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Functional outcome of proximal femoral nail antirotation with helical blade fixation in extra capsular hip fractures in Himalayan region

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Abstract

Background: Extra capsular Intertrochanteric hip fractures occur in older age person. These are pathological fracture mostly (osteoporosis). Currently, these hip fractures are generally fixed with intramedullary or extramedullary implants. Implants preference mainly determined by the fracture classification (stable or unstable). Most common complications in standard proximal femoral nail and extramedullary implants is neck screw cutout. Due to Research and improvement in surgical technique incidence of neck screw cutout has reduced considerably but still remains the most common fixation failure with intramedullary implants. With this question in mind we did study to find out functional outcome of proximal femoral nail antirotation with helical blade fixation in extra capsular hip fractures in Himalayan region.

Methodology: This prospective study was done on 75 patients with extra capsular hip fractures, for fixation of fracture, implant of choice were used proximal femoral nail antirotation with helical blade. Study were done during the period from September 2015 to August 2016. Informed written consent were taken from all patients. The study was approved by institutional ethical committee. We included > 45 year cases. Fracture was classified according to Boyd and griffin classification. Exclusion criteria were age<45 years, open intertrochanteric hip fractures, pathological fracture other than osteoporosis and polytrauma patients. After discharged from hospital patients were called in OPD for clinical and radiological evaluation at regular intervals (6wks, 12wks, 24 wks, 36 wks. and 48 wks).

Results: 75 cases of hip intertrochanteric fractures were included and operated with proximal femoral nail antirotation with helical plate. Mean age of patients was 65.67 ± 10.60 yrs. (45–94 yrs.). Based on preoperative x-rays fracture pattern 8 cases in type1, 18 cases in type 2 and 3 in each group, 31 cases in type 4 were recorded. Assessment of osteoporosis were done according to Singh index. Type 1 (n=8), type 2 (n=18), type 3(n=18), type 4 (n=31) were had mean Singh's index 5.13, 4.59, 4.76, 4.70 respectively. Maximum number of patients (97.2%) showed sign of union between 18 to 24 weeks. The mean TAD was $24.69 \text{ mm} \pm 3.16 \text{ mm}$ (Range 20-32mm). Union was achieved in all patients (n=66) at 48 weeks Harris Hip score was 38.47 ± 13.14 , 61.70 ± 19.10 , 83.44 ± 12.24 , 94.06 ± 4.71 , 98.18 ± 4.27 and 98.68 ± 1.84 respectively. At all the follow up intervals, Harris Hip score was improved ($p < 0.001$). In our study overall outcome of patients (n=70) at 48 weeks who could complete the follow-up were good in 41 (58.5%), average in 25 (35.7%) and poor in 4 (5.7%) cases.

Conclusion: Proximal femoral nail antirotation with helical blade gives better fixation even in osteoporotic intertrochanteric unstable femoral fractures. But preoperative assessment and planning, reduction and surgical technique should be followed. Intramedullary fixation has biological and biomechanical advantages over extra medullary fixation, helical blade has better bone holding due to less bone loss moreover also give cancellous bone impaction which lead to lower rate of implant losing and failure.

Keywords: Extra capsular intertrochanteric fracture, proximal femoral nail antirotation, helical blade, osteoporosis

Introduction

Extra capsular hip fracture is common fracture in geriatric population. In India due to better health care life expectancy has increased which lead to high proportion of older population in society, because of that morbidity of hip fracture also in raising trends ^[1-3].

50% cases of hip fractures are extra capsular Intertrochanteric femoral fractures in geriatric population [4]. This needs early mobilization to prevent medical co-morbidities and regain pre-injury activity operative management have become preferred [5]. Implants should be used which have characteristics of less invasion, allow early weight bear and have less complication [6, 7]. Two methods of fixation are available in the form of intramedullary or extramedullary devices [8]. The choice of implant is mainly determined by the fracture pattern (stable or unstable). Unstable intertrochanteric fractures are those with major disruption of the posteromedial cortex because of comminution or are fractures with reverse oblique patterns or fractures with sub trochanteric extension. Fractures without posteromedial cortex disruption or sub trochanteric extension are considered stable [9, 10].

The surgical management of trochanteric fractures has evolved over the past two decades. The Biomechanical advantages of intramedullary (IM) implants like Gamma nail (GN) and proximal femur nail (PFN) an attractive option especially in unstable fractures [11]. Initial reports have suggested that IM nails may have an advantage over side plate devices in unstable fractures but have not demonstrated a clear superiority and have a reported complication rate of around 20% [12-13]. The incidence of neck screw cutout has reduced considerably with improvements in the surgical technique but still remains the most common mode of fixation failure with IM implants [15, 16]. The proximal femur nail antirotation (PFNA) was developed aiming to reduce this complication and initial studies have shown promise [17, 18]. With this background, we evaluated the functional and radiological outcome of proximal femoral nail antirotation (PFNA) in the treatment of unstable intertrochanteric fractures in Indian patients of Himalayan region.

Materials and methods

This prospective study was done on 75 patients with extra articular hip fractures, for fixation of fracture, implant of choice were used proximal femoral nail antirotation with helical blade. Study were done during the period from September 2015 to August 2016. Informed written consent were taken from all patients. The study was approved by institutional committee. We did not include < 45 year cases. Clinical and radiographic examinations were conducted on admission to the inpatient and emergency dept. of Orthopaedics of Shri Mahant Indiresh Hospital, Shri Guru Ram Rai Institute of Medical and Health Sciences, and fracture was classified according to Boyd and griffin

classification.

We excluded those aged <45 years, open intertrochanteric fractures, pathological fracture other than osteoporosis and associated multiple injuries. After the completion of the hospital treatment, patients were discharged and called for follow up at outpatient level, at regular intervals at 6, 12, 24, 36 and 48 weeks, for serial clinical and radiological evaluation.

All patients were evaluated clinically using pain assessment by numeric rating scale [19], Harris hip score [20], patient's quality of life by Jensen's social scale [21], mobility assessment by Parker and palmer system [22] and radiologically at 6 weeks, 12 weeks, 24 weeks, 36 weeks and 48 weeks. Anteroposterior and lateral plain radiographs were obtained at each visit to look for the progression and time of fracture union, tip apex distance, fracture alignment, cut-out or lateral migration of helical blade and other implant related complications were recorded. Data collected at the end of the study was statistically analyzed.

Surgical technique

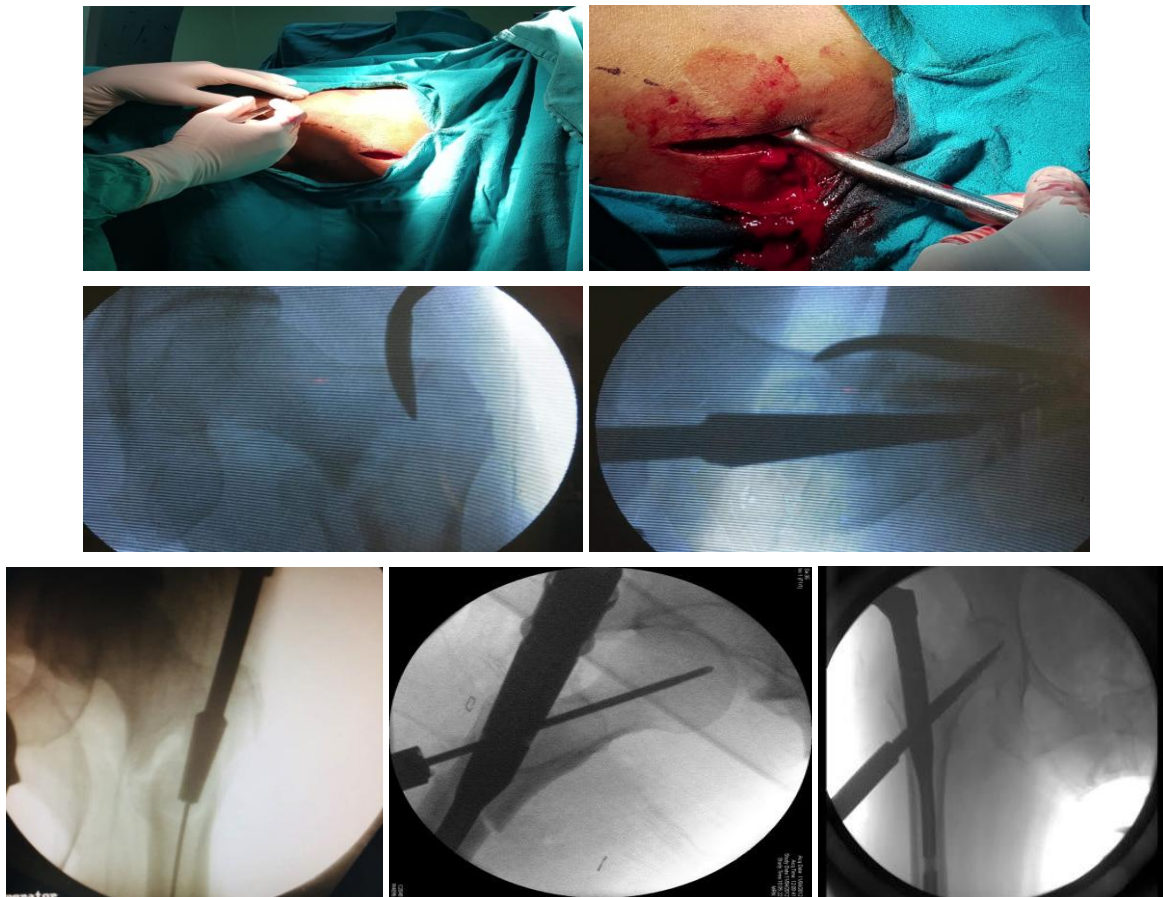
Under spinal or general anesthesia all patient were placed in supine on fracture table with unaffected lower limb flexed and abducted in order to accommodate the image intensifier. Operative lower limb put on traction. Closed reduction of the fracture under fluoroscopic guidance was possible in 50 cases. Rest were reduced with minimal opening of the fracture site using various reduction maneuvers like strategically placed homann retractors and reduction clamps. After making entry point, guide wire was inserted and medullary canal reamed by 1.5 mm greater than the nail size. Than nail was inserted. Guide wire was inserted and placed subchondrally with the help of image intensifier, size of helical blade was taken. After drilling blade was inserted and hammered. Distal screw was locked after releasing the traction.

Postoperatively, patients were encouraged to sit in bed and active isometric and isotonic quadriceps exercises were started from 2nd post-operative day. Intravenous antibiotics were given till 48 hours of surgery. Non-weight bearing ambulation with the help of walker was started from 2nd post-operative day. Partial weight bearing ambulation was started from 6th week, full weight bearing ambulation was started after radiological signs of union.

Photographs

a. Surgical intraoperative pictures





b. Postoperative x-ray pictures



Preoperative and immediate postoperative x-ray

Results

The study included 75 cases of intertrochanteric fractures that were operated with PFN with helical blade plate with fitted in to the inclusion criteria. The mean age was 65.67 ± 10.63 years (45–95 years) and there were 49 females and 26 males. In 56 patients fractures were caused by trivial fall and the rest were caused by road traffic accidents or fall from height and assault. Boyd and griffin classification was used to classify these fractures [23].

The study included 75 cases of intertrochanteric fractures in which 8 fractures were classified as type 1 and 18 fractures as type 2, 18 fractures in type 3 and 31 fractures in type 4 based on pre-operative radiograph. Singh index was used to assess the osteoporosis radiologically. Type 1 (n=8), type 2 (n=18), type 3(n=18), type 4 (n=31) were had mean Singh's index 5.13, 4.59, 4.76, 4.70 respectively. Severity of fracture increased with decreased mean Singh's index, this indicates that high incidence of comminuted fractures are seen in more osteoporotic bones. All surgeries were carried out at our tertiary care level hospital OT within a mean of 4.21 ± 2.21

days (range 1-10 days) from date of injury. All surgeries were done over fracture table in supine position. Mean operative time was 69 minutes (range 50-130 minutes). Mean intraoperative blood loss was 167 ml (range 100-300 ml). All patients received prophylactic antibiotic (cefuroxime) within 1 hour of skin incision. Patients were followed for a minimum of 48 weeks. A total of 70 patients were available for final follow-up after accounting for deaths and patients lost in follow-up.

Maximum number of patients (97.2%) showed sign of union between 18 to 24 weeks. The mean TAD was $24.69 \text{ mm} \pm 3.16 \text{ mm}$ (Range 20-32mm). Union was achieved in all patients (n=66) at 48 weeks who were available for follow up. The VAS score of mild grade was present in 17 patients at the final follow-up, rest all painless. The mean Parker and Palmer mobility score was 8.74 ± 0.75 at 48 weeks. Fracture stability did not have significant bearing on clinical and functional outcome measures. Jensen functional score at 48 weeks follow-up was 1.03 ± 0.127 . All cases (n=66) were independent at or after 48 week follow up. At 6 weeks, 12

weeks, 18 weeks, 24 weeks, 36 weeks and 48 weeks follow up intervals mean Harris Hip score was 38.47 ± 13.14 , 61.70 ± 19.10 , 83.44 ± 12.24 , 94.06 ± 4.71 , 98.18 ± 4.27 and 98.68 ± 1.84 respectively. At all the follow up intervals, a continuous increment in Harris Hip score was observed from preceding follow up ($p < 0.001$).

A total of 35 (50%) patients did not experience any complication. There were 35 (50%) patients who had mild to severe complications. Limping was the most common complication in 13 patients (18.5%) followed by trochanteric

pain in 7 patients (10%), thigh pain in 5 patients (7.1%), delayed union in 4 patients (5.7%), implant failure and hip pain in 2 patients each (2.8% each) respectively. A total of 5 (7.1%) patients were lost to follow up.

In our study overall outcome of patients ($n=70$) at 48 weeks who could complete the follow-up were good in 41 (58.5%), average in 25 (35.7%) and poor in 4 (5.7%) cases.

Radiographs and clinical photos of results Case



Preoperative x ray



immediate post OP xray



United fracture at 1 yr



able to SLR



walk without support

Discussion

An intertrochanteric fracture is one of the most common fractures of the hip especially in the elderly with porotic bone, usually due to low-energy trauma like simple falls. The incidence of intertrochanteric fracture is rising because of increasing number of senior citizens with osteoporosis [24]. The primary goal in the treatment in elderly patients with an intertrochanteric hip fracture is to return the patients to his prefracture activity level as soon as possible [25].

Surgery is the treatment of choice for early mobilization and prompt return to prefracture functional level, as well as for reducing mortality and morbidity [26]. The dynamic hip screw is accepted as the gold standard for stable trochanteric fractures. It provides controlled compression at the fracture site. Treatment of unstable trochanteric fracture with cephalomedullary implant or with extramedullary implant has been the topic of discussion for years together. Kim *et al.* [27] concluded in their study that unstable fractures with osteoporosis had a failure rate of more than 50% and in such cases dynamic hip screw should not be the first choice for treatment. In unstable proximal femoral fractures, control of axial telescoping and rotational stability are essential intramedullary implants inserted in less-invasive manner are better tolerated by the elderly.

PFNA incorporates the use of the helical-shaped blade to achieve fixation into the femoral neck unlike the use of screws in the earlier generation IM devices. The blade insertion technique compacts cancellous bone that makes it suitable for osteoporotic fracture situations [28]. The blade concept has also been shown *in vitro* to be biomechanically superior to screws in terms of axial and rotational stability [29, 30].

In our study majority of cases were females (65.33%). Similar finding also reported in previous studies done by kasha *et al.* [31] and sadic *et al.* [32]. The higher proportion of females in different studied could be due to high incidence of osteoporosis among women after menopause. Leading cause of injuries in our study was trivial fall in 30 patients accounting for 74.67%. Majority of patients (65.33%) in this study had unstable fractures (type 3 and 4). The chances of unstable fracture increased with declining Singh's indices.

In our study mean intraoperative blood loss was 167 ± 66.52 ml, mean surgical time was 69.01 ± 13.74 min, and mean duration of hospital stay was 11.04 ± 4.47 days. Short incision, less operative time, minimal blood loss and rapid rehabilitation of patient have been reported to be the characteristic advantages of PFNA.

Though the overall complication rate was 20% but implant failure rate was only 2.8% no cut out has been reported. Yu *et al.* [33] in their study reported combined implant failure cut-out in 9.7 of their cases. Implant failure rate is relatively lower in cephalomedullary nails with helical blade fixation technique. In our study limping (18.5%), trochanteric pain (10%) and thigh pain (7.1%) were the major complication encountered.

Park *et al.* [34] also reported trochanteric area pain in 21.7% cases. Our study showed 2.7% cases of non union. Other study done by Kasha *et al.* [31] Kumar *et al.* [35] Monereal *et al.* [36] and De Landevoisin *et al.* [37] did not report non-union in any case. However, Sadiq *et al.* [32] in their study reported 1.8% cases of nonunion. Functional outcomes assessed by Harris hip score reached to < 90 within 24 weeks and to near perfect (98.14) at 48 weeks of follow up. Our study was relatively better outcome compared to studies done by bajpai *et al.* [38] and kumar *et al.* [19]. This might be due to relatively

younger age group and inclusion of both stable and unstable fractures. Jensen function score was 3.21 ± 0.50 at 6 weeks which showed a gradual declining trend to reach at 1.03 ± 0.17 at 48 weeks showing an almost independent social functioning in all the patients. Similarly, mean Parker mobility score was 1.68 ± 0.50 at six weeks which reached at 8.74 ± 0.74 at 48 weeks, thus showing that almost all the patients were mobile without difficulty.

Conclusion

In our study, we concluded that proximal femoral nail with helical blade provides good fixation for unstable intertrochanteric fractures if proper preoperative planning, good reduction and surgical technique are followed. However, functional outcome in fractures with severe osteoporosis varied. Intramedullary fixation has biological and biomechanical advantages over extra medullary fixation, helical blade has better bone purchase because of less bone removal and bone impaction in osteoporotic bones leading to less implant failure. It prevents the rotational complications and implant failures like cut out and 'Z' effect, so it is a better design than the older gamma nail and proximal femoral nail. We recommend PFN with helical blade for fixation of unstable intertrochanteric fractures with less operative time, less intraoperative blood loss and low complication rate. Proximal femoral nailing requires a higher surgical skill, good fracture table, good instrumentation and good c-arm control. The implant is comparatively expensive and it has a steep learning curve and should be used after proper training.

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