

Evaluation of Clinical Outcome of Subtrochanteric & Proximal Femur Fracture treated by Interlocking Intramedullary Nail with Side plate

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Abstract

Background:

Fractures of the subtrochanteric region and proximal femur can be especially challenging to manage, and they warrant special consideration to obtain consistently satisfactory results. The subtrochanteric zone of the femur is generally considered to include the area extending 5 cm distally from the inferior border of the lesser trochanter, or the junction of the proximal one third and middle third of the femoral shaft. Fractures that have their major displacement in this area are considered subtrochanteric fractures despite the possibility that some of them may extend into the trochanteric area proximally or the distal femoral shaft. The management of fractures of the subtrochanteric region and proximal femur has always held a particular interest for orthopedic surgeons. Biomechanically, the subtrochanteric area of the proximal femur is an area of high stress concentration, which has led to high rates of implant failures in the treatment of these fractures. Current evidence suggested that interlocking intramedullary nail with side plate offer better outcome. **Objectives:** To evaluate the operative efficacy and clinical outcome of interlocking intramedullary nail with side plate in the treatment of subtrochanteric & proximal femur fracture. **Methods:** This prospective cross sectional study was conducted in Cumilla General Hospital and private Clinics, Cumilla, from April 2018 to November 2019 among the 62 cases of subtrochanteric femur fractures. Objective of this study was to find out a safe, effective management of fracture, early mobility of patient, functional joint motion and short stay in hospital. All patients were treated by interlocking intramedullary nail with side plate. Routine follow up was carried out and outcomes were assessed. Radiographic examination was used to evaluate callus formation and fracture healing in postoperative 1, 3, 6 and 12 months follow-up. Functional recovery was evaluated by Harris Hip Scoring (HHS) system. **Result:** In this study, the mean age was 49.3±8.5 years. Among 62 cases 52 cases (83.9%) were male and 10 cases (16.1%) were female. The male and female ratio was 5.2:1. Regarding the causes of injury, out of 62 patients 50 (81%) had a history of fall from height. In 12 (19%) cases, motor vehicle accident was the cause of fracture. Average time of healing was 18 weeks. According to Harris hip score findings, 46 cases were considered as excellent in functional recovery, 11 good, 4 fair and 1 poor. The proportion of the patients with excellent and good recovery was 91.8%. **Conclusion:** Study showed interlocking intramedullary nail with side plate provides better functional outcome with early mobility of patients, and fracture unites without joint stiffness and less complication.

Key words: Subtrochanteric & Proximal Femur Fracture, Interlocking Intramedullary Nail, Fixation with Side plate.

Introduction: Fractures of the proximal femur is a very important topic in the field of orthopedic surgery, but much of that attention is placed on fractures of the

femoral neck and intertrochanteric areas. An additional area that must be well understood is the subtrochanteric (ST) region of the femur, which is

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defined as the proximal femoral shaft located within 5 cm of the lesser trochanter¹. This area experiences high levels of stress and fractures to this area can result in significant complications and poor clinical outcomes if not managed properly.

Fielding² proposed a definition that is still frequently used: the subtrochanteric region corresponds to the interval between the lesser trochanter and around 5–7.5 cm below it, toward the femoral isthmus. The fractures can extend to the proximal region (trochanteric or femoral neck) or distal region (diaphyseal). Due to the anatomical peculiarity and, especially, due to the difficulty in reduction, the treatment of subtrochanteric fractures is still a great challenge to the traumatologist, not only because of the osteosynthesis difficulties, but also for the still frequent complications³.

Subtrochanteric fractures occur with a bimodal distribution. Fractures seen in young patients tend to occur as a result of high-energy trauma and often have significant comminution, whereas fractures occurring in older patients are often caused by low-energy injuries⁴. These fractures account for approximately 7% to 34% of femur fractures. They are sustained equally between males and females. Studies have shown that 7% of patients with atypical subtrochanteric femur fractures were exposed to the bisphosphonate alendronate. The reported one-year mortality of elderly patients with subtrochanteric femur fractures is 25%⁵.

Features unique to subtrochanteric fractures that complicate treatment include both anatomic and biomechanical characteristics. The subtrochanteric area of the femur is primarily cortical bone that heals more slowly and tends to fracture with comminution. The femoral medullary canal widens in the intertrochanteric area, which makes intramedullary fixation in this region more difficult because of the possibility of less secure fixation and higher risk of malunion^{3,6}. Intramedullary nails do not fill the capacious proximal canal and therefore do not effect a reduction of the fracture as the nail is passed across the fracture site, as may occur in the midshaft area. If the fracture is malaligned as the nail is passed, it will remain in the malaligned position; therefore, the fracture has to be held in a reduced position as the intramedullary fixation is accomplished. In the subtrochanteric region, special reduction techniques may be needed because there are strong deforming

forces across these fractures. Biomechanically, the subtrochanteric area of the proximal femur is an area of high stress concentration, which has led to high rates of implant failures in the treatment of these fractures⁷.

Previous study noted that algorithm for the treatment of subtrochanteric femur fractures is as follows: For fractures 2 or 3 cm or more distal to the lesser trochanter, a standard locking piriformis fossa entry intramedullary nail is used. Subtrochanteric fractures that extend proximally into the area of the greater trochanter or trochanteric fossa may be treated with a condylar blade plate or cephalomedullary locking intramedullary nail^{1,8}. The choice between these two implants is based on the degree of fracture comminution, the bone quality, the amount of distal extension of the fracture, and the presence of other fractures in the femur. Current evidence demonstrated that interlocking intramedullary nail with side plate associated better outcome than others.

Overall, the use of intramedullary fixation has become the gold standard for the treatment of ST femur fracture. Intramedullary nails are typically placed with closed methods, although open reduction and nailing of displaced or highly unstable fractures is occasionally necessary^{1,8}. Previous study reported that intramedullary fixation is feasible for the treatment of subtrochanteric femur fracture. The average bone union time was 4.5 months and maximum cases were considered as excellent in functional recovery⁹. Standard interlocking intramedullary nails offer the advantage of familiarity to most surgeons, the biomechanical advantages of an intramedullary implant, the ability to be placed by a closed technique. Nails with standard proximal interlocking screws are suitable only for subtrochanteric fractures that are completely distal to the lesser trochanter. Cephalomedullary locking (sometimes called second-generation) intramedullary nails offer the same advantages of intramedullary fixation but are technically more demanding because the proximal interlocking screw must be placed in the appropriate position in the femoral head.

Aside from intramedullary nailing, plating is used to enhance the feasibility of union & overcome the IM nail related complications. The most successful type of plating involves the use of fixed angle blade plates¹. Intramedullary nailing with side plate increases the functional outcome of surgery. Despite

some studies revealing moderately good results with fixed angle plating with nonunion rates of approximately 0-10% with times to union of approximately 5 months^{10,11}, more recent studies have found less appealing results¹². These recent changes in outcomes, coupled with the high degree of stability of fracture, higher union rates, and better outcome with intramedullary nailing, have led to increased use with side plates. These systems have been shown to have better biomechanical properties. But due to the lack of data in Bangladesh as well as worldwide in this regard, the present study was aimed to see the operative efficacy and clinical outcome of interlocking intramedullary nail with side plate in the treatment of subtrochanteric & proximal femur fracture.

Methodology:

This prospective cross sectional study was carried out at Cumilla General Hospital and private Clinics, Cumilla from April 2018 to November 2019. A total of 62 patients with closed fracture of sub trochanter and proximal femur were selected. Inclusion criteria were: (1) the fracture line was located within 5 cm below the lesser trochanter; (2) interval from injury to operation <3 weeks; and (3) normal anatomic structure of proximal femur before fracture with no history of hip diseases. The patients with old fracture, open fracture, history of hip diseases or pathologic fracture were excluded. After fitting in the inclusion criteria of the admitted patient thorough history was elucidated, complete physical examination performed and investigations carried out. Informed consent was taken from all the Patients. Ethical approval was taken as per rule of institute and informed written consent taken from each patient's prior enrollment of study. Prior to consent they were explained the aim and purpose of the research. Confidentiality was assured and maintained.

SAMPLE SIZE CALCULATION

To determine the sample size the following formula followed-

$$n = \frac{z^2 pq}{d^2}$$

= The desired sample size

z= Standard normal deviate usually set at 1.96

p= Proportion in the population (0.01-0.99). In unknown prevalence of event p-value considered 50.0%, or 0.5.

q= 1-p, or 0.5

d= Degree of accuracy which is considered as 13%, (or, 0.016).

According to this formula the targeted sample is 60. So, total 62 samples were selected.

Management of the patients: In a lateral position, patients underwent open reduction. After reduction, according to the intramedullary nail placement procedure, intramedullary fixation was performed. With femoral greater trochanter as the center, a 3–5 cm skin incision was made to separate soft tissue until the greater trochanter. The entry point of intramedullary nails was located in the vertex or medial side of greater trochanter, and lateral projection was in the front 1/3 of greater trochanter. Make an incision at the entry point and insert the needle. Then slightly ream until intramedullary nail can be properly inserted, using soft tissue protective sleeve to ensure the needle position and avoid lateral derivation. Afterwards, the antegrade intramedullary nailing of the right width and length was given, meanwhile the force line of the limbs and fracture position were properly maintained. Insert the nail until the right depth, install the guide, insert the proximal and distal locking screws and confirm the fracture position meticulous visualization. Following that plate's fixation was done by manually customized the plate to provide a stable fixation.

Follow-up & postoperative care: All patients were given prophylactic Inj. Ceftriaxon (2gm). Patients were mobilized and exercise of muscle strength of lower limbs and functional exercises of hip joint were initiated immediately after operation (on first postoperative day), and weight-bearing was prohibited for postoperative 6 weeks. Patients were followed up for fortnight for first visit and then every four weeks for subsequent visits for total time period of about 30 weeks. In each visit the progress of healing of fracture site was examined clinically and radiologically. The conventional X-ray examination of the injured hip in pelvic anterior-posterior and lateral planes was conducted at postoperative follow-up time to assess the fracture healing, the morphology of hip joint and the implant status. After fracture healing, the Harris hip scoring system was used to evaluate the hip joint function.

Data collection procedure: A structured data collection form containing history and examination findings of the patient, operative procedure and

follow-up all the variables of interest was used. Data were collected by interview, observation and clinical examination.

Statistical analysis: Data was collected with a pre-tested structured questionnaire containing history, clinical, radiological findings, peri-operative and follow up findings in a formulated sheet. Data was processed and analyzed. Qualitative data had been expressed as frequency and corresponding percentage, while the quantitative data as mean and range. Postoperative final outcome was evaluated.

Result & Observation:

Table I: Demographic characteristics study population (n=62)

Variables	Frequency	Percentage
Age (yr.)		
25-45	29	46.7
46-65	33	53.3
Mean±SD	49.3±8.5	
Sex		
Male	52	83.9
Female	10	16.1

Demographic features mentioned in Table I. Mean age of patients were 49.3±8.5 years. Among 62 cases 52 cases (83.9%) were male and 10 cases (16.1%) were female. The male and female ratio was 5.2:1.

Figure I: Distribution of cases according to mode of injury (N=62)

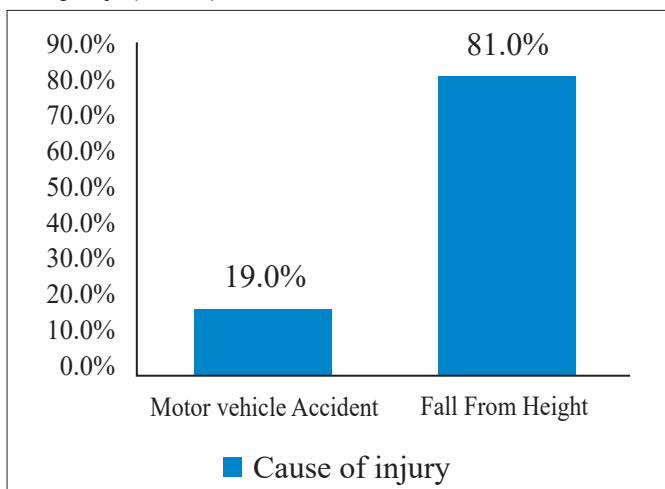


Figure I: show the mode of injury. Among 62 cases Motor Vehicle Accident was 19.0% cases, fall from Height was 81.0% cases. All cases of femoral subtrochanteric fracture were followed up for 30

weeks. One patient had delayed healing, and the others healed uneventfully. The average time of healing was 18 weeks. 10 (16.1%) fractures healed in 12-16 wks, 33 (53.2%) in 17-20 weeks, 16 (25.8%) in 21-24wks and 3 (4.8%) in >24 wks (Table II).

Table II: Distribution of cases according to duration of radiological union & pain status (N=62)

Variables	Frequency	Percentage
<i>Radiological union (weeks)</i>		
12-16	10	16.1
17-20	33	53.2
21-24	16	25.8
>24	3	4.8
<i>Pain status (mild to moderate pain)</i>		
After 2 wks	51	82.2
After 4wks	6	9.6
After 6wks	3	4.8
After 12 wks	3	4.8

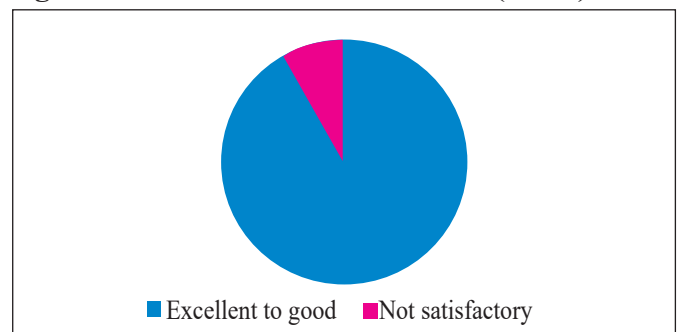
Although 82.2% patients had mild to moderate pain after 2nd weeks of follow up, end of 12th weeks shows only 4.8% noticed pain. But in majority patient's pain subsided (Table II).

Table III: Functional outcome according to Harris hip score criteria (N=62)

Remarks	Frequency	Percentage
Excellent	46	74.1
Good	11	17.7
Fair	4	6.4
Poor	1	1.6

According to Harris hip score, 46 cases were considered as excellent in functional recovery, 11 good, 4 fair and 1 poor. The percentage of the patients with excellent and good recovery was 91.8% (Figure II).

Figure II: Overall outcome of cases (N=62)



Discussion:

In this study, the mean age was 49.3 ± 8.5 years. Among 62 cases 52 cases (83.9%) were male and 10 cases (16.1%) were female. The male and female ratio was 5.2:1. This data supports the studies of Jackson et al, (2018)¹ and Zhou et al., (2015)⁹.

Regarding the causes of injury, out of 62 patients 50 (81%) had a history of fall from height. In 12 (19%) cases, motor vehicle accident was the cause of fracture. Subtrochanteric fractures occur with a bimodal distribution. Fractures seen in young patients tend to occur as a result of high-energy trauma and often have significant comminution, whereas fractures occurring in older patients are often caused by low-energy injuries⁴.

In this study average time of healing was 18 weeks. According to Harris hip score, 46 cases were considered as excellent in functional recovery, 11 good, 4 fair and 1 poor. The proportion of the patients with excellent and good recovery was 91.8%. So using interlocking intramedullary nail with side plate considered a safer & effective technique for treatment of closed fracture of subtrochanter and proximal femur. All findings were accordance with result of other previous study.

Umer et al¹³ reported the results of the treatment of subtrochanteric fractures with IM nails. In their study, with 33 patients, the authors obtained consolidation in 94% of the cases up to six months after surgery. Borens et al¹⁴ treated 90 patients with subtrochanteric fracture of the femur using IM nails. No infections noticed and better outcome were reported. Zhou et al⁹ demonstrated that intramedullary fixation is feasible for the treatment of subtrochanteric femur fracture. The average bone union time approximately 4.5 months. The proportion of the patients with excellent and good recovery was 96.05%.

Even with modern implants, the complication and poor functional outcome in the treatment of the subtrochanteric fractures is not uncommon. Infection, pseudarthrosis, vicious consolidation, and loss of the reduction are the most frequent complications⁶. Herscovici et al¹⁵ conducted a retrospective study in which they compared intra- and extra-medullary implants in the treatment of subtrochanteric fractures of the femur. The authors demonstrated that, although intramedullary fixation

was quicker and had less bleeding, the functional results and the complication rates were not insignificant.

Another common complication after fixation is a varus and procurvatum malunion or nonunion due to the characteristic deformity at the fracture site. This complication can be decreased by achieving an adequate reduction and stable fixation at the time of initial intervention⁵. In this circumstance use of side plate stabilize the union, lowers the stress on the implant, increases the bone contact, and makes the consolidation easier. It is emphasized that biological fixation with intramedullary nail with side plate lead to better functional outcome with low complication rates. Fixation with IM nail with side plate gained popularity and, due to their synergistic favorable biomechanical properties, overall outcome is satisfactory with low reoperation rates in recent time.

Boopalan et al¹⁶ reported the results of 22 patients with 23 subtrochanteric fractures of the femur treated with blade plates using the minimally invasive biological technique. Nineteen patients did not need additional surgeries. Two patients were reoperated due to varus reductions, and one patient underwent surgical debridement due to infection. The functional results were considered excellent in ten patients, good in one patient, and poor in two patients.

Previous study demonstrated that intramedullary nailing is obviously preferred technique, but submuscular plating is added the feasibility in closed fracture of subtrochanter and proximal femur. Side plate also indicated in certain instances, such an instance might include an extension of the fracture into the greater trochanter or piriformis fossa, preventing a safe, adequate start site for a nail¹⁵. Saini et al.¹⁷, using proximal femur-locking compression plate for the treatment of comminuted subtrochanteric fractures in 35 patients, achieved consolidation in all cases. Two patients presented infection, two presented 1-cm shortening, and one evolved with vicious consolidation in external rotation. The authors concluded that biological fixation with intramedullary nail with side plate in subtrochanteric fractures promotes stable fixation, with a high rate of consolidation and low rate of complications.

Conclusions:

From the study, it can be concluded that interlocking

intramedullary nail with side plate is safe and effective method in treating Subtrochanteric & Proximal Femur Fracture.

Conflict of Interest

Authors declare no conflict of interest.

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