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Clinical study of outcome of unstable intertrochanteric fracture treated by proximal femoral nail: A prospective study

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Abstract

Background: The AO/ASIF proximal femoral nail (PFN) is a new device designed for the treatment of the unstable intertrochanteric femoral fracture. The purpose of this study to find the outcome of such fractures treated by PFN at Silchar medical college in north-eastern part of India.

Materials & Methods: From July 2015 to June 2016, we included 41 patients (21 female and 20 male) who were operated with the PFN for unstable intertrochanteric hip fractures. Intra-operative and post-operative complications were noted. Functional outcome were assessed by Harris hip score and radiologically union were assessed at 3, 6 and 12 months.

Results: Majority of the cases i.e. 16 (39%) were in the age group of 61-80 years with average age of 61.9 years. The mean interval between trauma and surgery was 7.43 day. Most common mode of injury is simple fall (73%). Closed reduction was achieved in 38 patients. Postoperative reduction were good in 28 (68.3%) of cases, acceptable in 9 (21.9%) and poor in 04 (9.8%) cases. We found 13 cases (31.7%) of intra-operative complication. We found 6 cases of post-operative complications in which one case of early complication (superficial wound infection) and 5 cases of late complication secondary varus malunion, shortening >2cm, one case of delayed union and one case of reverse z effect. We did not encountered any case of implant failure or avascular necrosis of femoral head. All the patient shows radiological union in our study with mean time of union was 18.02 weeks (12-32 weeks). According to Harris hip score, we had excellent results in 29.27%, good result in 43.90%, fair result in 24.39% and poor result in 2.44% of cases.

Conclusions: PFN is a very good choice of implant for unstable intertrochanteric fracture in respect of minimal blood loss, less soft tissue injury, early weight bearing, few complications and with good functional outcome.

Keywords: unstable intertrochanteric fracture, proximal femoral nail, soft tissue injury

Introduction

Intertrochanteric fractures are common fractures among elderly because of osteoporosis, inadequate reflex and shock absorbers [1]. Intertrochanteric fractures can be classified as stable and unstable fractures. Unstable fractures (type 31A2 and type 31A3) have higher complication rate than stable fracture irrespective of treatment modalities. There are two main options for treatment of intertrochanteric fracture: extramedullary and intramedullary implant. Extramedullary implant consist of sliding neck screw connected to a plate in the lateral femoral cortex. Additionally, depending upon the instability antirotation screw or trochanteric stabilisation plate can be used. Intramedullary implants have biomechanical advantage over extramedullary implant as they have short lever arm which decreases the tensile strain on implant and bending moment on the implant [2]. Intramedullary implants also have biological advantage of closed reduction, lesser blood loss and soft tissue dissection, short duration of surgery and early mobilisation of the patients. For stable fractures, most of the studies shows comparable failure rate while in unstable dynamic hip screw have failure rate upto 21% [3]. Gamma nail also have several complication particularly fracture shaft of femur below the nail tip. A meta-analysis of the Gamma nail and dynamic hip screw in treating peritrochanteric fractures showed that there was statistically significant rate of post-operative femoral shaft

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fractures in gamma nail group with clearly indicate the need of further studies [4].

To overcome the limitation of gamma nail AO/ASIF designed proximal femoral nail (PFN). In the pioneer study done by Simmermacher *et al.* [5] on 191 unstable proximal femoral fractures reported only 4.6% technical failure rate and only one patient showed a cut-out of the implant but there were no mechanical failures (bending, breaking of the implant) or ipsilateral fractures of the femoral shaft at the tip of the implant.

In our study we are going to study clinical outcome of unstable intertrochanteric fracture treated by proximal femoral nail, mechanical and technical failure

Material and method

A prospective study was carried out on 41 cases (male-and female-)of unstable intertrochanteric fracture attending at the emergency and the out-patient department of Orthopaedics, Silchar Medical College and Hospital with a compulsory follow up of 6 months. Our study was carried out for a period of one year from 01-06-2015 to 31-05 -2016. Fractures were classified according to AO/OTA system.

After the patient with unstable intertrochanteric fracture (AO/OTA type 31A2 and type31A3) was admitted to hospital all the necessary clinical details were recorded in proforma (age, sex, mode of injury, previous illness) prepared for this study. All patients were started on antibiotics prophylactically A third generation Cephalosporin was administered via IV route prior to induction of anaesthesia, and continued at 12 hourly intervals for 3-5 days.

All patients were treated by proximal femoral nail. Intra-operative data (type of reduction, closed reduction, duration of surgery and intra-operative complication) were recorded. After the completion of the hospital treatment patients were discharged and called for follow up at outpatient level at regular intervals for serial clinical and radiological evaluation till 6 months and if required subsequent follow-up was done.

All patients were clinically assessed by using the Harris hip score at the end of 6 months. Radiological assessment for progression and time of union, fracture alignment and implant related complications were analysed. Data collected at the end of the study was statistically analysed.

Proximal femoral nail

In our study we used a standard length PFN of 250 mm with distal diameter of 9, 10, 11,12mm. The proximal diameter of nail is 14mm. The proximal derotation screw of 6.5mm and distal lag screw of 8mm. Distal locking is done with self-tapping 4.9mm cortical screws one in static mode and the other in dynamic mode allowing 5mm dynamisation. The nail is universal with 6 degrees mediolateral angulation and with a neck shaft angle of 135 degrees. We did not use end cap.



Operative technique

After the patient was positioned in fracture table and reduction was typically done by traction and internal rotation and adduction. After provisional reduction, reduction was checked under c-arm then traction, internal rotation, external rotation and adduction and abduction was adjusted accordingly. In difficult reduction Steinman pin were used as a joystick to reduce the fracture percutaneously and fracture was provisionally fix with two 2.5mm k wires, which pass along the anterior cortex of the proximal femur into the neck and head of femur. The tip of the greater trochanter was located by palpation and 5 cms longitudinal incision taken proximal from the tip of the greater trochanter. A parallel incision was made in the fascia lata and gluteus medius was split in line with the fibres. Tip of the greater trochanter is exposed. Then, the guide wire is inserted distally in the direction of center of medullary cavity to the depth of 2-3 cm and checked under C-arm guidance in both AP and lateral view with power drill or T-handle.

Over the guide wire, a 15 mm cannulated reamer was inserted through the protection sleeve and manual reaming was done up to the level just below lesser trochanter. The guide wire is exchanged with plain guide wire. Now the nail was inserted manually into the femoral canal. 2 mm guide wire for neck screw was inserted through the sleeves into the femoral neck and head using image intensification and advanced deeper into the head up to the subchondral bone and final position of guide wire was in the lower half of neck in AP view and center in lateral view. After the proper insertion of first guide wire, the guide wire for the antirotational screw is inserted. Tip of second guide wire should be little shorter than the first one, so that both the guide wire lie in the same horizontal plane. 6.5mm antirotation screw is inserted first after drilling over guide wire. Thereafter, neck screw is introduced over guide wire after drilling. The length of the both screw was indicated on measuring device and is calculated 5 mm before the tip of the guide wire. Distal locking was done after release of traction. We mostly did dynamic locking in our study except few cases of gross comminution.

Post-operative reduction were assessed according to Baumgaertner criteria modified by Fogagnolo *et al.* [6] and categorized as good, acceptable and poor. Post-operatively; patients pulse, blood pressure, respiration, temperature were monitored. Foot end elevation is given depending on blood pressure and spinal anesthesia patients. Antibiotics were continued in the post-operative period. Analgesics were given as per patient's compliance. Blood transfusion was given depending on the requirement. Sutures removed on 10th postoperative day. Patients were encouraged to sit in the bed after 24 hours after surgery. Patients were taught quadriceps setting exercises and knee mobilization in the immediate post-operative period. Patient was taught gait training before discharge from the hospital. Only in very unstable fracture patterns weight bearing was not advised. Rest of the patients were encouraged to weight bear partially with axillary crutches or walker depending on the pain tolerability of individual patient. Patients were discharged from the hospital on 10th day after suture removal.

Results

In our series, majority of the cases i.e.16 (39%) were in the age group of 61-80 Years, followed by 15 (36.6%) cases in the age group 41-60 years. The youngest patient was 28 years old and eldest patient was 90 years. The mean age was 61.9 years. In our study male and female were equally involved.

The number of male patient was 20 and female patient was 21.

Right side was involved in 28 cases (69.3%) and left side was affected in 13 cases (31.7%). Right side was more commonly involved than left side. 30 cases (73.2%) affected were due to Simple Fall, 8 cases (19.5%) due to RTA, and 3 cases (0.7%) due to fall from height. Simple fall was the most common Mode of injury. In cases less than 40 year of age the most common mode of injury was road traffic accident. This study included 41 cases of unstable intertrochanteric fracture (AO/OTA Classification 31A2 AND 31A3). Among 41 cases 25 cases were 31A2 and 16 cases were 31A3. All the cases included in our study group were fresh fractures. The mean interval between trauma and surgery was 7.43 day. The delay was due to delay in arrival to the hospital, medical condition of the patient and associated injuries. Until then the patients were on skin or skeletal traction. Singh index was used to assess the osteoporosis radiologically. 1 (2.4%) patient had Grade II, 10 (24.3%) patients had Grade III, 19 (46.3%) patients had grade IV and 08(19.5%) patients had grade V osteoporosis. 3 patients (7.3%) had grade VI Singh's Index. Average blood loss in our study is 100ml, mean operative time (skin to skin) is 73.04 min. Closed reduction were done in 38 cases while 3 cases required open reduction. Postoperative reduction were good in 28 (68.3%) of cases, acceptable in 9(21.9%) and poor in 04 (9.8%) cases. We

found 13 cases (31.7%) of intraoperative complication. We found 6 cases of post-operative complications in which one case of early complication (superficial wound infection) and 5 cases of late complication secondary varus malunion, shortening >2cm, one case of delayed union and one case of reverse z effect. We did not encountered any case of implant failure or avascular necrosis of femoral head. The average duration of hospital stay was 21 days (ranging from 12-32 days). All patient followed up at 6 week, 3 month and 6 month. At every visit, patient was assessed clinically and radiologically. Patients were followed up monthly in between the visits and after 6 month if required. Patients were followed up, for a minimum of 6 months and maximum of 1 year. Three patient were lost in follow up. The average time of union was 18.02 weeks, the range being from 12 to 32 weeks in 41 cases. Maximum number of fractures united between 12 to 16 weeks. One case of delayed union was dynamized late at 24 weeks which finally united at 32 weeks. In our study, According to Harris Hip Scoring System, Good to excellent results were seen in 76% cases of 31A2 trochanteric fractures and 68.75% cases in 31A3 trochanteric fractures. Fair to poor result were seen 24% cases of 31A2 trochanteric fractures and 31.25% cases in 31A3 fractures. Overall, we had excellent results in 29.27%, good result in 43.90%, fair result in 24.39% and poor result in 2.44% of cases.

Case 1



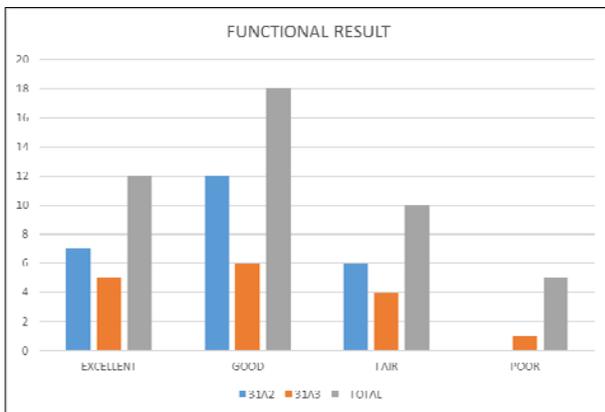
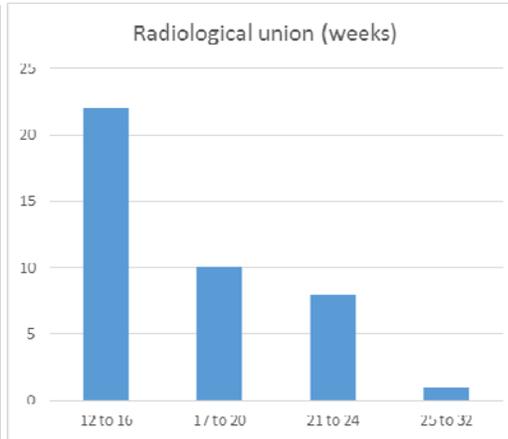
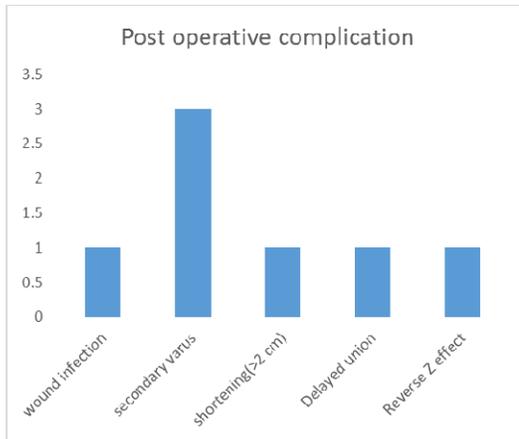
Complications



Reverse Z Effect



Varus Malunion



Discussion

The treatment of unstable intertrochanteric fracture remain controversial. Biomechanically and biologically intramedullary devices have advantages over extramedullary devices. previously used intramedullary devices have certain complications. AO/ASIF designed PFN to reduce these complication associated with previous nails. the main design changes between PFN and other intramedullary devices are introduction of antirotation screw, fluting nail tip and more proximal position of distal locking screw. Fluting nail tip and more proximal location reduces stress concentration distal to tip of the nail and hence reduces femoral fracture distal to tip. In this study, we did not encountered any such complication. In our study we found intraoperative complications in 13 cases. Loss of anatomical reduction occurred in two case during the procedure. In one cases it occurred at the time of proximal reaming and second during at the time of insertion

of nail. Longitudinal fracture of femur above the tip of nail occurred in one case at the time of hammering. After that open reduction was done with encirclage of the fracture fragment. In one case we failed to put de-rotational screw because of jamming of the nail. This case showed varus deformity but with excellent outcome. Varus angulation occurred in 2 of our cases because of difficult reduction. It occurred in 2 of cases. We fixed the distal lock by free hand method in these cases. Mismatch leads to difficulty in placing proximal screws also. This can also leads to missed distal locking, but in our study none of the case have missed distal locking. GT # occur in two cases while inserting the nail. In early post-operative complication we found only one case of superficial wound infection (2.4%) while Schipper *et al.* [7], Al-Yassari *et al* [8], Tyllianakis *et al.* [9] and Gadegone *et al.* [10] found 4.1%, 1.3%, 4.3% and 4% respectively. We didn't found any deep infection, delayed wound healing and hematoma of the wound in our study.

In our study we found no complication of implant failure, cut-out, fracture shaft of femur below the tip of nail, avascular necrosis of head and non-union. In our study, we also didn't found any case of Z effect but we found one case of reverse Z-effect.

Absence of Z effect can be explained by proper positioning of screw, proper size and short duration of follow up. Varus malunion occur in 7.3% of cases in our study which is comparable to the study of Gadegone *et al.* [10] and Tyllianakis *et al.* [9] Domingo *et al.* [11] found shortening in 11% of cases with average shortening of 5mm. In our study we found shortening in 17% of cases with average shortening of 0.2mm. Gadegone *et al.* [10] found shortening (<2 cm) in 10 (10%) number of cases while we found 4 (9.7%) number of cases had shortening less than 2 cm. We had comparable

results of shortening with the study done by *Domingo et al.* [11] and *Gadegone et al.* [10]. The average duration of hospital stay in our study was 21 days (ranging from 12-32 days). The average hospital stay in a study done by *Morihara et al.* [12] was 25 days. The average time of union was 18.02 weeks, the range being from 12 to 32 weeks in 41 cases. Maximum number of fractures united between 12 to 16 weeks. One case of delayed union was dynamized late at 24 weeks which finally united at 32 weeks.

In our study, According to Harris Hip Scoring System, Good to excellent results were seen in 76% cases of Type 31A2 trochanteric fractures and 68.75 % cases in Type 31A3 trochanteric fractures. Fair to poor result were seen 24% cases of type 31A2 trochanteric fractures and 31.25% cases in type 31A3 fractures. Overall, we had excellent results in 29.27%, good result in 43.90%, fair result in 24.39% and poor result in 2.44% of cases.

Conclusion

Good instrumentation with proper technique will lead to a good outcome in management of unstable intertrochanteric fracture and high rate of bone union.

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