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Early management of proximal femoral fracture and subtrochanteric by proximal femoral nail

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Abstract
Introduction: The subtrochanteric region is usually exposed to high stresses during routine activities. Axial loading forces through the hip joint create a large moment arm, with significant lateral tensile stresses and medial compressive loads. In addition to the bending forces, muscle forces at the hip also create torsional effects that lead to significant rotational shear forces.
Objective: To evaluate the results of internal fixation of subtrochanteric fractures of the femur with proximal femoral nail.
Methods: This was a prospective study carried out at Department of Orthopedic Surgery, BSMMU, Dhaka, Bangladesh from January to June 2023 on 60 patients who had suffered subtrochanteric fracture and were subsequently treated with a proximal femoral nail (PFN). Proximal femoral nail was inserted through the tip of greater trochanter. All patients were followed up for a period of one year; at an interval of 3 months and during each follow-up visit for the functional outcome by modified Harris Hip Score, was assessed in the form of walking, squatting, sitting and rising from chair.
Results: Total 60 cases with proximal femur Subtrochanteric fractures. In our study, the average age was 43.33 years, with a maximum age of 65 years and a minimum age of 18 years. The majority of the patients were males, with 44 (73.3%) of the 60 patients being males and 16 (26.7%) being females. Modified Harris hip score was used for the evaluation of results in our study which showed excellent result in 42 patients (70%), good results in 6 cases (10%), fair results in 6 patient (10%) and poor results in 6 cases (10%). The mean Harris hip score in our study was 90.6.
Conclusion: PFN is an intramedullary load-sharing implant. Reduction and treatment of subtrochanteric fractures are a challenge in traumatology. Proximal total femoral nailing with proximal and distal locking appears to be a satisfactory implant for the treatment of subtrochanteric femoral fractures.

Keywords: Fracture femur, closed reduction, proximal femoral nail

Introduction
The subtrochanteric region is usually exposed to high stress during daily activities. Axial loading forces through the hip joint create large lateral tensile stresses and medial compressive loads on the large lever arm. In addition to bending forces, hip muscle forces also create a twisting effect, resulting in large rotational shear forces [1]. High compressive and tensile forces from the muscles separate the fracture fragments, making the fracture unstable. Therefore, this fracture is difficult to treat and is associated with many complications, including malunion, delayed union, nonunion, and implant failure [2]. Due to these anatomical features, conservative treatment is not preferred. If there are no absolute contraindications and the patient can tolerate surgery, this is the treatment of choice. In adults, high forces are applied. h. A high-energy injury is required to break this bone, but in elderly people, it may fracture due to the weakening of the bone under low stress. Reduction of subtrochanteric fractures of the femur is one of the most challenging tasks in traumatology due to the complex anatomy, strong muscle tension, and highly stressed location of the femur [3]. The subtrochanteric area contains several muscle attachments, such as the lateral hip abductors,

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medial hip adductor, iliopsoas, and short external rotators, which increase tension around the hip joint and proximal femur [4]. In terms of mechanism, treatment, and complications, these fractures are significantly different from femoral shaft fractures [5]. Previous studies have shown that the overall incidence of this type of fracture is 15-20 per 100,000, with women over 50 years of age being the most commonly affected [6]. The goal of surgical treatment is to restore normal length, anatomical alignment and angulation to restore adequate tension to the abductor muscles [7]. Advances in implants and fixation techniques have allowed for early mobility and weight bearing. The two main treatment options for subtrochanteric fractures are intramedullary fixation and superficial fixation [8]. Nonunion rarely occurs in these injuries because the subtrochanteric region has a robust muscle sheath with a rich blood supply. Due to the significant socio-economic impact of this fracture, the treatment of choice is one that allows early bone mobilization and rehabilitation while reducing the risk of malunion, shortening and stiffness. Non-operative treatments are not suitable for the treatment of subtrochanteric fractures as they increase morbidity and mortality, making early surgical intervention the only option.

Materials and Methods

This was a prospective study carried out at Department of Orthopedic Surgery, BSMMU, Dhaka, Bangladesh from January to June 2023 on 60 patients who had suffered subtrochanteric fracture and were subsequently treated with a proximal femoral nail (PFN). Proximal femoral nail was inserted through the tip of greater trochanter. All patients were followed up for a period of one year; at an interval of 3 months and during each follow-up visit for the functional outcome by modified Harris Hip Score, was assessed in the form of walking, squatting, sitting and rising from chair. The duration of follow-up ranged from 6 to 12 months, with an average of 11 months. Patients were chosen based on their age range of 18 to 65 years, their willingness to give written informed consent for the trial, and their ability to present within 15 days of injury. Patients who refused to give informed consent, patients aged 65 and under 18, open fractures, patients with systemic injuries such as thorax, abdomen, or head injuries, pathological fractures, and patients who presented after more than 15 days were all excluded.

Treatment

All patients were treated similarly to inpatients. On arrival, a medical history was taken including the date, cause of injury, and other relevant details. The neurovascular status of the affected limb was examined and recorded. Below-knee skin or skeletal traction was used to immobilize the injured limb. Radiographs were taken of thermodynamically stable subjects. Anteroposterior and lateral radiographs of the femur including the knee of the affected limb, anteroposterior and lateral radiographs of the pelvis including both hips, anteroposterior and lateral radiographs of the femur including the knee of the affected limb were taken. X-rays were used for diagnosis. Further periodic examinations were performed if necessary. When the patient was fit for elective surgery under anesthesia, internal fixation was performed.

All patients were called for a first follow-up examination after 4 weeks, a second follow-up examination after 10-12 weeks, and then every 3 months. Patients were examined for wound status, pain, swelling and tenderness at the fracture site, leg length discrepancy, implant entrapment and other symptoms, and range of motion of the hip and knee. Radiographic examination was completed. Partial or full weight bearing with axillary crutches or walker was allowed depending on the clinical-radiological course and status of fracture healing. Absence of pain at the fracture site is a clinical marker of fracture healing, and appearance of bridging callus on radiographs is a radiographic sign of fracture healing. If no clinical-radiological evidence of fracture healing was obtained, dynamization was performed with removal of the distal fixation bolts after approximately 6 weeks. In our study, the Studntt test was employed for statistical analysis, with p.05 being statistically significant. IBM SPSS statistics version 22.0 for Windows was used to conduct the statistical analysis.

Results

Total 60 cases with proximal femur Subtrochanteric fractures. In our study, the average age was 43.33 years, with a maximum age of 65 years and a minimum age of 18 years. The majority of the patients were males, with 44 (73.3%) of the 60 patients being males and 16 (26.7%) being females.

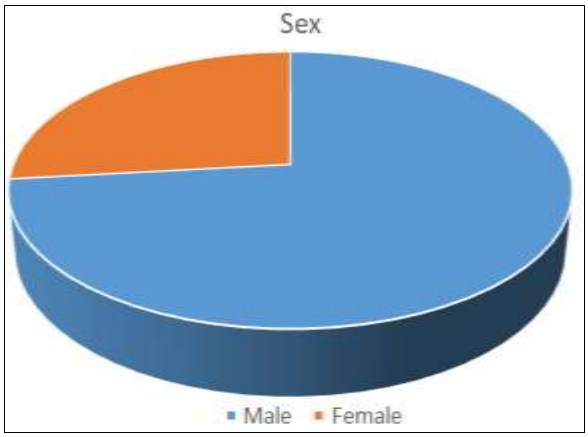

Fig 1: Sex distribution of the study patients.

In our study, 34 patients (56.7%) had a right-side subtrochanteric femur fracture and 26 patients (43.3%) had a left-side subtrochanteric femur fracture.

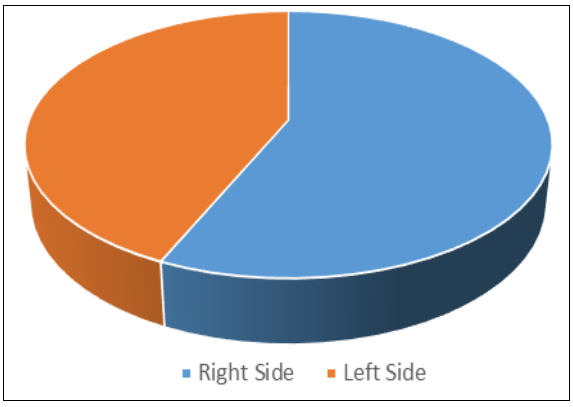

Fig 2: Side affected study of the patients.

Mode of injury- The majority of the incidents in our analysis were roadside accidents (53.33 percent) and falls (46.66 percent).

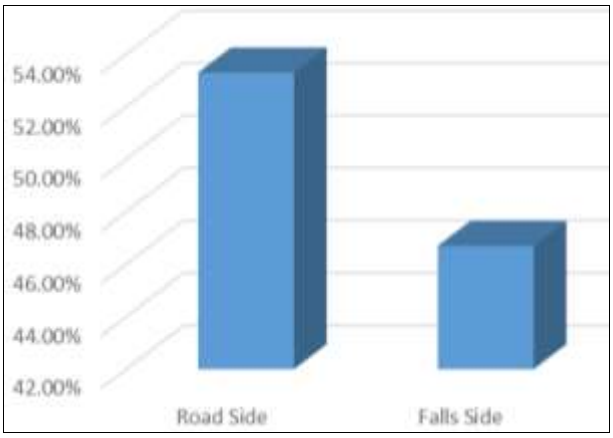

Fig 3: Mode of injury.

Table 1: Showing number and percentage of cases according to Seinsheimer classification.

Type	Number of cases	Percentage %
1	0	0%
2A	4	6.66%
2B	16	26.66%
2C	6	10%
3A	8	13.33%
3B	6	10%
4	2	6.66%
5	16	26.66%

Classification of Subtrochanteric fractures- Seinsheimer classification is used to classify subtrochanteric fractures [11]. The majority of fractures in our study were type 2B and type 10 (25 percent of cases in each group), with type 3b having the least number of instances [Table 1]. Days between admission and surgery- In our study, the average time between admission and surgery was 6.83 days. In our study, the majority of the patients, 42 (70 percent), were operated on within seven days of arrival [Table 2]. Following intraoperative complications were encountered- fracture of lateral cortex in 4 cases (6.66%) and guide wire breakage in 2 (3.33%) case.

Table 2: Showing No of days between admission and surgery and their percentage

Days between admission and surgery	Number of patients	Percentage of patients
1-4 days	22	36.66%
5-8 days	20	33.33%
9-12 days	12	20%
13-16 days	6	10%

Table 3: Showing Post Op complications and their percentage

Post op Complications	Number of patients	Percentage%
Hip Joint Stiffness	6	10%
Knee Joint Stiffness	4	6.66%
Non-Union	4	6.66%
Implant Breakage/Failure	2	3.33%
Varus angulation	8	13.33%
Superficial Skin Infection	2	3.33%
Z effect	6	10%

Table 4: Showing Union rates and their percentage

	Number of patients	Percentage
Union by end of 6 months	52	86.66%
Delayed union	4	6.66%
Non-Union	4	6.66%

Fig 4: showing management of subtrochanteric fracture femur by PFN

Table 5: Showing Functional results of subtrochanteric fracture treated with PFN

Functional results	Harris hip score (modified)	Number of Patients	Percentage%
Excellent	90-100	42	70%
Good	80-89	6	10%
Fair	70-79	6	10%
Poor	0-69	6	10%

Table 3 shows the postoperative complications that were seen until the last follow-up, which was one year following surgery. At their follow-up appointments, all of the patients were evaluated for radiological evidence of union [Fig-4]. By the end of six months, 52 of the 60 patients had radiological signs of union. Exchange nailing and bone grafting were used to treat two patients who had delayed union and two patients who had gone into non-union [Table 4]. The average length of time spent in union was 14.6 weeks. We evaluated 60 participants in our trial at the end of the study. During the study period, no deaths were documented. In our study, the average Harris hip score was 90.6 [Table 5].

Discussion

Subtrochanteric femoral fractures occur in the area 5 cm below the lesser trochanter. The incidence of proximal femoral fractures has increased significantly due to increased life expectancy and motor vehicle accidents. Subtrochanteric femoral fractures are a major problem due to the high stresses placed on this area, resulting in different fracture patterns and difficult anatomical reduction, which, if not properly treated, leads to poor outcomes. In elderly patients, low-energy trauma usually results in fractures with multiple fragments, sometimes with unstable geometry [9]. Intramedullary nails offer biomechanical advantages due to their stiffness, increased strength, and shortened lever arm, which results in a stronger construct and reduced load on the implant. The nail entry point and construct design can affect fracture reduction and stability. Thus, surgeons should be aware of modifiable variables that can improve surgical outcomes [10]. Intramedullary nailing has many advantages, including ease of insertion with a closed technique, preservation of fracture hematoma, and lower infection rates due to fewer surgical incisions. Closed nailing is a form of biological fixation of the femur, which may be responsible for the faster healing time [10]. Traffic accidents (53.33%) were the most common injury type in our analysis. Subtrochanteric fractures account for 10-34 percent of all hip fractures, with a bimodal age distribution [11, 12]. Self-fall fractures were found in 46.66 percent of the patients in our study. The average age of the patients was 43.33 years, with a maximum age of 65 years, a minimum age of 18 years, and a mean age of 65 years. The most common types of fractures were Seinsheimer type 2B and type 5 (25 percent of occurrences in each category), with type 3b being the least common. By 6 months, 26 patients had radiographic evidence of union. There were two examples of delayed union and two cases of non-union. In our study, the average Harris hip score was 90.6. The patients in the current series had an average age of 43.33 years, compared to 73 years in Boldin *et al.* [13] and 82.2 years in IB Schipper Series [14]. This preference for young comes from the fact that they rely more on outdoor activities to make a living. In our study, the right side of injury was the most common (56.66 percent), whereas the left side was afflicted in 43.33 percent of patients. In a study by I.B. Schipper [14] 52 percent of the cases were right-sided, whereas 48 percent were left-sided. In our study, the average time from admission to surgery was 6.83 days, compared to 2 days in the I. B. Schipper study [14]. Longer surgical times could be owing to a lack of operating room availability or a delay in case fitness for surgery. We used Seinsheimer's classification system [11]. The most common types of fractures in our study are type 2B and type 5 (25 percent of cases in each group), with type 3b having the fewest cases and type 1 having none while most common type in Sandeep Sharma Study and Seinsheimer Study was type 3A [11, 15]. The average period of union in our study was 14.6 weeks, which was similar to the 13.88 weeks in the Vivek Pradhan Study [16]. It took about 16 weeks in the I.B.SCHIPPER series [14]. One patient developed a superficial skin infection after surgery that was treated with wound care and antibiotics and showed no signs of osteomyelitis at the last follow-up. Non-union in two patients, implant fracture in one, varus angulations in four patients, and z effect in three patients were among the other surgical problems identified in our patients. Sandeep Sharma's study found a nonunion rate of 3.5 percent, D.M. Rahme's study reported a rate of 24 percent, and W.M. Gadegone's study recorded a rate of 26 percent [15, 17, 18]. The outcomes of our study were evaluated using the modified Harris hip score, which revealed outstanding results in 42 patients (70%) and good results in three patients (10%), acceptable results in three patients (10%), and poor results in three patients (10%). In our investigation, the mean Harris hip score was 90.6, which was greater than the I.B. Schipper series [14] which had a mean of 77.6. To examine the outcomes as per a Bangladeshi activity of daily living, we replaced the 6th and 7th elements of the Harris Hip Score, 'put on socks and shoes' and 'sitting' with 'squatting' and 'cross legged sitting.' Our findings are comparable to those of other studies, according to Harris Hip Score [15, 16, 17, 18]. The goal of treatment for a subtrochanteric fracture of the femur is to return to pre-trauma status as soon as feasible with minimal morbidity and death. In the past, many treatment methods such as traction, plaster, femoral/tibial pinning, external fixator, and others were utilized to treat these types of fractures. The advancement of plate osteosynthesis (Dynamic Compression Screw and Plate, Dynamic Hip Screw and Plate, angle blade plate, Jewett plate, and so on) has improved the reduction, but factors such as surgical time, blood loss, infection, non-union, and implant failure remain key unsolved issues. Closed reduction with PFN requires less time for surgery, and the patient can be mobilized sooner after PFN fracture repair.[4] Our findings demonstrate that proximal femoral nailing can be a viable alternative to surgery.

Conclusions

Proximal femoral nailing in traumatology, intramedullary load-sharing implants, reduction and treatment of subtrochanteric fractures are challenging. For the treatment of subtrochanteric femoral fractures, nailing the proximal femur throughout the femur with proximal and distal fixation is considered an appropriate implant.

Conflict of Interest

Not available

Financial Support

Not available

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