

Study Of Ender's Nailing In Subtrochanteric Fracture Of Femur In Adults

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Abstracts: Background: Fractures of the subtrochanteric area of the femur represents a difficult therapeutic problem for the orthopaedic surgeon. Comminution, high stress concentration and osteoporosis in this region can lead to failure of fixation, shortening and nonunion. Favourable mechanical conditions are obtained following flexible intramedullary nailing like Ender's nailing, because axial forces are distributed along the entire length of the nail and bending moments are minimized. Compression of the fracture fragments occur without excessive stress on the nails, enabling the patient to bear weight on the extremity. Methodology: This is a study of 34 cases of subtrochanteric fractures of femur in adults treated by Ender's nailing at our place. Age ranging from 19 to 70yrs..In our study patient's distribution according to frank-seinsheimer classification was as follows : Type I: nil, II-a: 1 pt., II-b: 5 pts., II-c: nil, III-a: 10 pts., III-b: 5 pts., IV: 5 pts., V: 8 pts. All the patients were having close fracture. We used 4.5 Enders nails in all patients. In 24 pts.total 3 nails and in 10 pts.total 4 nails were used. In 5 patients open reduction and encirclage wiring was done. In all other patients close reduction was done. Results: Average union time was 15 weeks. No pt. got postope. infection. Excellent and good results were found in 27 pts.out of 34 pts. Conclusion: Average duration of surgery was 1 hour and 10 minutes. Per-operative average blood loss was only 75cc. Post- operatively 23 patients out of 34 patents started partial weight bearing walking from 1stpost operative day. Union rate was 97%, no malunion in coxavara, 6% patient got external rotation deformity. [Ladani H NJIRM 2015; 6(2):20-25]

Key Words: Subtrochanteric fracture of femur in adults, Ender's nailing, closed reduction.

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Introduction: Fractures of the subtrochanteric area of the femur represents a difficult therapeutic problem for the orthopaedic surgeon. Comminution, high stress¹ concentration and osteoporosis in this region can lead to failure of fixation, shortening and nonunion. Furthermore the involved bone is cortical rather than more rapidly healing cancellous bone that predominates in the intertrochanteric area².

Froimson³ showed that because of muscle activity, the proximal fragment tends to be abducted, flexed and externally rotated leading to shortening and varus. Despite strong skeletal traction, the fracture may be difficult to reduce. Many of the fractures result from high energy trauma in relatively young patients leading to displaced and comminuted fractures. Subtrochanteric fractures are also frequent in elderly osteoporotic patients, who as a group have a decreased tolerance for blood loss, lengthy operations and prolonged immobility.

Several methods of internal fixations have been used in the management of this fractures. Various nail plate⁴ and compression screw with side plate devices and intramedullary devices are the

common type of implants in use. When properly applied the nail (screw) plate combination acts as a tension bend against the predominant medial compression forces. If medial comminution exists, enormous demands are placed on the internal fixation device laterally, often leading to penetration of nail into the acetabulum, cutting out of the nail from the femoral head or bending or breaking of the screws or plates.

Intramedullary fixation devices like PFN⁵ is technically demanding, needs perfect entry site and many times it needs open reduction of fracture before inserting nail taking more operative time and increased chances of infection and wash out of fracture haematoma delaying fracture union. It is also more rigid type of fixation.

Ender⁶ and Simon-Weidner introduced flexible intramedullary nailing of the proximal femur in 1970, since then it has become an accepted mode of treatment.Favourable mechanical conditions are obtained following flexible intramedullary nailing because axial forces are distributed along the entire length of the nail and bending moments are minimized. Compression of the fracture fragments occur without excessive stress on the nails,

enabling the patient to bear weight on the extremity⁷. A review of the literature fails to demonstrate a large series of flexible intramedullary nailing of subtrochanteric fractures alone. Most studies combine intertrochanteric and subtrochanteric fractures, making analysis of the latter often difficult. I have tried to study Ender's nailing in subtrochanteric fractures of femur.

Materials and methods: This is a study of 34 cases of subtrochanteric fractures of femur in adult treated by Ender's nailing at our place. Relevant details of these cases are as follows: 27 males and 7 females were selected for study. Their age profile was as follows: Range – 19 to 70 years. 19 to 30 yrs- six pts., 31 to 40 yrs.- ten pts., 41 to 50 yrs.- five pts., 51 to 60 yrs.- nine pts., more than 60 yrs.- four pts.. Average age was 44 yrs.

Causes of fracture: 20 road traffic accident, 7 fall from height and 7 domestic fall. 19 right sided and 15 left sided fracture. Out of 34 patients 2 patients were having same side fracture Colle's, one same side fracture olecranon, one same side fracture S/C humerus, one posterior dislocation of opposite hip and one having 10% 2* to 3* burns over the body. Six patients were anaemic, four with hypertension, one having TB, one IHD, one DM and one was malnourished.

In present study we followed frank-seinsheimer classification⁸ which is based on number of fragments and the location and configuration of fracture lines. In our study patient's distribution is as follows : Type I: nil, II-a: 1 pt., II-b: 5 pts., II-c: nil, III-a: 10 pts., III-b: 5 pts., IV: 5 pts., V: 8 pts. All the patients were having close fracture.

After admission, below knee skin traction given. Patients assessed and investigated for medical fitness. The use of fracture table and image intensifier is mandatory. Preoperatively nail size is measured by distance from anterior superior iliac spine to adductor tubercle of normal limb and deduction of 4 cm from this measurement, this usually gives correct length. Instruments required are (1) Awl (2) Benders (3) Introducer with bar to control rotation of nail (4) introducer without bar (5) Extractor (6) Hammer.

Under suitable anaesthesia patient is put on orthopaedic table into the supine position with legs well abducted to allow the operator access to the medial side of the knee of the affected limb and to allow the head of IITV to rotate for the lateral x-rays. Close reduction is done and checked in IITV. Minor displacement can be adjusted during the operation either by manual pressure or using nail as levers.

After painting and drapping a longitudinal incision of about 7 cm is made running proximally from the adductor tubercle. After dividing the fascia and separating the vastus medialis from the adductor magnus tendon, the muscles can be held back by Hohman levers and the femoral shaft becomes visible. There is no muscle attachment in this region. The collateral ligament lies distally and only a branch of the medial superior genicular artery and two small veins cross the shaft. These should be cauterized. The medial cortex is now perforated with the help of drill bit at the level just proximal to these vessels. The entry should be posterior. Then this opening is widened to an elliptic hole by awl. The length of the nail is confirmed by placing nail on the surface of the thigh. The length is correct when the nail appears to reach 1 cm beyond the femoral head. The chosen nail is bent as required (at the tip, at middle part – general bend and near distal part – approx 20* posterior bend) and introduced into the medullary cavity one by one under IITV guidance. Due to posterior bending at distal end the nail more easily follows the natural anteversion of femoral neck, avoiding the tendency to outward rotation of the leg and chipping of bone which can occur at the point of introduction⁹.

The first nail should be hammered medially along the calcar and into the femoral head. Two or three more nails are then inserted and should be placed so that their proximal tips are arranged in a fan shape in the head. This can be achieved by proper bending of nails and use of rotator. If a nail is not in correct position it should be withdrawn and reinserted after altering the curve of the nail. The flat proximal end of each nail should lie smoothly on the femoral cortex. In femoral neck and head the nails should fan out in both planes and reach to between 5mm and 10 mm of the subchondral zone. Minimum of three and preferably four or five

nails are inserted. If possible a nail from lateral side is inserted to greater trochanter (or from greater trochanter to downwards). It gives better stability. Proper jamming of the nails into the medullary cavity reduces the possibility of the nails backing out. Encirclagewire is added in long oblique subtrochanteric fractures. This prevent shortening malrotation and backing out of nails. Then check the stability by rotating the limb.

Kempf and Bitar modified the distal part of the nail with the slot for sliding locking. The aim of sliding locking was :-

- To limit strictly the consecutive descents of the nails, consecutive to impaction at the fracture site.
- To stop proximal perforation.
- To oppose against external rotation.

After operation the fascia is approximated and then skin sutures taken. A Robert Jones bandage is applied. The patient is allowed to bear weight as early as possible after surgery usually first postoperative day if stability of fixation permits. Impaction at the fracture site will take place with weight bearing and if nails are correctly chosen for length they may extrude downwards for a few mms but cause no symptoms.

- Total time taken for surgery : Between 30 mins.& one hour- 16 pts., between 1 hour and 1.5 hours- 11 pts., more than 1.5 hours- 7 pts..Average time is one hour ten mins.
- Blood loss : Upto 50 cc- 17 pts., 50 to 100 cc- 14 pts., more than 100 cc- 3 pts.. Average blood loss 75 cc.
- Implant: (no. and placement): We used 4.5 Enders nails in all patients. In 24 pts.total 3 nails and in 10 pts.total 4 nails were used. In 16 patients nails in lateral to lateral direction going to greater trochanter was inserted along with nails going to heads.
- In 5 patients open reduction and encirclage wiring was done. In all other patients close reduction was done. All patients were given only prophylactic antibiotics. For close reduction only for one day and for open reduction three days antibiotic were given. No patients had postoperative wound infection. No patients had postoperative systemic or other local complications.

- Assessment of reduction: Perfect in 9 pts.,near perfect in 12 pts.,approximate in 8 pts.,valgus in 4 pts.,distraction in 1 pt..
- Lower end complications : Supracondylar fracture in no pts.,minimal cortical chip in 20 pts.& no chip in 14 pts..
- Postoperative course: Traction in 1 pt.,non weight bearing 9 pts.,partial weight bearing from 1stpostope.day in 24 pts.

Results: In one patient Enders nail cut through the superior cortex of neck and proximal fragment gone into abduction. That patient was kept on skeletal traction after that. But patient died about 2.5 months of operation. In rest of the 33 patients results of follow up cases were assessed in the form of : (1)Union (2) Deformity (3) Movements (4) Functional activities (5) Duration of inability to work (6) Implant (7) Infection.

1. **Union.**

Time of radiological union	No. of patients
10 to 14 weeks	12
14 to 20 weeks	19
20 to 26 weeks	1

Average union time 15 weeks, one nonunion was there.

2. **Deformity.**

(A) Limb length discrepancy	No. of patients
(a) Shortening	9
Upto 1 cm	
Between 1 and 2 cm	13
More than 2 cm	2
(b) Lengthening	0
(c) No discrepancy	9
(B) Valgus more than 10 *	4
(C) Varus	0
(D) External rotation deformity (both having 5* ext. rotation deformity)	2

3. **Movements:** Best criteria for judging the movement of hip and knee is ability to sit cross legged and squat. Sitting cross legged was possible in 30 pts.,difficult in 2 pts.& not

possible in 1 pt. Squatting was possible in 25 pts.& difficult in 6 pts.

4. **Functional Activities**

(A) Make shift	No. of patients
No support	31
One stick	2
(B) Walking ability	
Partial weight bearing after	No. of patients
1 st post ope. day	23
Less than 3 weeks	2
3 to 6 weeks	7
More than 6 weeks	1
Full weight bearing after	No. of patients
Less than 6 weeks	2
6 to 12 weeks	22
12 to 18 weeks	7
More than 18 weeks	2
(C) Pain	No. of patients
No pain	23
Occasional pain	4
Slight pain	4
Moderate pain	2

5. **Duration Of Inability To Work:** This was defined as the period during which patient was unable to do routine work.

- Upto 1 month-6 pts.
- Upto 2 months-17 pts.,
- Upto 3 months-8 pts.&
- Upto 4 months-2pts..

6. **Implant:** In situ-28 pts.,removal entirely-4 pts.,broken-1 pt.& cut through-1 pt. In all four patients nails removed as they were backed out causing pain at knee after union of fracture.

7. **Infection – Nil**

Table 1: Criteria Of Evaluation Of Final Results

	Union time in weeks	Def-orm-ity	Hip movements			Short-ening in cms	Knee move-ment s
			F	ER	Ab		
Excell ent	<18	Nil	Full	Full	Full	Nil	Full
Good	<18	Nil	120-135	30-45	30-45	Up – to 1	Full

Fair	18 to 32	Nil	90-120	15-30	15-30	2.5	>90
Poor	>32	Pres ent	<90	<15	<15	>2.5	FFD /flex .<90

FFD = Fixed Flexion Deformity, F = Flexion, ER = Ext. rotation in 90* flexion, Ab = Abduction

We have taken this criteria from Indian journal of orthopaedics vol. 18 , no. 1 January 1984 and modified it to some extent.

Our results according to types of fractures are as below(Table II).

Table II: Result according to type of fracture

Type Results	II a	II b	III a	III b	IV	V	Total
Excellent	1	1	3	2	-	-	7
Good	-	4	4	3	4	5	20
Fair	-	-	1	-	1	2	4
Poor	-	-	2	-	-	1	3

Patients with broken nail and cut through of nails through superior cortex are included among 3 poor results.

Discussion: Many of the subtrochanteric fractures result from high energy trauma in relatively young patients leading to displaced and comminuted fractures. In our study average age of patients was 44 and most frequent causes was Road Traffic Accident. Elderly patients having subtrochanteric fractures have a decreased tolerance for blood loss, Lengthy operations and prolonged immobility. Ender's nailing has the advantages of closed method, providing adequate stability, minimal surgical stress, decreased risk of infection and behaving as weight sharing device. In our study average operation time was 1 hour 10 minutes and average blood loss 75cc, both were less in comparison with other methods of internal fixation. (e.g. sliding screw plate).

Biomechanically operative treatment of subtrochanteric fractures with Ender's nails corresponds to the physiological flow of forces of bending, torsion and shearing by its axial position in the field of force and by virtue of its elasticity. Forces are distributed along the entire length of the nail resulting in low incidence of device failure

and nonunion. The dynamically controlled motion (compressive force) at the fracture site after Ender's nailing is probably responsible for the early appearance of External callus and early bridging of fracture site. Bone grafting of even comminuted fractures is found to be unnecessary because bending and torsional forces are neutralised at the fracture site.

In 16 patients out of 34 patients nails in lateral to lateral direction were inserted either from lateral side of lower femoral end going to greater trochanter or from greater trochanter downwards alongwith 2 or 3 nails going to head of the femur. This technique gives better reduction of fracture and better stability. Greater trochanter must be intact for that.

In 5 patients out of 34 patients open reduction and encirclage wiring was added. Encirclage wiring prevent shortening, malrotation and backing out of nails. It is indicated mainly in long spiral fractures. In our study majority of the patients started partial weight bearing from 1st post operative day and full weight bearing from 6 to 12 weeks. Only one patient with comminuted fracture needed traction postoperatively. Postoperatively infection rate was nil. This results are in favour of Ender's nailing in comparison with other methods of internal fixation,

CHI-CHUAN WU et al presented a study of 31 subtrochanteric fractures treated with Gross and Kempf interlocking nails¹⁰.

There were 4/31 nonunion (one with nail breakage, 3 without nail breakage) and union period of 4.2 +_ 1.8 months. Knee range of motion in 28 acute traumatic cases were on average 127.5 +_ 23.0 degrees.

He compared his results with a large number of reports about the results of subtrochanteric fractures treated by various types of internal fixations which were as follows: with Nail plate devices: Nonunion rate 10-26%, union period 7.8 months, implant failure 0-35%, infection rate 0-5.8%. With the Angle blade plate: Nonunion rate 0-16.6%, union period 4.2-5.4 months, implant failure 0-5.3%, malunion 0-8.3%. With the Sliding

screw plate: Nonunion rate 0-4.4%, union period 2.5-3.6 months, no implant failure, infection rate 0-8.0%, malunion 2.2-8.0%, lag screw cut out 4.4%. With the Zickel¹¹ nail: Non union rate 1.3-3.8%, union period 4.4 months, implant failure 0-1.3%, infection rate 3.8-9.6%.

As compared to that in our study the results are following: Non union rate 3% (1/33 patients), average union period 3.5 months (15 weeks), one implant failure (3%), infection rate 0%, Ender's cut through 3% (1/34 patients). No varus union.

To minimize migration and penetration of the nails proximally and distally and early reoperation following things are important^{2,12,13}:-Inserting the nails past ward's triangle into cancellous bone of the femoral head, stacking the femoral canal with nails, splaying the nails within the femoral head, selecting proper size of the nails and subchondral placement of the tip in the femoral head.

Knee irritation is usually the result of insertion portals situated too far anteriorly or distally or protrusion of the nails from the portal sites². Ideal nails portals are just proximal to the genicular artery, which runs vertically within the periosteum of the distal femur and also entry should be posterior and posterior bend should be given to the nails.

When nails are inserted from both medial and lateral sides of the lower femoral end the entry site should not be at same level but must be somewhat different level to minimize the chances of supracondylar fracture. Propagation of linear cracks at the insertion site can be prevented by placement of a Lawman Clamp on the femoral shaft just proximal to the portal site and tightened securely prior to inserting the nails², which technique we have tried in last few patients of our study.

Conclusion: The study covered 34 cases of subtrochanteric fractures in adults treated by Ender's nailing. Average duration of surgery was 1 hour and 10 minutes. Per-operative average blood loss was only 75cc. Post-operatively 23 patients out of 34 patients started partial weight bearing walking from 1st post-operative day. No patients

had postoperative wound infection. Average union time was 15 weeks. Union rate was 97%, no malunion in coxavara, 6% patient got external rotation deformity. Implant breakage found in one patient. Excellent/good results were found in 27 patients.

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