



## Management of Intertrochanteric Fracture of Femur with Proximal Femoral Nailing

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### ABSTRACT

*Intertrochanteric femoral fractures are of intense interest globally. They are the most frequently operated fracture type, have the highest post-operative fatality rate of surgically treated fractures & have become a serious health resource issue. The incidence of fractures in Proximal femoral area has risen with increasing numbers of elderly persons with osteoporosis & traffic accidents in young adults. The aim of the study is to assess clinical & functional results in Intertrochanteric fractures that were treated by closed reduction & internal fixation using a Proximal Femoral Nail. To assess intra-operative and post-operative complications of closed reduction and internal fixation of intertrochanteric fractures using a Proximal Femoral Nail. From our study that Proximal femoral nail (PFN) can be considered the most rational method of treating intertrochanteric fractures, But Proximal femoral nailing requires a higher surgical skill, good fracture table, good instrumentation and good C-arm control. It has a steep learning curve. Thus we can conclude that the proximal femoral nail is after proper training and technique a safe and easy implant option for treatment of complex intertrochanteric fractures.*

### INTRODUCTION

Intertrochanteric femoral fractures are of intense interest globally. They are the most frequently operated fracture type, have the highest post-operative fatality rate of surgically treated fractures & have become a serious health resource issue<sup>1</sup>. The incidence of fractures in Proximal femoral area has risen with increasing numbers of elderly persons with osteoporosis & traffic accidents in young adults<sup>2</sup>. In elderly patients the incidence has increased markedly in recent years. Due to their poor bone quality, it is very difficult to achieve & maintain a stable fixation. The aim of surgery is to achieve early mobilization &

prompt return to pre-fracture activity level. The treatment of this fracture remains a challenge to the surgeon<sup>3</sup>. The most widely used extra-medullary implant- Dynamic Hip Screw {DHS}- seems to have a biomechanical disadvantage when compared with Intramedullary devices because the load bearing in Proximal femur is predominantly shared by the calcar. Intramedullary devices such as the Proximal femoral nail {PFN}, are more stable under loading with shorter lever arm, so the distance between hip joint & the nail is reduced compared with that of a plate, thus diminishing the deforming forces across the implant<sup>4</sup>. The PFN system, developed by AO/ASIF, has some

major biomechanical innovations to overcome the limitations of the DHS & Gamma nail The addition of the 6.4 mm anti-rotation hip pin to reduce the incidence of implant cut-out & the rotation of the cervico-cephalic fragments The smaller diameter & fluting of the tip of the nail, specially designed to reduce stress forces below the implant & therefore the incidence of low-energy fracture at the tip. The greater implant length, smaller valgus angle & setting of this angle at a higher level (11 cm from the proximal end) The more proximal positioning of the distal locking, to avoid abrupt changes in stiffness of the construct. In this respect, it should be borne in mind that the neck screw must be adjacent to the calcar, taking into account the need to place the anti rotational hip pin<sup>5</sup>. So we would like to plan a study using PFN for the management of Intertrochanteric fractures [OTA/AO 31A] in our institution.

**MATERIALS AND METHODS**

The study was conducted on 20 cases of intertrochanteric fractures admitted Rajiv NIMRA medical & general Hospital Vijayawada in Department of Orthopaedics during November 2015 to September 2016. The study includes Patients with age 20 years & above. All fresh fractures with Fractures about Trochanteric area classified according to the Orthopaedic Trauma Association system AO/OTA 31A1/A2/A3. The study excludes Patients younger than 20 years. Non ambulatory patients. Malunited fractures. Patients admitted with Intertrochanteric fracture were examined and investigated with X-ray pelvis with both hips AP and Lateral view (whenever possible). Skin traction was applied to all cases, upto 10% body weight till the date of surgery. Blood and urine examinations were investigated. includes Blood – Hb%, Total count, Differential count, E.S.R, sugar levels, urea Urine routine. Blood grouping and Rh type Bleeding time and Clotting time. HIV, HbsAg, HCV, Serum Creatinine, ECG Chest X –ray ,Cardiac evaluation if needed.

Physician fitness was taken for all cases. All the cases had Pre-Anaesthetic evaluation before taken up for surgery.

**INTRA-OPERATIVE PHOTOS**



Position of the patient on fracture table



Draping



Incision and entry point



Guide wire and reaming



Jig in-situ and guide wire of the proximal Femur placement for proximal screws



Placement of hip screws and distal locking



Skin closure

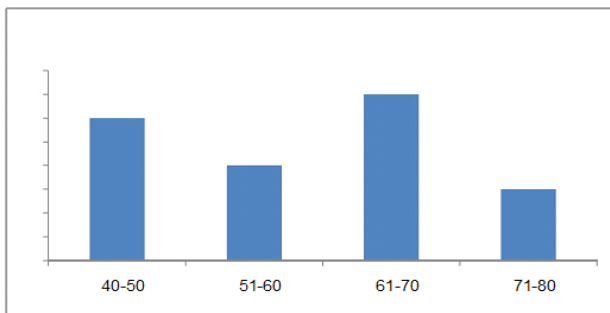
**RESULTS AND OBSERVATION**

The study involved 20 cases of Intertrochanteric fractures of either sex from November 2013 - September 2015. All the cases were treated with Intramedullary fixation- “Proximal femoral nail”. The analysis of the patient data, intra operative data & post operative outcome is as follows.

**AGE**

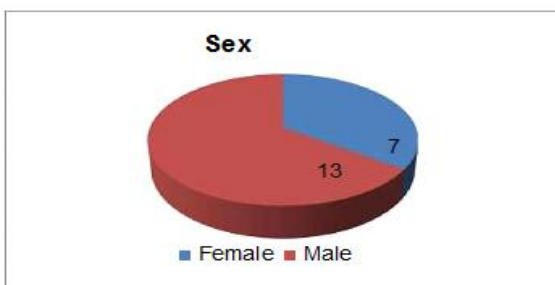
The study involved patients above 20 years of age. The age distribution was from 40 to 80 years. The mean age was 60.65 years the largest group of patients being from 61 to 70 years.

FIG 1



**SEX:** There were 7 females and 13 males in this study.

FIG 1



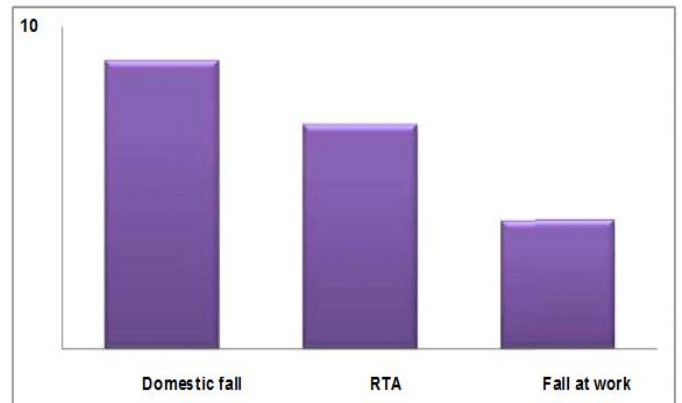
**MODE OF INJURY**

Domestic fall, road traffic accident and fall at work were three modes of injury among the patients. Most of the patients with domestic fall were older in age or had osteoporosis

Table 1

MODE OF INJURY	FREQUENCY	PERCENT
Domestic fall	9	45%
Road traffic accident	7	35%
Fall at work	4	20%
<b>Total</b>	<b>20</b>	<b>100%</b>

FIG 3 MODE OF INJURY



**SIDE OF INJURY**

The following is the data of Left and Right hip involvement

Table 2

Side of injury	Frequency	Percent
Left	12	60%
Right	8	40%
Total	20	100%

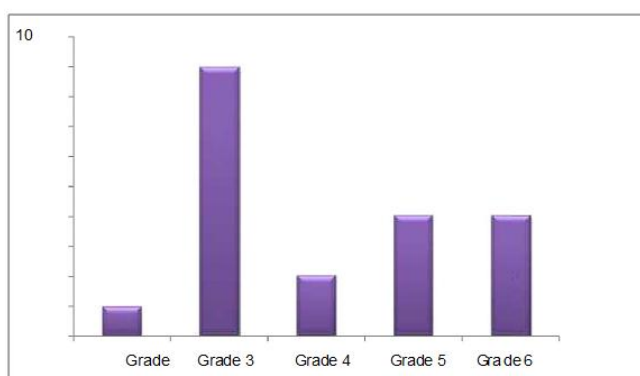
**SINGH'S INDEX**

The following data is on Osteoporosis, graded by Singh's Index among the patients involved in our study.

**Table 3**

Singh's Index	Frequency	Pe rcent
Grade 2	1	5 %
Grade 3	9	45%
Grade 4	2	10%
Grade 5	4	20%
Grade 6	4	20%
<b>Total</b>	<b>20</b>	<b>1000%</b>

FIG :4



**FRACTURE PATTERNS**

All the fractures were classified as per Orthopaedic Trauma Association (OTA) classification. In which 31A1 were considered stable fractures. 31A2 and 31A3 were uns table fractures.

Table 4

Fracture pattern	Frequency	Percent
3.1 A1	Nil	Nil
3.1 A2	14	70
3.1 A3	6	30
<b>Total</b>	<b>20</b>	<b>100</b>

**Associated injuries**

Our study had one patient with an associated injury of fracture distal end radius of contralateral side which was treated with closed reduction and internal fixation with K-wire and cast application. There were no other associated injuries like fracture ribs, ilium, pelvis or fracture shaft of femur.

**Co-Morbid illness**

The co-morbid illness that were associated with patients included in our study were, diabetes mellitus, hypertension, low pre-operative haemoglobin and basal crepitations on chest auscultation and patients were treated and made fit for surgery.

**BLOOD LOSS AND BLOOD TRANSFUSION**

Blood loss was calculated intra operatively by number of mops used during the surgery. One mop equal to 50ml blood loss approximately. The average blood loss was 1.60 mops, so 80ml. 2 patients required post operative blood transfusion as their pre-operative hemoglobin was less (9-10gm%). None required blood transfusion intra-operatively.

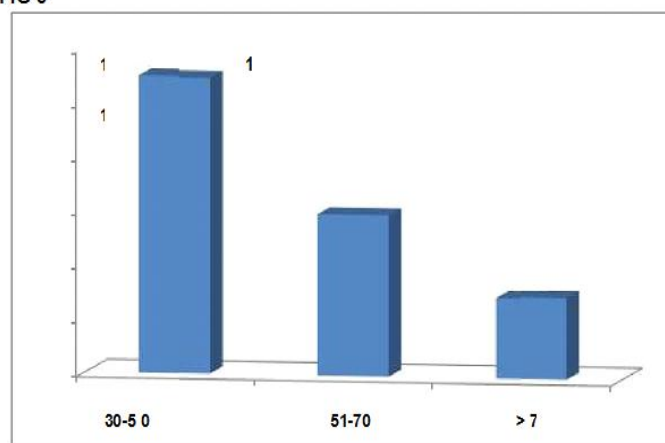
**OPERATING TIME**

The following table provides the data on duration of surgery, that includes from the time of incision upto skin closure. The average operating time was 53.25 minutes.

Table 5

Duration of surgery(min)	Frequency	Percent
30-50	11	55%
51-70	6	30%
>70	3	15%
<b>Total</b>	<b>20</b>	<b>100%</b>

FIG 5



**REDUCTION**

Fracture was reduced anatomically by closed means.

**Intra-Operative**

The intra-operative period was uneventful

**Post-operative period:**

Antibiotics and analgesics were administered. Broad spectrum antibiotics (cephalosporins) were administered an hour before surgery followed by 48 hours after surgery parenterally and then was continued with oral antibiotics until suture removal.

**COMPLICATIONS**

**1. INFECTION**

There were 2(10%) cases of infection seen in the study. All were superficial infection and were treated with antibiotics, none required debridement or implant removal and both healed well.

**2. IMPLANT FAILURE**

There was 1 (5%) case of implant failure, that was the Z-Effect in which revision surgery was required. Early weight bearing and improper screw placement was the cause o this failure.

**3. NON-UNION**

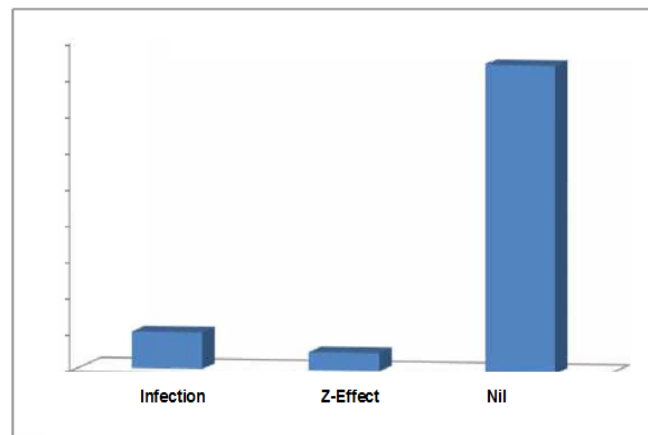
There were no cases of non-union in this study.

**4 GREATER TROCHANTER SPLINTERING**

There were no cases of greater trochanter splintering seen.

**Table 6**

Complications	Frequency	Percent
Infection	2	10%
Z-Effect	1	5%
Nil	17	85%
<b>Total</b>	<b>20</b>	<b>100%</b>



**HOSPITAL STAY**

The average hospital stay was 14.08 days, from the date of admission to the date of discharge. It varied due to management of co-morbid medical conditions of the patients.

**CRITERIA FOR EVALUATION AND RESULTS [ Harris Hip Score]**

All the patients were evaluated on follow ups at the intervals of 6 weeks, 3 months and 6 months according to Harris Hip Score.

**Table 7**

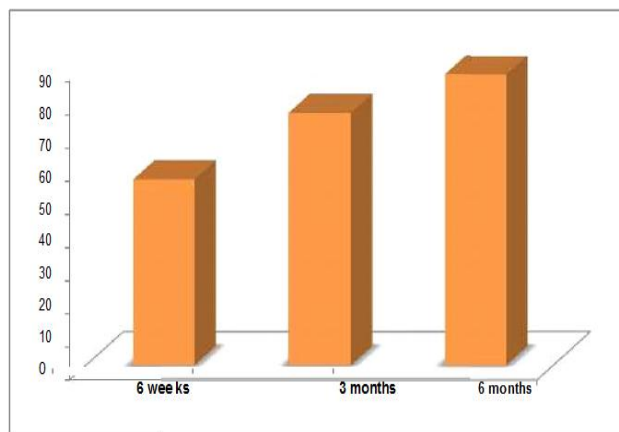
IMPRESSION	TOTAL SCORE
Excellent	91-100
Very good	81-90
Good	71-80
Poor	<70

Results according to Harris Hip Score:

**Table 8**

Characteristic	Follow up score		
	6 weeks	3 months	6 months
<b>Mean</b>	55.9	75.9	87.55
<b>SD</b>	10.64	9.75	10.91

FIG 7

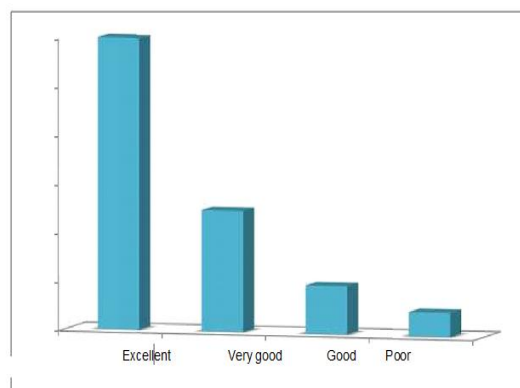


The overall functional outcome of the patients are as follows:

Table 9

Functional outcome	Frequency	Percent
Excellent	12	60%
Very good	5	25%
Good	2	10%
Poor	1	5%
<b>Total</b>	<b>20</b>	<b>100%</b>

FIG 8



The Cross tabulation of the functional outcome and the gender is as follows:

Table 10

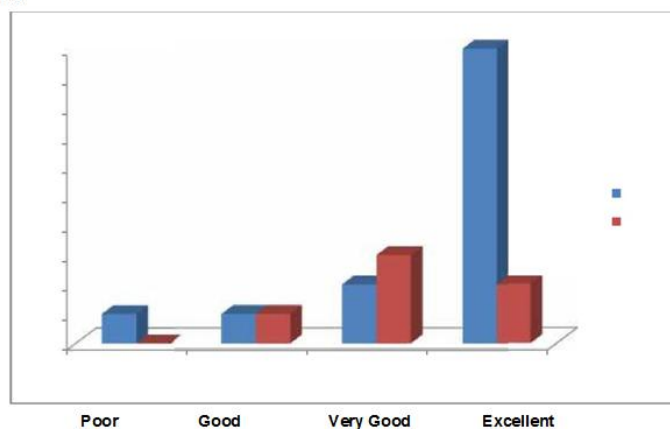
Sex	Functional outcome				Total
	Poor	Good	Very Good	Excellent	
Female	1	1	1	4	7
Male	0	1	4	8	13
<b>TOTAL</b>	<b>1</b>	<b>2</b>	<b>5</b>	<b>12</b>	<b>20</b>

The cross table tabulation of the functional outcome & fracture pattern are as follows

Table 11

Fracture pattern	Functional outcome				Total
	Poor	Good	Very Good	Excellent	
3.1 A2	1	1	2	10	14
3.1 A3	0	1	3	2	6
<b>Total</b>	<b>1</b>	<b>2</b>	<b>5</b>	<b>12</b>	<b>20</b>

FIG 9



### DISCUSSION

The successful treatment of Intertrochanteric fractures depends on many factors like: Age of the patient, Time from fracture to treatment, The adequacy of treatment Concurrent medical illness, Stability of the fixation ,Osteoporosis At present it is generally believed that all Intertrochanteric fractures should be internally fixed to reduce the morbidity and mortality of the patient. But the appropriate method and the ideal implant by which to fix the Intertrochanteric fracture is still in a debate. Because each method having its own advantages and the disadvantages. In the present study 20 patients with Intertrochanteric fractures were studied.

1} Age

In a study done by Li Z, Liu Y et al<sup>6</sup> the average age was 75.61 years with minimum age being 65 years and maximum age being 91 years. In a study done by Domingo et al<sup>7</sup> the average age was 80.1

years. In a study done by K Akan et al<sup>8</sup> the average age was 81 years with minimum age being 65 years and maximum age being 95 years.

### SEX

In the present study, out of the 20 patients studied 13 were male patients and 7 were females. In the present study there was an increase in male to female ratio of 1.8:1 with 13 being males and 7 being females which was similar to W.M. Gadegone et al<sup>9</sup> who had a male to female ratio of 1.7:1 with 62 males and 36 females and Ozkan K et al<sup>10</sup> who had a male to female ratio of 1.5:1 with 9 males and 6 females. Unlike the present study there was female predominance in other studies like Domingo et al<sup>11</sup> with a ratio of 1:3 with 76% being female patients. K Akan et al<sup>12</sup> who studied 80 patients with 18 being males and 62 being females with a ratio of 1:3. Pu JS et al<sup>13</sup> who studied 87 patients with 21 being males and 66 being females. Zhi Li et al<sup>14</sup> who studied 66 males and 90 females with a ratio of 1:1.3

### 3) MODE OF INJURY

The most common mode of injury in our study was domestic fall in 9 patients accounting to 45%. The other modes of injury were RTA in 7 patients accounting to 35% and fall at work place in 4 patients accounting to 20%. The mode of injury was also affected by the age, as older patients were more likely to sustain a fracture by domestic fall. W.M Gadegone et al<sup>15</sup> in his study observed the most common mode of injury to be domestic fall in 75% of patients, while RTA accounted for 25% of patients.

Minos Tyllianakis et al<sup>16</sup> in his study observed that domestic fall was the most common mode of injury accounting to 67% of patients while RTA accounted for 12 patients (27%).

### 4) SIDE OF INJURY

In the present study 40% patients (8 patients) had right sided fracture and 60% patients (12 patients) had left sided fracture. Ozkan K et al<sup>17</sup> in their study observed that 66.66% patients (10 patients)

had right sided fracture and 33.33% (5 patients) had left sided fracture. K Akan et al<sup>18</sup> in their study observed that 55% patients (44 patients) had right sided fracture and 45% patients (36 patients) had left sided fracture. Pu JS et al<sup>19</sup> in their study observed that 35.6% patients (31 patients) had right sided fracture and 64.3% patients (56 patients) had left sided fracture.

### 5) FRACTURE PATTERN

In the present study 14 patients (70%) had 3.1 A2 fracture pattern and the remaining 6 patients (30%) had 3.1 A3 fracture pattern. In a study done by Domingo et al<sup>20</sup>, 26% patients had 3.1 A1 fracture pattern, 59% had 3.1 A2 fracture pattern and 15% had 3.1 A3 fracture pattern. In a study done by W.M Gadegone et al<sup>21</sup> 36 patients (37.5%) had 3.1 A1 fracture pattern, 40 patients (41.6%) had 3.1 A2 fracture pattern, 20 patients (21.5%) had 3.1 A3 fracture pattern and 4 patients had combination of injuries. In a study done by K.Akan et al<sup>22</sup> 34 patients (42.6%) had 3.1 A1 fracture pattern, 34 patients (42.6%) had 3.1 A2 fracture pattern and 12 patients (15.1%) patients had 3.1 A3 fracture pattern. In a study done by Ujjal Bhakat et al<sup>23</sup> 17 patients (56.6%) had 3.1 A2 fracture pattern and 13 patients (43.4%) had 3.1 A3 fracture pattern.

In a study done by Minos Tyllianakis et al<sup>24</sup> 21 patients (45.6%) had 3.1 A2 fracture pattern and 25 patients (54.4%) had 3.1 A3 fracture pattern.

### 6) SINGH'S INDEX

Osteoporosis was measured by the Singh's index. More osteoporosis was present in older patients and post menopausal females. In our study 45% had a grade -3 osteoporosis which was in comparison to the Indian study of Singh & Maini.<sup>25</sup> K.Akan et al<sup>26</sup> in their study observed that 18.8% patients had Grade 1 Singh's index, 38.8% patients had Grade 2, 31.3% patients had Grade 3, 10% patients had Grade 4 and 1.3% patients had Grade 5 Singh's index. Ujjal Bhakat et al<sup>27</sup> in their study observed that 13.33% patients had Grade 1 Singh's index, 23.33% patient had Grade 2

Singh's index, 20% patients had Grade 3 Singh's index, 20% patients had Grade 4 Singh's index, 13.33% patients had Grade 5 Singh's index and 10% patients had Grade 6 Singh's index. In the present study 5% patients had Grade 2 Singh's index, 45% patients had Grade 3 Singh's index, 10% patients had Grade 4 Singh's index, 20% patients had Grade 5 Singh's index and 20% patients had Grade 6 Singh's index.

#### 7) BLOOD LOSS

In the present study the average intra operative blood loss was very minimal. The average was 80ml. Only 2 (10%) of the patients required post operative transfusion as they had very low pre-operative haemoglobin (9-10 gm%). Pu JS et al<sup>28</sup> in their study observed that the mean blood loss was 80 ml in A.2 fractures and 200 ml in A.3 fractures. 38% of patients required blood transfusion. W.M Gadegone et al<sup>29</sup> in their study reported that 3 patients (3%) required post operative blood transfusion.

#### 8) SURGERY TIME

In the present study, the average operating time was 53.25 minutes from the incision to skin closure with minimum operating time being 35 minutes and maximum being 80 minutes. We had a greater operating time in the beginning which reduced greatly in the later part of the study. This signifies the learning curve of the Proximal femoral nailing. Ujjal Bhakat et al<sup>30</sup> in a comparative study between Proximal Femoral Nailing and Dynamic Hip Screw in Intertrochanteric Fracture of Femur done in 2013 noted that the average duration of surgery for the PFN (Avg. time 48.73 min) was shorter than DHS (Avg. time 69.03 min), which was statistically highly significant with a p value < 0.0001. Pu JS et al<sup>31</sup> in their study observed that the mean duration of surgery was 53 min for the A.2 fractures and 78 min for A.3 fractures. In the present study the average hospital stay was 14.08 days. It was more in patients with co-morbid

conditions and complications with highest being 22 days.

#### 9) COMPLICATIONS

Total complications in the present study were 15%. "Z - effect" was seen in 5% (1 patient) of patients which was mostly due to improper placement of the hip screw or cervical screw and early mobilization of the patients. This was comparable to W.M. Gadegone et al<sup>32</sup> where 7% of the patients had superficial infection and 3% of the patients had Z-effect, which was slightly lower than the present study. K.Akan et al<sup>33</sup> in their study of 80 patients observed total complications in 8 patients (10%) and Z-effect in 1 patient (1.25%). Werner Tutschku et al<sup>34</sup> in their study of 70 patients observed total complications in 18 patients (25.7%) and Z-effect in 5 patients (7.1%). In the present study infection was present in 10% (2 patients) of the patients which was superficial and was treated with antibiotics and regular dressing in the ward, none required debridement or implant removal or revision surgery and healed well.

In the series of 295 patients with trochanteric fractures treated with PFN by Domingo et al<sup>35</sup>. the average age of the patient was 80.1 years, which possibly accounted for 27% of the patients developed complications in the immediate postoperative period.

There was no case of non-union or greater trochanter splintering which is usually encountered while inserting the nail. There was shortening of 0.5 to 1 cm seen in 8 patients. Ujjal Bhakat et al<sup>36</sup> in their study observed average shortening of 0.5 cm in the PFN group. Results were evaluated by Harris Hip Score. In our series we had 60% excellent, 25% very good, 10% good and 5% poor results which was similar to Ozkan et al<sup>37</sup> that concluded the use of PFN is a good option in the treatment of intertrochanteric fractures especially the reverse oblique type. The functional outcome of patients were evaluated at each follow up. The mean score was 55.9, 75.9 & 87.5 at 6 weeks, 3 months & 6 months



respectively. In the present study the mean Harris hip score at 6 months was 87.5 which was comparable to Ujjal Bhakat et al<sup>36</sup> who reported mean Harris hip score of 82.8 at 6 months. We also cross tabulated the functional outcome with gender & fracture pattern which showed 8 male patients & 4 female patients showed excellent results and 12 patients with 3.1 A2 fracture pattern had excellent results. In the present study one of the important factor was the cost of the plant as Proximal femoral nail is costly than the dynamic hip screw, but at the end it didn't cause much of a difference as: Less operative time thus reducing the cost .No or less need of transfusion of blood. Post operative antibiotics were used less reducing the cost of the drugs. Less hospital stay. Early return to daily activities.

#### SUMMARY

20 patients of either sex with Intertrochanteric fractures were studied with follow up, up to 6 months. The mean age of the patient was 60.65 years with male:female ratio of 1.8:1. 45% fractures were due to domestic fall, 20% due to fall at work place and 35% were due to road traffic accidents. The most common side involvement in the study was left hip accounting for 60% 70% had 3.1 A2 type of fracture pattern and the remaining 30% had 3.1 A3 or reverse oblique pattern.

45% of patients had grade-3 Osteoporosis. Average blood loss was 80 ml and 2 patients required post-operative blood transfusion. The average Operating time was 53.25 minutes. In all cases, fractures were reduced by closed method on a fracture table with the aid of C-Arm. All cases underwent fracture fixation with standard Proximal femoral nail (240 mm) Total complications were 15%, with superficial infection being 10% and Z-effect being 5% The average hospital stay was 14.08 days. We had 60% excellent, 25% very good, 10% good & 5% poor results according to Harris hip score. Our results were comparable with most of the similar studies.

#### CONCLUSION

We conclude from our study that Proximal femoral nail (PFN) can be considered the most rational method of treating intertrochanteric fractures, especially the unstable & reverse oblique type due to the following reasons Minimally invasive procedure with less operating time & less blood loss. Closed technique preserving the fracture haematoma, leading to early union & early mobilization. It is used with equal good results in all grades of osteoporosis. Rate of complications being minimal. Early mobilization and weight bearing.

But Proximal femoral nailing requires a higher surgical skill, good fracture table, good instrumentation and good C-arm control. It has a steep learning curve.

Thus we can conclude that the PROXIMAL FEMORAL NAIL is after proper training and technique a safe and easy implant option for treatment of complex intertrochanteric fractures.

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