 61.29 ± 5.60 on 1st month, mean score of 72.35 ± 4.07 on 3rd month and mean score of 78.23 ± 2.33 on 6th month with F-value of 1812.81 and P-value of less than 0.0001. Conclusion: Osteosynthesis with proximal femoral nail with augmentation in unstable intertrochanteric femur fracture in the adult patients leads to better functional outcomes as compared with osteosynthesis with proximal femoral nail without augmentation.

Categories: Physical Medicine & Rehabilitation, Orthopedics, Trauma

Keywords: ss wire, internal fixation, unstable intertrochanteric femur fracture, proximal femoral nail, osteosynthesis

1. Introduction

Traditional Intertrochanteric femur fractures are common in the elderly, but they can also occur in the younger population. The treatment for these fractures is usually conservative. Major drawback of non-surgical intervention is mal-union with coxa-vara deformity leading to limb length discrepancy and limp.[1] Major reason for trochanteric fracture increase is attributed to decrease in bone density in old age. Low energy trauma is reason for majority of trochanteric fractures in elderly while high energy trauma is responsible in younger age group.[2] High energy vehicular trauma is responsible for comminuted fracture of trochanter in young age group and it poses a major problem to surgeons to restore the normal function in such individuals.[3]

Various modalities of treatment of intertrochanteric are available which includes extra-medullary devices like DHS and intramedullary nails like PFN, PFNA, TFN, GAMMA nail. DHS when used for unstable intertrochanteric fractures have higher complications as compared to intramedullary nails [4]. The PFN's intramedullary position prevents the proximal fragment from collapsing and the distal fragment from medialisation. The proximal femoral nail, as an intramedullary load sharing device, aids in early post-operative movement, weight bearing, and, eventually, early fracture union [5]. Present study was aimed to compare Harris hip score in proximal femoral nail with augmentation and proximal femoral nail without augmentation in unstable intertrochanteric femur fracture treated in adults at a tertiary hospital.

2. Materials and Methods

Present study was single-center, prospective, comparative study, conducted in Department of orthopedics, at NKP Salve medical college & hospital, Nagpur, India. Study duration was of 2 years (July 2019 to Dec 2021).

Inclusion criteria

- Patients > 20 years age, either gender, admitted with unstable inter-trochanteric femur fractures amenable to osteo-synthesis by Proximal Femoral Nailing, willing to participate in study.

Exclusion criteria:

- Sub-trochanteric femur fractures
- Compound fractures• Patients with associated fractures in ipsilateral lower limb
- Associated pelvic fractures

After approval of ethical committee, all the patients getting admitted in tertiary care teaching hospital fulfilling the inclusion and exclusion criteria, were included in the study. Study was explained in local language & consent was taken for participation. Detailed Pre-op clinical evaluation was done as clinical examination, laboratory & radiological evaluation, fitness taken from anaesthesia for surgery. Patients were operated under spinal or epidural or general anesthesia for closed reduction and internal fixation (CRIF) with proximal femoral nail (PFN). Pre-operative randomization of patients was done using computer-based randomization software & patients allocated as:

- Patients operated with proximal femoral nail with augmentation using SS wire - Group A
- Patients operated with proximal femoral nail - Group B

Closed reduction and internal fixation with proximal femoral nail with augmentation using SS wire: Group A

Patients were operated under spinal or epidural or general anesthesia. A fracture table was arranged for all the cases and controls. following suitable anesthesia patient was placed supine on fracture table. Patient injured leg was placed in neutral or adduction with 10 to 15 degrees on internal rotation and uninjured leg placed in flexion and abduction as far as possible to accommodate the image intensifier. The image intensifier was positioned so that simultaneous antero-posterior and lateral view can be taken.

FIGURE 1: Patients position on fracture table

Closed reduction attempt was carried out in all patients. All steps of reduction were carried out under fluoroscopy control. The first step of reduction is in the antero-posterior plane and is accomplish through traction. Once it appears that appropriate angle has been obtained and that the tip of trochanter is at the center of the femoral head then a lateral view was obtained. If the fracture was not reducible in lateral view, without disturbing the AP view then the leg should be placed in approximately 15 degrees. Usually, satisfactory reduction was obtained in both AP and lateral views. If reduction is not attained by closed reduction methods, then reduction (open) has to be performed. The patient was given a scrub and then parts were painted and draped for the standard hip fracture fixation. Prophylactic antibiotic was given to all the patients. The tip of greater trochanter was located by palpation or occasionally by using image intensifier in obese patients. A 5 cm longitudinal incision was taken proximal from tip of trochanter.

FIGURE 2: Incision

FIGURE 3: C-arm image showing site of incision

Fascia lata was opened in line of incision and the gluteus medius was split in line with fibers and tip of trochanter was exposed. At the level of the lesser trochanter (LT) a stab incision is made, and a cerclage wire (SS wire) is passed using an AO cerclage instruments. The two ends of the wire now project in the wound.

Through the incision of the IMN entry portal, Kocher forceps are introduced and passed sub muscularly distally and the anterior end of the cerclage wire is grasped and delivered proximally. Another stab incision is made at the level of the GT anterolaterally. Kocher forceps is introduced into the wound and into the abductor muscles. The forceps are now brought into the entry point incision and the end of the wire is grasped and brought medial to proximal end of the IMN. The same Kocher forceps, grasping the wire is now passed distally in a sub muscular plane down to the previous stab incision. Now both wires are held and tensioned. The excess wire is cut and the knot bent and tapped inside the wound.

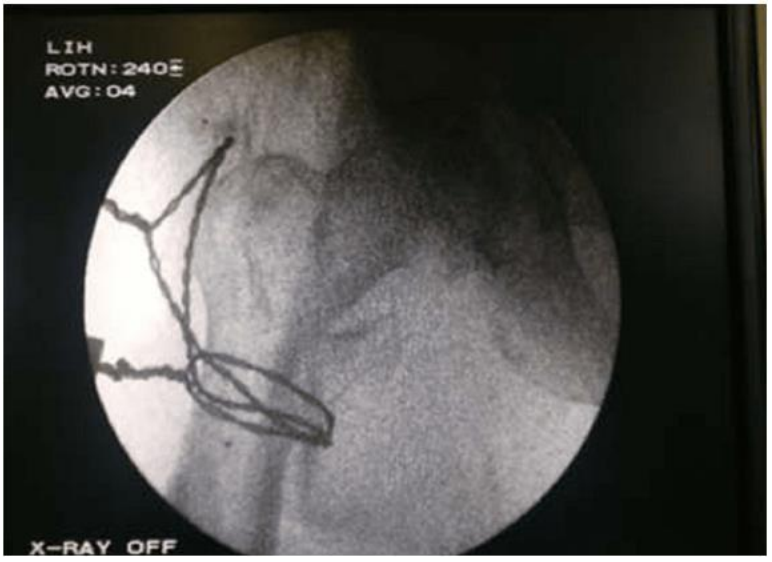

FIGURE 4: Circlage SS wiring

Entry point was taken with the help of curved awl by placing it upon tip of greater trochanter (in AP view). On the lateral view, it was conformed that tip of awl lies in the center of medullary canal. Awl was driven into cancellous bone till medullary canal was opened.

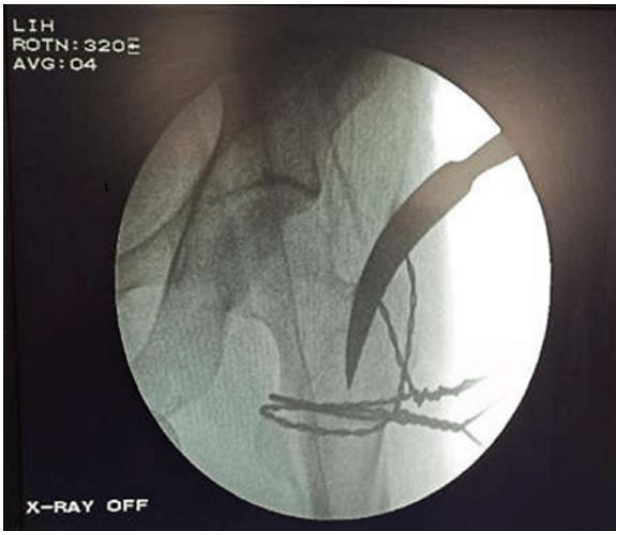

FIGURE 5: Entry into medullary canal

The awl was removed and guide a wire was inserted in entry point made with awl using T handle under image intensifier. Proximal cannulated reamer was used to open the proximal portion of femur to about 14 mm to accommodate the proximal portion of nail (14 mm). Reaming was carried out over the guide wire. Also, serial reaming was done to open a medullary canal by 8, 9, 10, 11 size reamer. Nail selected as per preoperative planning was tightly connected to the insertion handle and all the guides are matched up to the holes. Then the nail placed over guide wire. The nail is then gently pushed through the trochanter region and across the fracture area under image intensifier using gentle twisting movements of handle. Nail is then pushed down until the profile of proximal locking hole is noted to appear to just pass the inferior aspect of the neck. Slight twisting hand movements help insertion. Guide wire was then removed. Proximal and distal screws were inserted through the insertion handle. These are inserted with the help of aiming device tightly secured to the insertion handle and using the appropriate guide wire sleeves. A 1.8 mm threaded guide pin is inserted through the sleeves approximate to the lateral cortex to avoid misdirection of the guide wire.

Position of the guide wire in the inferior aspect of the neck in AP view and center in lateral view for the 8 mm hip screw is ascertained with the help of image intensifier. Similarly, another guide wire was inserted through the proximal hole for insertion of the 6mm derotation screw. Proper positioning of the nail will aid in proper anteversion of the guide wire as there is inbuilt anteversion in the hole of the nail.

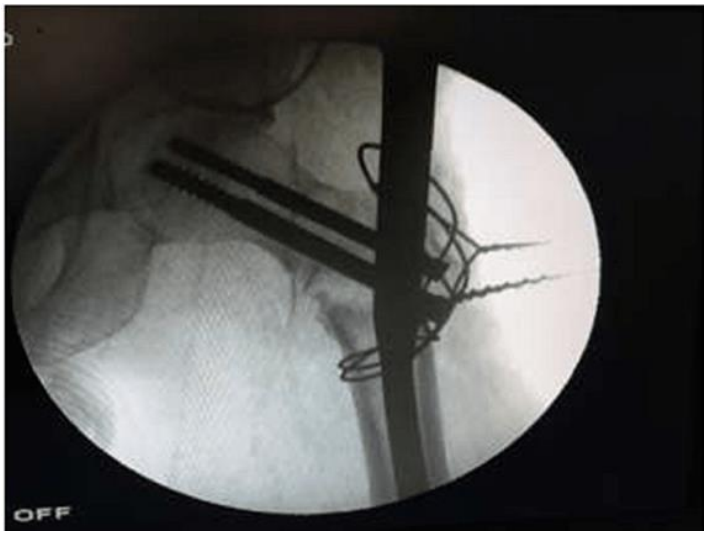

FIGURE 6: Proximal bolts under C-arm

Two holes are available one for static interlocking & the other for dynamic interlocking. Distal locking was done. Using appropriate guide, stab incision was made on lateral aspect of thigh and distal locking of nail is done with 4.9 mm locking bolt after drilling both cortices using 4 mm drill bit and taking measure of screw length.

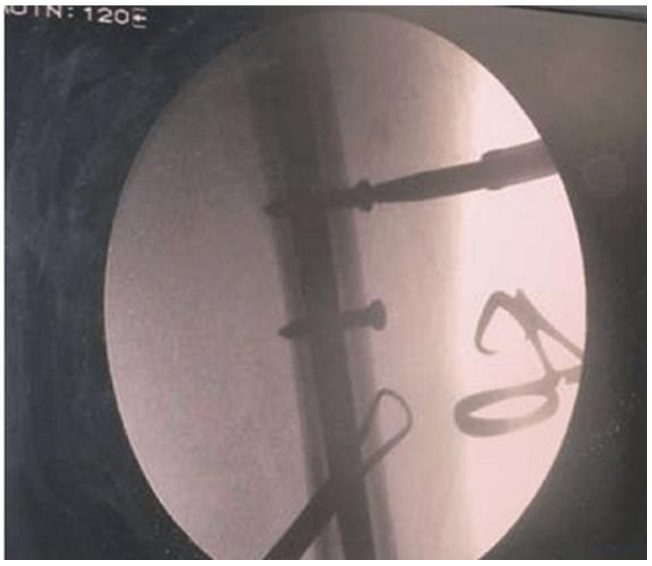

FIGURE 7: Distal Locking under C-arm

The instrument is removed, wash given with normal saline and wounds were closed in layers. At this time the position of screws was reviewed to make sure that there is no intraarticular penetration.

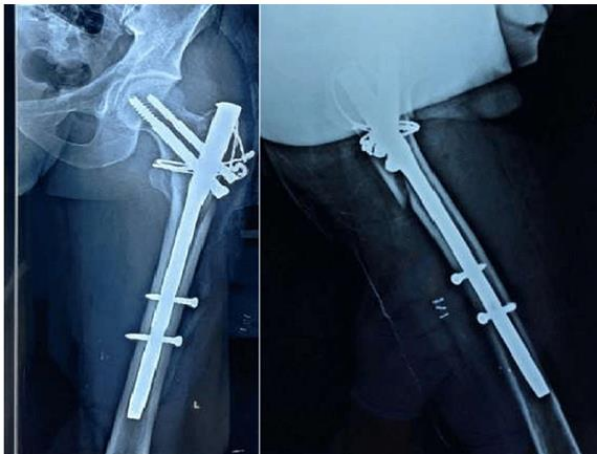

FIGURE 8: Post operative x-ray

Closed reduction and internal fixation (CRIF) with proximal femoral nail (PFN): Group B Anesthesia, positioning of patient, reduction method of fracture and incision was same as of Proximal femoral nail with augmentation in proximal femoral nail without augmentation.

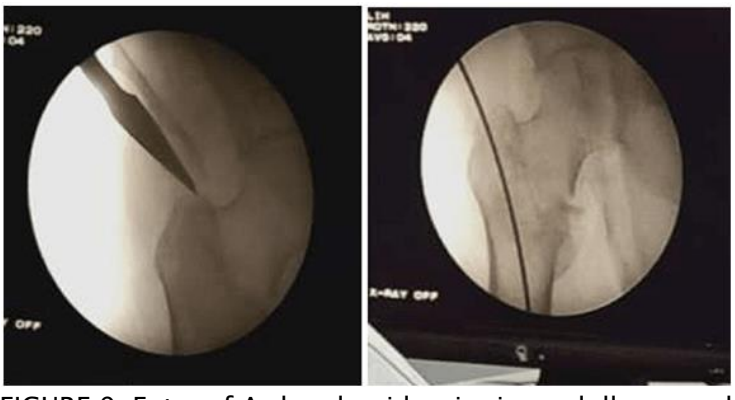

FIGURE 9: Entry of Awl and guide wire in medullary canal

FIGURE 10: Insertion of PFN

FIGURE 11: insertion of bolts

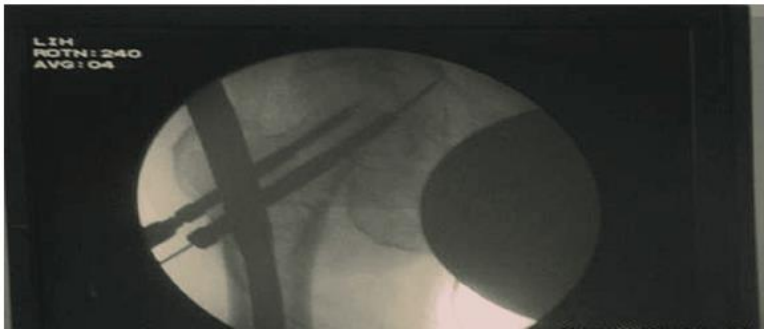

FIGURE 12: Bolts under C-arm

FIGURE 13: Closure after surgery

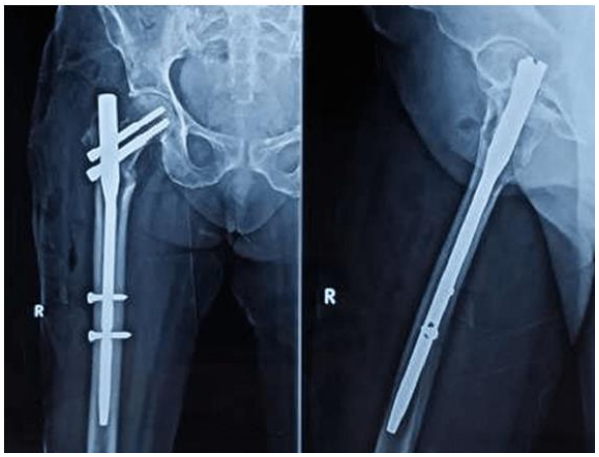

FIGURE 14: Post operative X-ray.

Postoperative protocol was same for both the groups. Check x-ray was taken after the surgery. I.V. antibiotics were given 12 hourly for 72 hours. Active and passive knee and hip exercises are started on the 1st Post Operative Day. 1st check dressing was done on 2nd Post Operative Day. 2nd dressing was done on 7th Post Operative Day. Suture removal was done on 10th/11th Post Operative Day. Crutch walking taught in the hospital. Patients were kept non-weight bearing till 1st follow up. Patient was advised to perform active hip and knee exercises.

Both groups were compared in terms of pre-operative, peri-operative and post-operative outcomes including functional outcome.

- Intra-operative blood loss, radiological exposure, operative time.
- Clinical, radiological, and functional evaluation will be done at 1, 3 and 6 months by Harris hip score Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version.

Frequency, percentage, means and standard deviations (SD) was calculated for the continuous variables, while ratios and proportions were calculated for the categorical variables. Difference of proportions between qualitative variables were tested using chi- square test or Fisher exact test as applicable. P value less than 0.5 was considered as statistically significant.

3. Results

TABLE 1: General characteristics

Characteristics	PFN with Augmentation - group A (%)	PFN - group B (%)	P value
Age (years)			
20-40	3 (21.43 %)	1 (5.88 %)	0.7520
41-60	2 (14.29 %)	9 (52.94 %)	
61-80	7 (50 %)	5 (29.41 %)	
>80	2 (14.29 %)	2 (11.76 %)	
Mean age ± SD	61.85 ± 18.89	59.88 ± 15.6	
Gender			0.092
Male	10 (71.43 %)	7 (41.17 %)	
Female	4 (28.57 %)	10 (58.83 %)	
Mode of Trauma			
Fall	11 (78.57 %)	15 (88.24 %)	0.0467
RTA	3 (21.43 %)	2 (11.76 %)	

In our study, in group A majority of patient belong to age range of 41- 60 (50 %) and in group B (52.94 %). Mean age in group A was 61.85 ± 18.89 and in group B was 59.88 ± 15.60. Group A had male patient 10 (71.43%) and female 4 (28.57 %) and in group B male\patient 7 (41.15%) and female patient 10 (58.85 %). Age, gender, mode of trauma were comparable among both groups & difference was not statistically significant.Complication, death in one year and blood transfusion required in both the groups that is, proximal femoral nail with augmentation and proximal femoral nail without augmentation, the "p" value in all three was insignificant.

TABLE 2: Operative characteristics

Characteristics	PFN with Augmentation – group A (Mean ± SD)	PFN – group B (Mean ± SD)	P value
Surgical time (mins)	122 ± 19.54	85.76 ± 22.28	<0.0001
Union time (weeks)	11.64 ± 1.08	14.52 ± 4.3	0.021
Hospital stays (days)	11.64 ± 1.08	14.17 ± 3	0.0056
Radiation Exposure (No. of C-arm shoots)	54.71 ± 8.53	49.47 ± 15.03	0.2562
Blood loss (ml)	108.57 ± 19.55	88.23 ± 31.47	0.0443
Blood Transfusion required	5 ± 35.71	3 ± 17.65	0.253

In our study, mean surgical time in group A was 122 ±19.54 minutes as compared to group B as 85.76 ± 22.28 minutes & difference was highly significant. Group A patient had mean union time after surgery was 11.64 ±
1.08 weeks, and in group B was 14.52 ± 4.40 weeks & difference was statistically significant. Group A patient had mean hospital stay of 11.64 ± 1.08 days and in group B was 14.17± 3 days, & difference was statistically significant. Group A patient had blood loss of 108.57 ±19.55ml and group B had mean blood loss of 88.2±
31.47 ml & difference was statistically significant. Group A mean radiation exposure was 54.71 ± 8.53 shoots and in group B was 49.47± 15.03. & difference was statistically significant.

TABLE 3: Comparison of Harris Hip Score at different follow up period.

Group	1 month	3 months	6 months	F value	P value
PFN with Augmentation – group A (%)	66.57 ± 4.78	75.71 ± 4.63	85.85 ± 2.87	2076, 13	<0.00 01
PFN – group B (%)	61.29 ± 5.6	72.35 ± 4.07	78.23 ± 2.33	1812. 81	<0.00 01
P value	0.0001	0.0401	<0.0001		

In study, in group A, patient had Harris hip score of 0 on day of trauma, mean score of 69.57 ± 4.78 on 1st month, mean score of 75.71 ± 4.63 on 3rd month and mean score of 85.85 ± 2.87 on 6th month with F-value of 2076.13 and P-value of less than 0.0001. In group B, patient had Harris hip score of 61.29 ± 5.60 on 1st month, mean score of 72.35 ± 4.07 on 3rd month and mean score of 78.23 ± 2.33 on 6th month with F-value of 1812.81 and P-value of less than 0.0001.

TABLE 4: Harris Hip Score

Characteristics	Harris hip score category	PFN with Augmentation – group A (%)	PFN– group B (%)	P value
1 month	< 70	10 (71.43 %)	16 (94.12 %)	0.087
	71–80 Fair	4 (28.57 %)	1 (5.88 %)	
3 months	< 70	4 (28.57 %)	7 (41.17 %)	0.045
	71–80 Fair	9 (64.29 %)	10 (58.83 %)	
	81–90 Good	1 (7.14 %)	0	
6 months	< 70	0	0	<0.001
	71–80 Fair	0	16 (94.12 %)	
	81–90 Good	13 (92.86 %)	1 (5.88 %)	
	>90 Excellent	1 (7.14 %)	0	

In our study, group A, at 1 month 10 patient had poor and 4 patients had fair Harris hip score, at 3–month 4 patient had poor, 9 patients had fair and 1 patient had good outcome, at 6 month 13 had good and 1 patient had excellent outcome. In group B, at 1 month 16 patient had poor and 1 patient had fair Harris hip score, at 3–month 7 patient had poor, 10 patients had fair, at 6 month 16 had fair and 1 patient had good outcome. P– value at 6th month was less than 0.001 which is highly significant.

TABLE 5: Incidence of complications, Deaths in one year of operation

	PFN with Augmentation – group A (Mean ± SD)	PFN – group B (Mean ± SD)	P value
Complication (Back out)	1 ± 7.14	0	0.263
Deaths in one year	2 ± 14.29	2 ± 11.76	0.835

Complication, death in one year and blood transfusion required in both the groups that is, proximal femoral nail with augmentation and proximal femoral nail without augmentation, the “p” value in all three was insignificant.

4. Discussion

Worldwide fractures of and around the hip are relatively seen more in elderly patient due to osteoporotic nature. Less energy trauma in aged and high intensity energy trauma in younger adults accounts for hip fractures. Per–trochanteric fractures are more common in female as compare to males [5]. Fixation devices used for unstable IT fractures are PFNA, DHS, GAMMA nail, Intertan PFN [6]. Among them, PFN require high skills and advantage of less blood loss, relatively smaller incision [7]. But it demands more time, and more surgical instruments during procedure. Furthermore, when closed reduction is not possible, opening the site and reduction should be attempted; however, to transfer the weight of the human body through aligned fracture debris and avoid displacement during the procedure, various reduction techniques used for auxiliary surgical treatment, such as cerclage cable, must be used to restore abductor function and repair the trochanteric fracture.

Fractures of proximal femur often develop on the confluence of cancellous and cortical bone, which experiences greatest mechanical stress, which is why they are so common. They contribute 10% to 34% of all hip fractures [2–6].

In our study the range of age of population studied was between 20 to 90 years and mean

age of study population was 60.86 years. Similarly in a study by Wasudeo M. Gadegone et al. [4], and Zackariya Mohamed Jafarullah et al. [5], the mean-age was 66 years in both studies. The mean age was comparatively lower in studies done by Joon-Woo Kim et al. [6], and You-Shui Gao et al. [7], which were 48.3 years and 42.5 years respectively whereas it was slightly higher in a study done by Sunil Govind Kulkarni et al. [8], which was 74 years. The mean age in both the groups in present study was comparable and it was 61.85 ± 18.89 years in study group and 59.88 ± 15.60 years in control group. The mean ages of cases and control groups in study done by Ahmet Imerci et al. [9], was comparable to our study and were 56 ± 19.92 and 56 ± 20.79 respectively. Mean age was higher than present study in study by Chaoqing Huang et al. [10], being 83:0 ± 10:6 in study group and 84:7 ± 7:5 in control group, difference was not significant statistically. In our study, there were total of 17 males and 14 females which shows slight male preponderance. Our study showed results like studies by Joon-Woo Kim et al. [6], You-Shui Gao et al. [7], Ahmet Imerci et al. [9], Zackariya Mohamed Jafarullah et al. [5], which suggest that there is more male preponderance.

In a study done by Zackariya Mohamed Jafarullah et al. [5], You-Shui Gao et al. [7], Wasudeo M. Gadegone et al.[4], the mean duration of surgery was 66 mins, 55 mins and 65 mins respectively which was shorter compared to our study whereas in study conducted by Joon-Woo Kim et al. [6], the mean duration of surgery was 118.5 mins which was slightly more than present study. In our present study the mean-duration of surgery in group A was 122.0 ± 19.54 mins whereas in group B it was 85.76 ± 22.28 mins. It suggests that time required for surgery in proximal femoral nail with augmentation is more as compared to proximal femoral nail without augmentation. In a study by Chaoqing Huang et al. [10], the mean duration of surgery was comparatively lesser in group A as compared to our study which was 77.4 ± 10.6 and it was 73.5 ± 11:80 in group B and the p value was 0.064 which was not significant in a study by Zheng-Hao Wang et al. [11], the mean duration of surgery in group A was 69.57 ± 12.34 and in group B was 79.05 ± 11.84 and p value was 0.01 which was not significant. The mean values of duration of surgery were least In a study done by Sunil Govind Kulkarni et al. [8], which was 44 ± 3.17 mins and 35.2 ± 3.5 mins in group A and group B respectively.

In present study, mean union time is 13.08 weeks with minimum time of union is 10 weeks and maximum time of union is 14 weeks in all subjects. In studies done by Zackariya Mohamed Jafarullah et al.,[5] You- Shui Gao et al.,[7] Wasudeo M. Gadegone et al. [4], Joon-Woo Kim et al. [6], the mean time of union was 14 weeks, 16 weeks, 14.2 weeks, 19.1 weeks respectively which is more than our present study.

In present study, mean time of union in group A patients is 11.64 ± 1.08 and 14.52 ± weeks in group B, difference was statistically significant. In study conducted by the Chaoqing Huang et al.,[10] mean age in group A was 13.44 weeks ± 1.61 in group B and it was statistically significant with p-value of 0.0001.

Similarly, the study done by Zheng-Hao Wang et al.,[11] mean age in group A 14.28 ± 1.27 and 13.35 ± 1 in group- B, and it was found to be statistically significant with p- value of 0.001. In study conducted by Ahmet Imerci et al. [9], the mean union time in group A was 17 ± 4.92 weeks, in group B was 17 ± 4.64 weeks with p - value of 0.569 and the study conducted by Sunil Govind Kulkarni et al.,[8] the mean union time in group A was 14.44 ± 2.98 weeks and in group B was 16.4 ± 2.98 weeks with p- value of more than 0.05. Time of union in both the study was not significant.

In present study, mean blood loss in group A was 108.57 ± 19.55 ml and in group B was 88.23 ± 31.47 ml, difference was not statistically significant. In study done by Zheng-hao Wang et al.,[11] mean blood loss in group A was 191.4 ±15.7 ml and in group B was 194.7 ± 13.2 ml, difference was not statistically significant.

In present study, mean Harris Hip score at end of study in group A is 85.85 ± 2.87 and in group B is 78.23 ± 2.33 difference was statistically significant, which concludes that Harris hip score was better in patients on unstable intertrochanteric femur fracture treated with proximal femoral nail with augmentation. In study done by Zheng-hao Wang et al. [11], mean Harris Hip score at end of study in group A was 86.16 ± 5.45 and in group B is 87.92 ± 6.91, its p-value is 0.001 which was highly statistically significant. In study done by Ahmet Imerci et al. [9], mean Harris Hip score at end of study in group A was 84 ± 8.33 and in group B is 79 ± 11.62, its p-value is 0.083 which was not statistically significant.

In present study, mean Harris hip score in group A, 1 patient has excellent score with 13 patients have good score with no patient having fair and poor score. Mean Harris hip score in group B, no patient has excellent score with 1 patient has good score with 16 patients having fair and no patient have poor score, with p- value of 0.0001 which is highly significant. And concludes that majority of patient of unstable inter-trochanteric femur fracture treated with proximal femoral nail with augmentation have excellent to good results. In study done by Chaoqing Huang et al. [10], mean Harris hip score in group A, 49 patients had excellent score with 2 patients have good score with 0 patient having fair and poor score. Mean Harris hip score in group B, 58 patients have excellent score with 11 patients has good score with no patient having fair and no patient have poor score, with p-value of 0.036 which is slightly significant. In study done by Sunil Govind Kulkarni et al. [8], mean Harris hip score in group A, no patient had excellent score with 46 patients had good score with 17 patients had fair and 14 patients had poor score. Mean Harris hip score in group B, no patient had excellent score with 26 patients has good score with 32 patient having fair and 19 patient had poor score, with p- value of 0.05 which is significant.

5. Conclusions

Osteosynthesis with proximal femoral nail with augmentation in unstable intertrochanteric femur fracture in the adult patients leads to better functional outcomes as compared with osteosynthesis with proximal femoral nail without augmentation. We can safely consider it as a viable option in the treatment of unstable intertrochanteric fractures in the elderly. So, this surgery can give predictable outcomes in trained hands.

Additional Information

Disclosures

Human subjects: Consent was obtained or waived by all participants in this study. Dr. A.S. Borkar issued approval ECR/88/Inst/MH/2013/RR-19. Animal subjects: All authors have confirmed that this study did not involve animal subjects or tissue. Conflicts of interest: In compliance with the ICMJE uniform disclosure form, all authors declare the following: Payment/services info: All authors have declared that no financial support was received from any organization for the submitted work. Financial relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. Other relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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