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RESEARCH ARTICLE

# COMPLICATIONS OF INTERNAL FIXATION BY A SHORT PROXIMAL FEMORAL NAIL (PFN) IN SUBTROCHANTERIC FRACTURES

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**ABSTRACT**

**Introduction:** Many implants have evolved for the management of subtrochanteric fractures, each with its associated set of complications. In this study, short PFN was used for the management of subtrochanteric fractures and various complications were noticed.
**Aim of study:** To study Operative complications with respect to technical aspects & implant and to study the post operative complications of short PFN.
**Material and Methods:** This study was a prospective study on adult patients of both sexes with a follow up of 24 weeks, conducted at orthopaedic department of Govt Medical College Hospital, Jammu. After proximal femoral nailing, patients were assessed clinically and radiologically on the 2nd post operative day, at 4 weeks, 12 weeks and then between 6 months to 1 year depending upon the fracture union.
**Results & Observations:** Most of the fractures were reduced by closed reduction. In 30% of cases, mini-open reduction was required. Reduction was anatomical in 30% of cases, and acceptable in 62.5% of cases. Varus reduction was seen in 35% of cases. Proximal locking was found difficult in 30% of cases. Post operative complications were seen more in patients with other co-morbidities like diabetes milletus.
**Conclusion:** Intramedullary fixation has biological and biomechanical advantages, but the operation is technically demanding. Proper case selection, gradual learning and great patience is needed in order to prevent complications. Early failure is due to poor reduction, whereas non-union results in late failure.



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## INTRODUCTION

Higher incidence of unsatisfactory results after operative treatment for subtrochanteric fractures have been reported by many authors. This is due to medial comminution, high tensile forces in this region and various muscular deforming forces acting on the fracture fragments (Koch, 1917).Variety of implants have been tried for the management of these fractures. The open technique entailing the sliding hip screw may result in deterioration of pre-existing comorbidities in elderly patients owing to increased blood loss, soft-tissue damage, and longer rehabilitation (Morris and Zuckerman, 2002).

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The DHS (dynamic hip screw) superseded the earlier devices like jewitt nail plate, but failure of fixation can still occur in up to 20% of cases (Simpson*et al.*, 1989). The common problems are cut through, screw breakage, and penetration of joint by the screw (Guyton, 1988). In cases of subtrochanteric fractures, DHS fixation usually prevents dynamization at the fracture site as well. The DCS (dynamic condylar screw) designed for distal femoral fractures, has found increasing application in certain trochanteric fractures, particularly in very proximal subtrochanteric fractures. Although more resistant to fatigue failure than 95 degree condylar blade plate because of its increased thickness, the DCS is not a panacea for to be used indiscriminately (Muller*et al.*, 1997).In some fracture patterns like reverse obliquity, the dynamization may lead to excessive medialization of the femoral shaft with increased stress on the implant resulting in hardware failure (Cedar, 2000).Therefore, AO/ASIF in 1996 designed a new intramedullary device—the proximal femoral nail (PFN) for the stabilisation of subtrochanteric fractures. The procedure demands accurate and meticulous operative technique in order to avoid technical complications.

### Aim of Study

- To study Operative complications with respect to technical aspects & implant.
- To study the post operative complications of short PFN.

## MATERIALS AND METHODS

A prospective study on adult patients of both sexes with a follow up of 24 weeks was conducted at Orthopaedic department of Govt Medical College Hospital, Jammu between June 2014 and December 2015. Of the many femoral fractures, 40 patients above the age of 18 years with subtrochanteric fractures were included in the study. After clinical assessment and haemodynamic stabilisation, patients were subjected for radiographs of Pelvis with both hips-AP view and full length thigh-AP and lateral views.

### Criteria for selection of patients

Age - above 18 years
Sex - both males and females.
Patients with Seinsheimer types I –IV subtrochanteric fractures

### Criteria for exclusion of patients

- Polytrauma
- Old complicated fractures.
- Pathological fractures.
- Seinsheimer type V subtrochanteric fractures.
- Subtrochanteric fractures with associated neck/intertrochanteric/shaft fractures.
- Patients with any contraindication for anaesthesia or surgery

All the patients were operated on a fracture table in supine position under image intensifier control using standard techniques. Patients were assessed clinically and radiologically on the 2nd post operative day, at 4 weeks, 12 weeks and then between 6 months to 1 year depending upon the fracture union.

## RESULTS AND OBSERVATIONS

Total number of patients in our study were 40, of which 23 were males and 17 females. Most of the patients belonged to age group of 41 – 50 years. The fractures were classified according to Seinsheimer classification (type II- 25 cases, type III – 12 cases, type IV – 3). In most of the cases (n = 22), the mechanism of trauma was a fall from a height, while as, in rest of cases (n = 18), Road traffic accident was responsible for trauma. Other characteristics noted are as mentioned below:

### Type of reduction for fixation

| Type of reduction | No. of cases | Percentage (%) |
|---|---|---|
| Open | 1 | 2.5 |
| Mini-open | 12 | 30 |
| Closed | 27 | 67.5 |

Table 1 shows that in most of the cases, close reduction was possible; whereas, mini-open reduction was done in 30% of cases. In 1 case, open reduction was required.

### Quality of reduction

| Quality of reduction | No. of cases | Percentage (%) |
|---|---|---|
| Anatomical | 12 | 30 |
| Acceptable | 25 | 62.5 |
| Unacceptable | 3 | 7.5 |

Table 2 shows that reduction was anatomical in 30% of cases, and acceptable in 62.5% of cases. In 7.5% of cases, reduction was not acceptable.

### Intra-operative complications

| Intra-operative complication | No. of cases | Percentage (%) |
|---|---|---|
| Difficulty in locating entry site | 6 | 15 |
| Open/mini-open reduction required | 13 | 32.5 |
| Difficulty in passing guide rod | 8 | 20 |
| Breakage of guide wire for neck screw | 6 | 15 |
| Fracture of greater trochanter | 2 | 5 |
| Fracture of femoral diaphysis. | 4 | 10 |
| Difficulty in introducing neck screw/hip pin. | 12 | 30 |
| Poor reduction(varus/valgus) | 14 | 35 |
| Difficult distal locking | 4 | 10 |

Table 3 shows various intraoperative complications. From the table, it can be seen that varus reduction was seen in 35% of cases (figure 3). Proximal locking was found difficult in 30% of cases.

### Early postoperative complications

| Early post operative complication | No. of cases | Percentage (%) |
|---|---|---|
| Superficial infection | 2 | 5 |
| Deep infection | 0 | 0 |
| Delayed wound healing | 4 | 10 |
| Re- operation | 10 | 25 |
| Compartment syndrome | 0 | 0 |
| Post operative bleeding | 0 | 0 |
| Fat embolism | 0 | 0 |

Table 4 shows early post operative complications, mainly delayed wound healing, seen in 2 cases and superficial infection was noticed in 2 cases. Re-operation was required in 25% of cases, owing to intra-operative fractures and hardware symptoms due to neck screws.

### Late postoperative complications

| Late post operative complication | No. of cases | Percentage (%) |
|---|---|---|
| Persistent infection | 0 | 0 |
| Pain in hip region | 5 | 12.5 |
| Fracture displacement | 2 | 5 |
| Knee stiffness | 1 | 2.5 |
| Diaphyseal tip of nail fracture | 2 | 5 |
| Intra-articular migration of neck screws | 0 | 0 |
| Cut out of neck screws | 4 | 10 |
| Z – effect | 3 | 7.5 |
| Reverse Z effect | 0 | 0 |
| Secondary varus | 2 | 5 |
| Shortening | 4 | 10 |
| Delayed union | 2 | 5 |
| Non union | 0 | 0 |
| Hypertrophic calcification at entry site | 1 | 2.5 |
| Nail bending | 0 | 0 |
| Nail breakage | 0 | 0 |
| Cut out/breakage of distal screws | 1 | 2.5 |

Table 5 shows late post operative complications. 12.5% of patients noticed pain in thigh, due to screw prominence.10% of patients developed superior cut out of neck pin (Figure 1). Incidence of Z- effect in our study was 7.5%. 10% cases had shortening of less than 2 cm.

### Duration of fracture union in weeks

| Period for union | No. of cases | Percentage (%) |
|---|---|---|
| 10 – 12 weeks | 18 | 45 |
| 13 – 14 weeks | 16 | 40 |
| 15 – 18 weeks | 5 | 12.5 |
| >18 weeks | 1 | 2.5 |

Table 7 shows duration of fracture union in weeks.85% of cases showed union in 10- 14 weeks time.

**Figure 1. Superior cutout of neck screw**

**Figure 2. Guide wirebreakage**

**Figure 3. Varus reduction**

**Figure 4. Varus reduction andiatrogenic fracture due to vigorous Hammering**

**Figure 5. Iatrogenic fracturedue to poor reduction and hammering**

## DISCUSSION

Proximal femoral nailing is a technically demanding procedure, but has several biological and biomechanical advantages. Intramedullary implants for internal fixation of the proximal femur tolerate higher static and several times higher cyclical loading as compared to sliding screw implants. As a result the fracture heals even without the primary restoration of the medial support. The implant temporarily compensates the function of the medial column. When this function is not restored in a limited period of time, the internal fixation, although correctly performed, fails. In this series of 40 completely evaluated PFN implantations, fracture consolidation was seen in 97.5% of the cases within 18 weeks. Intraoperative difficulties were noted in 50% of the implantations and the overall rate of late technical and mechanical complications was 40%. Comparison of failures in this study to those in other series is not easy because an exact definition of failure is absent in most cases. Distal locking difficulties in this series were seen in 4 (10%) cases. These can be avoided by firmly tightening the bolt joining the nail and the insertion handle at the time of distal locking. In 20% of cases, only 1 locking screw could be inserted distally. The result of the reduction was considered acceptable in 60% of the patients and anatomical in 32.5% of patients. Poor reduction was noted in 8% of patients and it was associated with poor outcome. In I.B.SCHIPPER's series (Schipper, 2004), reduction was good to acceptable in 96.2% of their patients and poor reduction was seen only in 2.9% of their patients. The high stress concentration at the distal holes of the locking bolts, the suggested necessary over-reaming of the shaft that had been seen to weaken the entire shaft and the frequent drilling for a proper distal interlocking because of misalignment of the aiming device (Aune *et al*., 1994; Heinz and Vescei, 1994) are some of the reasons for the high incidence of fracture below the tip of the short PFN. The PFN modifications might be credited for the positive outcome in this study, only two fractures at the tip of nail during the follow-up period were noticed. Intraoperatively there were 4 fractures below the tip due to inadequate reaming and vigorous hammering during nail insertion. Surgical technique may also be responsible, due to abnormal strains imparted by the implant to the femur (Friedl *et al*., 1994; Parker and Pryor, 1996). In other series, the rate of fixation failure, femoral shaft fracture, and re-operation is high (Menezes *et al*., 2005) (12 %) The anterior curvature of the femur affects insertion of the intramedullary nail. This may cause cortical penetration or fracture angulation if the mismatch between the nail and femoral curvatures is significant (Siwach and Dahiya, 2003). Intra-operative complications such as splintering and fractures are due to oversized implants that are manufactured according to western population parameters (Egol *et al*., 2004). So, it is suggested that the nail dimensions should be modified to suite Indian population. Most of the cases in this study were managed by close reduction. In 30% of cases, mini-open reduction was required. Here, a small incision was made over the fracture site without extensive soft tissue dissection and using bone levers or bone clamps, fragments were held in reduced position till nailing was done. This is high in comparison with the studies of Boldin *et al*. (2003) (90.90% closed reduction) and other studies done elsewhere. Varus malreduction was the most common complication noticed in this study. This can be attributed to initial malreduction in which proximal fragment remained abducted. It is important that fracture should be reduced first, even if open reduction is required, before intramedullary nailing. Open reduction increases the risk of infection, soft-tissue devitalisation, and non-union. With varus malreduction, neck screws will seem to point towards superior cortex of neck and it will be difficult to insert hip pin after inserting hip screw. In this study, difficulty in proximal locking, while introducing head and neck screws, the incidence of which in this series was 30% was experienced. Inability to apply the anti-rotational hip pin was noted in 5 patients, due to mainly two reasons. Firstly, the neck screw had been applied first in a position higher than the distal 1/3 of the neck thus leaving no room for the hip pin and secondly, due to varus malreduction, it was not possible to insert proximal screw in the femoral neck. The incidence of difficulty in proximal locking in a series by Christos garnivos *et al* was 33.3%.Four cut-outs through the femoral head (10%) occurred in this study. The cut-out was noted in the early postoperative period as the patients had been allowed to walk with full weight bearing. Screw cut out is related to malposition and can be prevented by proper positioning of the neck and anti-rotation screws (the anti-rotation screw should be shorter to allow sliding of the screws through the nail during weight bearing). In a multi-centre study (Simmermacher *et al*., 1999), the failure rate of PFN secondary to poor reduction, malrotation or wrong choice of screw was reported to be 5%, whereas the screw cut-out rate varied from 0.6% (Christian Boldin *et al*., 2003) to 10% (Simmermacher *et al*., 1999; Lustenberger and Ganz, 1995). Other complications of proximal femoral nailing include lateral protrusion of screws resulting in thigh pain, Z effect or a reversed Z effect, and fracture of the lateral wall of the trochanter (Strauss *et al*., 2007). In this study, the reoperation rate was 25%, the main reasons being iatrogenic fractures and removal of cephalic screw due to lateral protrusion at the proximal thigh. In patients with unstable subtrochanteric fractures treated with proximal femoral nailing, technical or mechanical complications seem to be related to the fracture type, operating technique, and time to weight bearing rather than the implant itself (Tyllianakis *et al*., 2004). Screw migration is attributed to fracture instability, presence of osteoporotic bones, and impaction at the fracture site. (Tyllianakis *et al*., 2004) In accordance with similar reports, systemic and local complications and death rate in this study were not different. Intramedullary nailing involves reaming and violation of the medullary canal, leading to increased blood loss and transfusion rates (Peyser *et al*., 2005). Most of the complications encountered in this series were not directly attributed to the nailing, but inexperience on the part of surgeon, unfamiliarity with the instrumentation, improper use of c-arm etc. However, the great majority of patients were provided with stable fixation, early mobilisation, early rehabilitation and return to pre-fracture status.

### Conclusion

Intramedullary fixation has biological and biomechanical advantages, but the operation is technically demanding. Proper case selection, gradual learning and great patience is needed in order to prevent complications. Early failure is due to poor reduction, whereas non-union results in late failure. Good reduction with minimal dissection, the use of appropriate nail length, and proper positioning of the nail and screw are necessary to prevent failure or revision.

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