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Study of Functional and Radiological Outcome in Elderly Patients with Unstable Intertrochanteric Fractures, Managed with Long Cephalo-Medullary Nail

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ABSTRACT
Intertrochanteric fractures are becoming increasingly common among elderly. It leads to loss of functional independence. Early surgical intervention and proper medical care can decrease the mortality in elderly patients with intertrochanteric fractures. Present study was aimed to study functional and radiological outcome in older patients with unstable intertrochanteric fractures, managed with long cephalo-medullary nail. Present study was single-center, prospective, observational study, conducted in patients >55 years, either gender, undergoing primary surgery for unstable types of fracture pattern AO/OTA type 31A2 and 31A3. In present study, 39 cases were studied. The fractures were classified according to AO/OTA classification 51.3% of patients were under 31A2.2 category. Fracture union time was assessed using reborne union score, maximum score is 16. Score above 11 can be considered as acceptable union. Mean Modified Harris hip score at the end of twelve months was 83.5 which falls in the good category. Mean parker mobility score at last follow up was 7.3. About 10 patients showed no decline in parker mobility score, 21 patients had a decline of 1 point, 6 patients had a decline of 2 points, 1 patient had 3 point decline and 1 patient had a decline of 5 points. The average parker mobility score had a decline of 1 which corresponds to the good outcome category. About 80% of the patient with CAL TAD value between 20-25 has shown good outcome, which is of statistically significant ($p = 0.001$). There is significant increase in fracture union time with CALTAD score less than 20 and more than 25, which is of statistically significant ($p = 0.002$). The load sharing effect of the intramedullary implant also helps in taking the load off the medial fracture fragments. Long implants will provide more axial and rotational stability.

INTRODUCTION

Intertrochanteric fractures are becoming increasingly common among elderly. It leads to loss of functional independence. A simple fall in an osteoporotic individual can lead to an intertrochanteric fracture. Most of the intertrochanteric fractures are unstable. Unstable fractures are mainly seen in the aged with osteoporotic bones[1]. Prolonged immobilisation in the elderly can lead to complication like, pneumonia, deep vein thrombosis, bed sores, urinary tract infections etc., leading to permanent morbidity and mortality[1,2].

Early surgical intervention and proper medical care can decrease the mortality in elderly patients with intertrochanteric fractures. Due to load sharing properties and lesser lever arm producing decreased torque at the fracture site and a closed procedure, intramedullary devices showed a biomechanical advantage over extra medullary implants[3,4].

Different generations of intramedullary nails had come into use in the past years. The cephalo-medullary nails had played an important role in reducing the failure rate and early mobilization of patients with intertrochanteric fractures[5]. In a developing country like India, where the care for elderly is at its budding stages an ideal implant for unstable intertrochanteric fractures which could provide early mobilisation and functional independence is an absolute requirement. Present study was aimed to study functional and radiological outcome in older patients with unstable intertrochanteric fractures, managed with long cephalo-medullary nail.

MATERIALS AND METHODS

Present study was single-center, prospective, observational study, conducted in Department of Orthopaedic Surgery, Preethi hospital, Madurai, India. Study duration was of 2 years (1st August 2019 to 31st January 2021). Study approval was obtained from institutional ethical committee.

Inclusion criteria:

- Patients >55 years, either gender, undergoing primary surgery for unstable types of fracture pattern AO/OTA type 31A2 and 31A3
- Willing to participate in present study

Exclusion criteria:

- Immature skeleton
- Pathological fracture of any cause other than osteoporosis
- Open fractures
- Previous surgeries in femur

Study was explained to patients in local language and written consent was taken for participation and study. A complete history regarding the nature of trauma, the side of injury, the duration since trauma and history of associated injuries or any other medical or surgical ailments taken. Radiological assessment using x-rays was done. Physician assisted traction and internal rotation view x ray of hip in anteroposterior view and lateral view was taken. The fracture was classified according to AO/OTA classification. Fractures of 31A2 and 31A3 were sorted. Singh's index was used to assess the amount of osteoporosis from the AP view. Grades equal to or <3 was considered definite osteoporosis.

Chest x-rays for anaesthesia evaluation, routine blood investigations, including Hb, TC, DC, RFT was done. Cardiology evaluation done. After fitness, patients were posted for surgery. After spinal anaesthesia, patient supine on fracture table. Closed reduction of fracture on fracture-table and confirmed the reduction by image intensifier. Lateral skin incision and entry point on tip of greater trochanter identified and made with awl. Introduction of guide wire into proximal fragment and distal fragment. Reaming of canal in ante-grade direction. Introduction of nail of appropriate diameter and length. We use indigenously made stainless steel nail 316L type. Proximal lag screw and de rotation screw placement with help of jig and distal locking with c-arm guidance, Closure done in layers. Blood loss was calculated.

Immediate postoperative x-rays was compared with pre-op x-rays. Post operatively patients were mobilised and non-weight bearing walking initiated by 2nd-5th day as per tolerance. Patients were discharged on 10th postoperative day after suture removal. Partial weight bearing is started by 4-6 weeks in elderly patients and full weight bearing started as per tolerance. Regular follow ups every 4 weeks up to 6 months, then every 3 months up to 1 year and then yearly follow up. Functional assessment of the patient is done at every follow up using modified Harris Hip Score and Parker mobility score. Radiological union was assessed using Reborn union score.

Statistical analysis was done by using SPSS version 26. All values were expressed as mean (SD) for continuous variables and number (%) for discrete variables. One-way ANOVA for continuous variables, Paired t-test will be used to find the significant difference between the two groups for continuous outcome variables and Chi-square test and fisher's exact test will be used to find out association between the categorical variables. The $p<0.05$ will be considered as statistically significant.

RESULTS

In present study, 40 cases were received and operated among which 1 patient expired during the course of study. So, 39 was taken as the sample size for assessment. Majority patients were from 70-79 years age group (46.2%) and 60-69 years age group (20.5%).

Table 1: General characteristics

Characteristics	No. of patients	Percentage
Age groups (years)		
50-59	3	7.7
60-69	8	20.5
70-79	18	46.2
80-89	7	17.9
>90	3	7.7
Mean age (Mean±SD)	73.3±9.6	
Gender		
Male	20	51.3
Female	19	48.7
Co morbidities		
Diabetes mellites	10	25.6
Hypertension	10	25.6
Diabetes mellites and hypertension	5	12.8
Diabetes mellites/hypertension/		
Coronary artery disease	4	10.3
Coronary artery disease	1	2.6
Obesity	1	2.6
Singhs index		
Osteoporosis	32	82.1
Mild	7	17.9

Table 2: Classification analysis

AO/OTA classifications	No. of patients	Percentage
31A2.1	3	7.7
31A2.2	20	51.3
31A2.3	10	25.6
31A3.1	1	2.6
31A3.2	3	7.7
31A3.3	2	5.1

Mean age was 73.3±9.6 years. Male patients (n = 20) were comparable with female patients (n = 19). Common comorbidities were diabetes mellites and Hypertension (25.6% each). Singh index was used to assess the level of osteoporosis in the patients, 33 patients had definitive osteoporosis with sighs index $\leq$3 (Table 1).

The fractures were classified according to AO/OTA classification 51.3% of patients were under 31A2.2 category (Table 2).

Mean blood loss was found to be 88.6 mL and mean surgery duration about 52.2 min. Pain over the later thigh region which did not interfere in normal routine activities was seen in 16 patients. For 2 patients had Z effect and 2 patients had reverse Z effect. No refractures noted in any of the patients. About 1 patient had expired during the period of study due to pneumonia. Two patients had gone for a varus collapse with a neck shaft angle <125° (Table 3).

Fracture union time was assessed using reborne union score, maximum score is 16. Score above 11 can be considered as acceptable union. Mean Modified Harris hip score at the end of 12 months was 83.5 which falls in the good category.

Mean parker mobility score at last follow up was 7.3. About 10 patients showed no decline in parker mobility score, 21 patients had a decline of 1 point, 6 patients had a decline of 2 points, 1 patient had 3 point decline and 1 patient had a decline of 5 points. The average parker mobility score had a decline of 1 which corresponds to the good outcome category (Table 4).

Table 3: Operative factors

Variables	No. of patients (Mean±SD)	Percentage
Blood loss (mL)	88.6±17.0	
Duration of surgery (min)	52.2±9.3	
Postoperative complications		
Pain	16	41.0
Reverse Z	2	5.1
Z Effect	2	5.1
Neck shaft angle		
Varus	2	5.1
Nil	37	94.9

Table 4: Functional and radiological outcome

Fracture union time (reborn score> = 11)	No.	Percentage
3 months	15	38.5
4 months	14	35.6
5 months	7	18.0
6 months	2	5.1
9 months	1	2.6
Modified harris hip score		
3 months	64.5±4.6	
6 months	73.2±4.5	
9 months	78.5±4.5	
12 months	83.4±8.8	
Parker mobility score		
Pre Injury	8.4±0.8	
Pre revision	0	
Last follow up	7.3±1.3	

Gender specific outcomes in Modified Harris hip score did not show any significance. There is no statistically significant difference in outcome between males and females (p = 0.53) (Table 5).

About 80% of the patient with CAL-TAD value between 20-25 has shown good outcome, which is of statistically significant (p = 0.001) (Table 6).

There is significant increase in fracture union time, with CALTAD score less than 20 and more than 25, which is of statistically significant (p = 0.002) (Table 7).

DISCUSSIONS

Intertrochanteric fractures in the elderly population constitutes about 50% of the proximal femur fractures. Prolonged immobilization can cause serious complications in the elderly like pneumonia, deep vein thrombosis, bedsores, urinary infections, malnourishment etc[6,7]. In a developing country like India, were the care for the elderly is still at its budding stage, it is required to find a suitable implant for such fractures, which would help in early mobilisation and decreased hospital stay, financial convenience and functional independence of the patient.

In the specific age group proximal femoral fractures are on increase with morbid outcome and intertrochanteric fractures account for approximately half of the hip fractures[8]. The extra stability provided by the length of the nail acting as an internal splint for the whole femur gives an improved support and stability compared to the short nails. Also, some complications, like anterior thigh pain, nail tip fractures etc., seen in a short nail can also be avoided.

Baumgaertner *et al*.[9] stated that the surgical times were higher in the DHS group in their series and was about an average of 120 min. The PFN group in the

Table 5: Gender specific outcome for harris hipscore

	Modified harris hip score								
	Excellent		Good		Fair		Poor		
Gender	No.	Percentage	No.	Percentage	No.	Percentage	No.	Percentage	p-value
Male	3	60	14	48.3	3	75	0		0.53
Female	2	40	15	51.7	1	25	1	100	
Total	5	100	29	100	4	100	1	100	

Table 6: CALTAD value vs modified harris hip score

	CAL TAD						
	<20		20-25		>25		
Modified harris hip score	No.	Percentage	No.	Percentage	No.	Percentage	p-value
Excellent	0		5	14.3	0		0.001 Sig.
Good	1	50	28	80	0		
Fair	1	50	1	2.9	2	100	
Poor	0		1	2.9	0		

Sig.: Significance

Table 7: CAL TAD value vs fracture union time

Fracture union time	Mean	SD	p-value
<20	4.0	1.40	
20-25	3.8	0.88	
>25	6.5	2.10	0.002 Sig.

SD: Standard deviation and Sig.: Significance

same series had 65 min surgical time. In our study, the average time of surgery was 53 min, which should be attributed to the improvement in theatre settings and the training of the surgeon and staff. Thus, it shows that intramedullary nails can reduce the surgical time and prolonged anaesthesia.

In the present study, the association of varus less than 125° was found in 5% patients. Russel *et al*.[10], in their study concluded that 5° should be the acceptable angulation after reductions in any plane they had similar finding with mal-reduction more than 5° in 6% cases and acceptable reduction in 94% cases which is comparable to our study. The varus mal-reduction may be due to severe communition, wrong trajectory of the entry portal and adducted position of the limb during final insertion of proximal part of nail.

Kim *et al*.[11], in their study showed 27.7% angular mal-reduction when an extramedullary implant was used in unstable trochanteric fracture. Thus we can conclude that cephalon-medullary implant have less angular malreduction when used in unstable trochanteric fractures.

In the present study, post operatively patients were followed up for 1 year and were assessed radiologically for the union at all follow ups. In our study, 38.5% patients showed union at the end of 12 weeks, 33% patients showed union by end of 16 weeks. Gadegone and Salphale[12] in their study with short proximal femoral nail, the average union time for unstable intertrochanteric fracture were 21 weeks.

Asif *et al*.[13] in their study showed than it took 24 weeks for union to occur with extramedullary implant. Thus our study shows that long proximal femoral nail has a better union time than short PFN and extramedullary implants.

In the present study, functional assessment was done by Modified Harris Hip Score in which 5 patients had excellent score, 29 patients had good score, 4 patients had fair score and 1 had poor score which was 85% good or excellent outcome when treated with long proximal femoral nail which allows early weight bearing and mobility.

Parmar *et al*.[14], in their study had similar findings who had 75% good or excellent outcomes when they used long proximal femoral nail. The same study states in patient whom short PFN was used only 44% had a good Harris hip score. Also, the complications like anterior thigh pain and fracture at the tip of the short PFN nail due the stress effect were also increased. Other variables like the operation time, blood loss were not significant in both types of nails.

Thus our study also proves that long PFN is a much superior implant than short PFN and extramedullary devices in terms of early patient mobility, decreased complications, short learning curve for the surgeon and improved functioning in the elderly.

Kumar *et al*.[15] in their prospective study comparing short and long PFN for unstable intertrochanteric fracture stated that, the quality of reduction attained with long PFN was much better than that of the short PFN. They found that there is a reduced blood loss and a decreased operating time when a short PFN is used. They also concluded that long PFN gives a lesser union time than the short PFN. This study is also comparable to our study where we had lesser union time when a long PFN is used.

Wang *et al*.[16] in their study has shown that TADCAL values more than 25 mm and <20 mm can cause mobilisation of the lag screw leading to loss of reduction and screw cut out. From our study we have found that CALTAD when not between 20 and 25 mm, there is significant chances for varus angulation and screw back out effects. This can also attribute to the osteoporotic nature of the elderly bones. Still more randomized studies is required in this area.

CONCLUSION

Majority of the intertrochanteric fractures sustained by elderly patients are unstable fractures. The blood loss is less when compared to extramedullary implants. The load sharing effect of the intramedullary implant also helps in taking the load off the medial fracture fragments. Long implants will provide more axial and rotational stability. Also, the large bone nail contact area during weight bearing provides resistance to torsional and bending forces.

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