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Functional outcome of trochanter fractures managed with dynamic hip screw versus proximal femoral nail

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Abstract
Background: The aim of this study to find out the pattern of fracture in proximal one third of femur in patient admitted in Orthopaedics department of IMS & SUM hospital. Also found the association of different risk factors with the fracture in proximal one third of femur.
Material/Methods: The study was carried out in the Department of Orthopaedics, IMS & SUM Hospital, Bhubaneswar under Siskha "O" Anusandhan, deemed to be university. The hospital is located in the capital city of Bhubaneswar, Odisha. The hospital is a tertiary care hospital with super speciality facility.
Results: Total 97 patients having fracture of Sub trochanter or intertrochanteric region of femur were included in the study. Out of them 5 participants were lossed during the follow up period of 6 months and 2 of the participants had incomplete data during the data collection process. So these 7 participants were excluded from the final analysis and total of 90 participants were included.
Conclusions: The current study tried to find out the type of fracture of proximal one third of femur and found that majority of fracture was intertrochanteric type followed by sub-trochanteric. Comparison of gender with type of fracture showed sub-trochanteric fracture more common in males while intertrochanteric fracture were more common in females. This difference in proportion was statistically significant.

Keywords: bone screws, hip fractures, meta-analysis as topic

Introduction
Mechanical properties and geometry of bone determines the strength and functionality. The possibility of a fracture occurrence is associated with magnitude of the acting forces; mechanism of trauma; bone quality, use of medications, the incidence of falls, and other factors, the knowledge of which may help for better prevention of this devastating injury. Femur fracture is one of the frequently occurring fracture for which a large number of patients admitted in the trauma ward or orthopaedic ward. The femur is one of the heaviest, strongest, longest and principal load bearing tubular bone in the human body. Inappropriate treatment of femoral fractures can lead tolon-term morbidity and widespread disability. Moreover, associated complication of inappropriately treated or appropriately treated cases can be life-threatening which includes wound infection, adult respiratory distress syndrome, haemorrhage, fat embolism, and internal organ injury.
Proximal femoral fractures in the patients more than 60 years are one of the leading public health issue. Worldwide, ageing individuals symbolize the fastest growing age group; the incidence of femur fracture likely to increase in coming years. It was estimated by 2050 worldwide incidence of femur fracture will increase to 6.26 million [1-4]. Risk of death following proximal femoral fracture significantly increases during the first year after surgical intervention and the risk still continues for several years. A study found that approximately one fourth of (23.8%) of patients die within the first year after Proximal femoral fracture and even more i.e. one third require long-term care [5, 6].
All most one fifth of hospital beds are occupied by patients with fracture at any given point of time. Hospital stay increases exponentially in postmenopausal women with proximal femoral fracture which was estimated to be more than some common chronic diseases like chronic obstructive pulmonary disease, acute myocardial infarction, breast cancer, and diabetes mellitus [7].

It was also estimated that one in six women who with age more than 80 years will suffer from a proximal femoral fracture in future. Apart from ageing other risk factors like sedentary life style and drug abuse / smoking etc. increases the risk. Many patients have associated co-morbid conditions like dementia, diabetes mellitus and hypertension etc. [8]

Mechanism of proximal fractures included falling from a height and poor protective mechanism. Along with this presence of osteopenia increases risk of femur fracture by seven fold. Five to fifty-one Joule of energy is required for a femur fracture shown by a study on cadavers. This finding suggest that only bone mineral density is not only a risk factors. Presence of energy absorbing material like soft tissue attenuates the force, which the biological reason of lesser fracture incidence among the overweight population. Studies have also shown that several other factors determine the fracture of femur like height of the patient, less exercise, medication especially sedative drugs, poor quality of life, poor visual depth perception etc. [9, 10]

A study found that "the rate of proximal femoral fracture per 1000 women-years in individuals with a bone mineral density in the lowest one-third for their age ranges from 2.6 (in those with two or fewer risk factors) to 27.3 (in those with five or more risk factors)" [9].

Not only geriatric population but also children are not immune to fractures. The incidence of injury in children is calculated to be 25%. Among those injury, fractures occurs in a significant proportion i.e.1 0% to 25%. Lifetime fracture risk among girls is lesser as compared to boys (40% for girls versus 64% for boys). The reasons of fracture in children are completely different from the geriatric population. Some of the risk factors are risk taking behaviour, gender, age, season, involvement in sports, violence, race and ethnicity etc. Considering the risk among children fracture femur is seen as one of the major public health problem [11]. Evidence among children is still lacking and there is a lack of consensus among researcher regarding the epidemiology femur fracture. So, further research should be carried out to find out a concrete evidence and to plan out a concrete prevention strategy [12, 13].

Since femur is a long bone it is surgically divided into three part for simplification namely proximal, middle and distal. Among them proximal femur fracture contributes more compared to other two. Older age and female gender were the major risk factors of proximal femur fracture [13]. High-energy trauma like fall from a height or road traffic accidents are the major cause of proximal fractures in young age peoples. Simple fall or low energy trauma is the major cause among ageing population (almost 90%). The conservative method of treatment has its own particular inborn dangers like expanded medicinal entanglements, dreariness and mortality in elderly age, and mental, monetary, and social misfortunes in instances of youthful patients with long hospital stay. Also, there are high odds of mal-union with this technique. The surgical method of treatment ought to be straightforward and safe, get satisfactory fixation of Proximal One third Femur has specific characteristics because of its Anatomical Architecture attachment of number of muscles and its structural variance. In this study, we find out the pattern of fracture in proximal one third of femur in patient admitted in Orthopaedics department of IMS & SUM hospital. Also found the association of different risk factors with the fracture in proximal one third of femur.

Materials and Methods

Study design: The current study was a hospital based prospective observational study.

Place of study: The study was carried out in the Department of Orthopaedics, IMS & SUM Hospital, Bhubaneswar under Siskha "O" Anusandhan, deemed to be university. The hospital is located in the capital city of Bhubaneswar, Odisha. The hospital is a tertiary care hospital with super speciality facility.

Study period: The study was carried out for 2 years from July 2016 to June 2018.

Study population: All the patient coming to Orthopaedic department with fracture of proximal femur constituted the study population.

Inclusion criteria

- All the patient admitted to Orthopaedic department with Intertrochanteric and Subtrochanteric fracture of femur and requiring surgical treatment for fracture reduction.
- All skeletally mature patients i.e. more than 18 years.
- Patient with closed fractures of proximal one third of femur.

Exclusion criteria

- Patients with Intertrochanteric and Sub trochanteric fracture who did not give consent to participate in the study.
- Patient with emergency condition or terminally ill.
- Associated fractures of other part of femur.
- Patients with pathological femur fracture.
- Old and untreated fractures.
- Secondary fractures

Sample size

Considering the prevalence of proximal femur fracture to be 16% (54) among all cancer patients presenting to orthopaedic/trauma care ward of tertiary health care centres and an allowable error of 10%, the sample size was calculated using the formula (55):

$n = 4 P * Q / E2$

Where
'P' = Prevalence,
'Q' = (100-P) &
'E' = Permissible error of 'P'
So, taking 'P' = 16, 'Q' = (100-16) = 84 and 'E' = 8%
Therefore, $n = 4 * 80 * 20 / 8^2$
$= 5376 / 64$
$= 84$
Adding approximately 10% of non-respondents, a total of 90 samples was taken for study.

Sampling Method

Since the study was a cross-sectional study we used a convenience sampling method to select the study population. Convenience sampling method was used to

choose the required sample size after taking written informed question from the participants.

Fig 1a

Fig 1b

Fig 1c

Fig 1d

Fig 1a-d: Different position of leg after surgery

Results

Total 97 patients having fracture of Sub trochanter or intertrochanteric region of femur were included in the study. Out of them 5 participants were lossed during the follow up period of 6 months and 2 of the participants had incomplete data during the data collection process. So these 7 participants were excluded from the final analysis and total of 90 participants were included.

Socio-demographic characteristics

Table 1: Socio-demographic and type of fracture of the study population

Characteristics	Number	Percentages
Age Group		
< 40 years	39	43.3
40 – 60 years	24	26.7
> 60 years	27	30.0
Gender		
Male	50	55.6
Female	40	44.4
Type of fracture		
Intertrochanteric	64	71.1
Sub-trochanteric	26	28.9

The mean age of the participants was 46.52 years ± 16.28 with lowest age of 25 years and highest age of 74 years. Distribution according to age group of the study participants revealed that 39 (43.3%) belonged to age group less than 40 years while almost equal proportion 26.7 % and 30% of participants fall into age group 40 to 60 years and more than 60 years respectively.

Table 2: Association of gender and age among study participants

Age group	Male N (%)	Female N (%)	P value
< 40 years	26(52.0)	13(32.5)	0.077
40 - 60 years	9(18.0)	15 (37.5)	
> 60 years	15 (30.0)	12 (30.0)	

Mode of injury

Association of age and gender with cause of fracture was shown in table 2. Almost two third of participants having RTA as a cause belong to less than 40 years of age and this proportion decreases as the age increases. Similarly, fall as a cause of fracture was highest in age group more than 60 years (70.6%) which decreases as the age decreases. This difference in proportion was statistically significant (P value < 0.001). Higher proportion male patient (66.1%) had RTA as a cause of fracture compared to females (38.2%) where fall is the major cause (61.8%). This difference in proportion was also statistically significant (P value = 0.010).

Table 2: Association of gender and age with cause of fracture among study participants

Variable	RTA N (%)	Fall N (%)	P value
Age group			<0.001
< 40 years	37 (66.1)	2 (5.9)	
40 - 60 years	16 (28.6)	8 (23.5)	
> 60 years	3 (5.4)	24 (70.6)	
Gender			0.010
Male	37 (66.1)	13 (38.2)	
Female	19 (33.9)	21 (61.8)	

Table 3 shows the association side of femur fracture with age and gender. In less than 40 years of age group almost equal proportion of patients had left (42%) and right side (45%) femur fracture. Similarly, rest of the age category had almost equal distribution of left and right side femur fracture. This showed no statistically significant difference (P value = 0.941). Similarly gender also did not show any statistical significant association with side of femur fracture (P value = 0.448).

Table 3: Association of gender and age with side of femur fracture among study participants

Variable	Fracture of left femur N (%)	Fracture of right femur N (%)	P value
Age group			0.941
< 40 years	21 (42.0)	18 (45.0)	
40 - 60 years	14 (28.0)	10 (25.0)	
> 60 years	15 (30.0)	12 (30.0)	
Gender			0.448
Male	26 (52.0)	24 (60.0)	
Female	24 (48.0)	16 (40.0)	

Type of fracture

Type of proximal femur fracture was divided into two categories namely intertrochanteric fracture and sub-trochanteric fracture. Figure 5 shows the distribution type of femur fractures. Majority of fracture was intertrochanteric type (71.1%) followed by sub-trochanteric (28.9%).

Association of different factor with type of femur fracture was shown in Table 4. Almost equal proportion patients in age group less than 40 years had intertrochanteric fracture (42.2%) and sub-trochanteric fracture (46.2%). Intertrochanteric fractures (32.3%) were more common in patients more than 60 years of age compared to sub-trochanteric fracture (23.1%). This difference in proportion was not statistically significant (P value= 0.643). Comparison of gender with type of fracture showed sub-trochanteric fracture more common in males while intertrochanteric fractures were more common in females. This difference in proportion was statistically significant (P value = 0.009). We did not find any statistical difference of type of fracture with mode of injury (P value= 0.176).

Table 4: Association of factors with type of femur fracture among study participants

Variable	Intertrochanteric N (%)	Sub-trochanteric N (%)	P value
Age group			0.643
< 40 years	27 (42.2)	12 (46.2)	
40 - 60 years	16 (25.0)	8 (30.8)	
> 60 years	21 (32.8)	6 (23.1)	
Gender			0.009
Male	30 (46.9)	20 (76.9)	
Female	34 (53.1)	6 (23.1)	
Mode of injury			0.176
RTA	37 (57.8)	19 (73.1)	
Fall	27 (42.2)	7 (26.9)	

Current study classified different fracture like intertrochanteric fracture and sub-trochanteric fracture into different sub-types.

Intertrochanteric fractures were classified into two groups namely stable fractures and unstable fractures. Two third of the participants having intertrochanteric fractures were stable in nature (62.5%) and rest (37.5%) had unstable fracture (Figure 7).

Seinsheimer classification was used to classify the sub-trochanteric fractures and according to this classification 20 (76.9%) of patients having sub-trochanteric fracture had type II fracture and rest 6 (23.1%) had type III fracture (Figure 8).

Associated injury with different type of fracture were given in table 5. Associated injury found in 51.6% of patients with Inter-trochanteric fracture while (42.3%) of patients with sub-trochanteric fracture had associated injuries. Similarly, associated injury not found in 42.3 % of patients with Inter-trochanteric fracture while (57.7 %) of patients with sub-trochanteric fracture had no associated injuries.

Table 5: Associated injuries with different type of fractures

Type of fracture	Associated injury present N (%)	Associated injury absent N (%)
Inter-trochanteric fracture	33 (51.6)	31 (48.4)
Sub-trochanteric fracture	11 (42.3)	15 (57.7)

Duration of surgery

Duration of surgery was 72.89 ± 20.53 minutes for intertrochanteric fractures and 71.54 ± 19.43 minutes for sub-trochanteric fracture. This difference in mean was not statistically significant. (Table 6).

Table 6: Association of duration surgery with type of fracture

Type of fracture	Number of patients	Mean	SD	P value
Intertrochanteric	64	72.89	20.53	0.775
Sub-trochanteric	26	71.54	19.430	

Blood loss during surgery

Mean blood loss during surgery for intertrochanteric fractures was 99.38 ± 48.18mland 114.62 ± 61.00ml for sub-trochanteric fracture. This difference in mean was not statistically significant (P value= 0.400). (Table 7).

Table 7: Association of blood loss with type of fracture

Type of fracture	Number of patients	Mean	SD	P value
Intertrochanteric	64	104.38	48.078	0.400
Sub-trochanteric	26	114.62	61.007	

Weight bearing by patients

Mean duration for partial weight bearing in patients with intertrochanteric fracture was 7.31 weeks and exactly same weeks i.e. 7.31 weeks were taken by patients with sub-trochanteric fracture to be able to bear partial weight. This difference was not statistically significant (P value= 0.992). Similarly, mean duration for complete weight bearing in patients with intertrochanteric fracture was 10.19 weeks compared to 9.77 weeks in sub-trochanteric fracture. This difference was also not statistically significant (P value= 0.428). (Table 8)

Table 8: Association of weight bearing with type of fracture

Weight bearing	Type of fracture	Mean	SD	P value
Partial weight bearing	Intertrochanteric	7.31	1.926	0.992
	Sub-trochanteric	7.31	2.035	
Complete weight bearing	Intertrochanteric	10.19	2.274	0.428
	Sub-trochanteric	9.77	2.215	

Radiological union and hospital stay

Mean duration for radiological union in patients with intertrochanteric fracture was 12.19 weeks compared to 11.77 weeks in sub-trochanteric fracture. This difference was not statistically significant (P value= 0.491).Mean duration for hospital stay in patients with intertrochanteric fracture was 10.21 weeks compared to 9.54 weeks in sub-trochanteric fracture. This difference was also not statistically significant (P value= 0.824) (Table 9).

Table 9: Association of radiological union and duration of hospital stay with type of fracture

Variables	Type of fracture	Mean	SD	P value
Radiological union	Intertrochanteric	12.19	2.274	0.428
	Sub-trochanteric	11.77	2.215	
Duration of hospital stay	Intertrochanteric	10.17	4.271	0.539
	Sub-trochanteric	9.54	4.768	

Discussion

Fracture of proximal one third of femur has been acknowledged as a maintask to the orthopaedic community not for attaining fracture union, but also for rebuilding of ideal function in the less possible time without any complications. The objective of the management has been focused onquick return of individual to the normal life without hampering the quality of life, achieving early mobilization, quick rehabilitation and to lead a functionally and psychologically productive life.

Socio-demographic Factors

In the current study, we found that the mean age of the participants was 46.52 ± 16.28 years. Distribution according to age of the study population revealed that 39 (43.3%) belonged to age group less than 40 years while almost equal proportion 26.7 % and 30% of participants fall into age group 40 to 60 years and more than 60 years respectively. Gallagher *et al*. reported, a 8 times increase in femur fracture in individual more than eighty years compared to individuals at their fifties. (56) A study conducted by Holiis *et al*. found in their study that age of the patients has an average of 39 years with minimum age of one year to a maximum of 96 years [13]. The cause of younger age group in our study as many of the subjects were came to orthopedic department following a road traffic accident. High force injury is the frequent reason of femur fracture in younger age people. Presence of older age group patient in our study may be due to old age is a risk for senile osteoporosis which lead to femur fracture. The high incidence and prevalence of proximal femur fracture among the elderly can be attributed to age associated loss of bone mineral density or may be linked to higher incidence of simple fall/ trivial injury among the elderly population [14].

The trochanteric region is the most frequent site of fracture. The reason behind it are "proximal femoral joint being a major joint in the mechanism of weight bearing, this already weakened part cannot withstand any sudden abnormal stress. The space between bony trabeculaeis enlarged and loaded with fat, whilst unsheathing compact tissue is thinned out and calcar is atrophied. Cleveland *et al*. [15] pointed out there are higher incidences of multiple fractures, as of the same or opposite side, which may occur at different occasions. This fact directs one's attention to the underlying instability and inherent weakness of the bone structure of the elderly which predisposes them to the injury. More wide spread measures to correct or prevent osteoporosis should be instituted. The elderly should be freed of potential danger of poor lighting, slippery floor, wet slippers etc. For some patients whose general conditions (i.e. Senility) makes them vulnerable to fall and fracture, total restriction of independent ambulation is indicated".

The current study almost equal proportion patients in age group less than 40 years had intertrochanteric fracture (42.2%) and sub-trochanteric fracture (46.2%). Intertrochanteric fractures (32.3%) were more common in individuals more than sixty years of age compared to sub-trochanteric fracture (23.1%). This difference in proportion was not statistically significant (P value= 0.643). Comparison of gender with type of fracture showed sub-trochanteric fracture more common in males while intertrochanteric fractures were more common in females. This difference in proportion was statistically significant (P value = 0.009).

A study conducted by Kathleen M Fox *et al*. [16] in United states found that more than half of the study participantshad an intertrochanteric proximal femoral fracture & lesser proportion of patients fractured the sub trochanteric region of femur. They did not found any difference in gender distribution between intertrochanteric and sub trochanteric fracture patients. They also reported that patients the average age of patients with intertrochanteric fracture were 1.8years higher compared to patients with sub trochanteric fracture ($p < 0.05$). They also reported no statistical significant difference between intertrochanteric and sub trochanteric proximal femoral fracture with respect to social and demographic characteristics. This study is in accordance with our study finding.

Conclusion

The current study tried to find out the type of fracture of proximal one third of femur and found that majority of fracture was intertrochanteric type followed by sub-trochanteric. Comparison of gender with type of fracture showed sub-trochanteric fracture more common in males while intertrochanteric fracture were more common in females. This difference in proportion was statistically significant. There was higher incidence of local infection in patients with intertrochanteric fracture during the follow up period of 6weeks whereas infection was lesser in cases with sub-trochanteric fracture. Mal-union and non-union found in very less proportion patient across the type of fracture. We found statistically significant better outcome in patient undergone PFN procedure compared to the patient undergone a DHS procedure.

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