SCIENTIFIC ARTICLE

Comparative study of the management of inter-trochanteric fractures in the elderly: short proximal femoral nail vs dynamic hip screw

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ABSTRACT

Introduction: Unstable intertrochanteric fractures of the femur are still a great challenge to surgeons with a dilemma of which implant is better. The objective of this study was to compare the results of the new generation short proximal femoral nails (PFN) with the dynamic hip screw (DHS) in intertrochanteric fractures in the elderly.

Method: This is a randomized prospective comparative study of 96 patients over the age of fifty years in two study groups; the first group of 48 patients operated with short proximal femoral nail (Group 1, n=48) and the second group of 48 patients operated with dynamic hip screw and a side plate (group 2, n=48). Patients were followed for at least one year or until union.

Results: Mean time of union in PFN was 9.8 weeks and DHS was 13.5 weeks; $p<0.05$. Duration of surgery was less with PFN (mean time 42 minutes vs. 65 minutes with DHS; $p<0.05$). Blood loss was less with PFN with mean 95 ml vs. 162 ml in DHS; $p<0.05$. Length of incision was small in PFN 8.5+/-1.2 cm while in DHS, the length of incision was 16.5 +/- 2.3 cm.; $p<0.05$ Post-operative complications were less with the PFN group as compared to DHS.

Conclusion: PFN, being a load sharing implant, provided a good biomechanically stable construct for intertrochanteric fractures of the femur allowing early fracture union and early weight bearing. It is an implant of choice for both stable and unstable types of intertrochanteric fractures.

Key words: Hip fracture; Dynamic hip screw; Proximal femoral nail.

Introduction

In the future, the incidence of hip fracture would be expected to double to 2.6 million by 2025 and 4.5 million by 2050 [1] , as the geriatric age population has been increasing

Conservative treatment for these type of fractures, with prolonged bed rest and traction has been associated with varus deformity and shortening, along with the general complications associated with prolonged immobilization. Operative treatment, which allows early rehabilitation and mobilization, has now become treatment of choice for virtually all trochanteric fractures [2,3]. Dynamic hip screw and side plate, for a long time, is the gold standard modality for fixation which permits the proximal fragment to collapse or settle on the fixation devices, seeking its own position of stability, with the shaft usually displacing medially [4,5]. Failure of fixation in up to 20% of cases are associated with "screw cut through", giving away from the shaft, implant failure and penetration of the joint by the screw. An intramedullary device has some theoretical advantages over extramedullary devices as it is not dependent on screw fixation of a plate to the lateral cortex, which can be a problem in very osteoporotic bone. In addition, shaft fixation is nearer to the centre of rotation of hip, as the load transmitted to the femur along with a more medial axis, has a shorter moment arm [6,7,8].

There is much confusion about when to use intramedullary nails and when load bearing implants in trochanteric fractures according to fracture comminution and instability. We hypothesized that the proximal femoral nail is a biomechanically more stable implant with good biological compatibility but that dynamic hip screw yet remains useful for stable fractures.

Material and methods

108 Patients were included in this study. None refused consent and this study was recognized by the Ethical Committee of our hospital. Twelve were lost to follow up, 8 of the PFN group and 4 of the DHS group. Hence two groups of 48 patients were each operated with DHS and PFN respectively. We used randomization tables. Patients were followed for at least one year or until bony union, as determined by radiological union of at least three cortices in both antero-posterior and lateral view and the absence

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of pain at the fracture site. All fresh cases (less than 3 weeks) of closed inter-trochanteric femur fracture in elderly age >50 years of both sexes were included. Open, infected fractures and un-cooperative patients were excluded along with very poor anaesthetic or general risk patients and those with inability to walk prior to fracture or with pre-existing proximal diaphyseal deformity of femur.

Dynamic hip screw comprised a 135 angle, 316 L stainless steel consisting of neck screw size from 55 mm to 110 mm, coupling screw and a plate of different hole size. The short proximal femoral nail comprised of 316 L stainless steel consisting of a 250 mm short nail with a shaft diameter of 9, 10, 11, 12 mm, neck shaft angle 1350 with valgus angle of 5 .

Table - 1

Pre-operative comparison of the two groups

Pre Operative Measures	Short PFN (n=48)	DHS (n= 48)
Average Age (Yrs)	68	67
Sex (M/F)	15/33	11/37
Mode of Injury		
(Low Velocity)	44	43
(High Velocity)	4	5
Type of Fractures		
(Stable)	18	35
(Unstable)	30	13

Surgical technique

All patients were operated on a traction table under Image Intensifier control. Fracture reduction was checked in both antero-posterior and lateral view. In case of PFN, the distal femoral canal was not reamed. Screw position was checked in according to the tip- apex distance (distance from the tip of the compression screw to the apex of the head after excluding the magnification coefficient). For the PFN, the ideal position of hip pin is slightly inferior to centre in the femoral head and for DHS, it is in the centre of the head. No displacement osteotomy was performed. Complete haemostasis was achieved and negative suction drain was used following DHS surgery.

The same postoperative protocols were followed for both of the groups. Patients were encouraged to mobilize the knee and perform static quadriceps exercise from day one after operation. Toe touching was encouraged from day 3 or as the pain reduced with help of a four post walker. Patients were followed at regular intervals and union at fracture site, position of screw, functional status of patients and infections were noted. The Modified Harris Hip Score System was used to evaluate the patients.

Data are presented as mean (+/-standard deviation) or median and range. Statistical evaluation was by a t-test or test of proportions as appropriate for parametric data and a Wilcoxon test for non-parametric data. Significance was assigned to a p-value <0.05.

Table - 2

Comparison of intra-operative parameters

Intraoperative measures	Short PFN (n=48)	DHS (n= 48)
Fluoroscopic measures	28	15
Blood loss (ml)	95	162
Length of incision (cm)	8.5 ± 1.2	16.5± 2.3
Duration of operation (min)	42	65

Results

96 patients were followed for a median of 18 months (12-30 months). Median age of the patients in PFN group was 68 years (55-88), and for the DHS group, 67 years (50-86). Seventy patients were female. Ninety one patients sustained injury due to trivial trauma due to fall on the floor. (Table 1) Both groups were found to be comparable.

PFN fixations were initially attempted with close reduction on the fracture table, which was successful in 46 cases; only two cases needed open reduction. Median time in DHS surgery was 65 minutes (45-110); comparatively PFN lasted around a median of 42 minutes (30-90). The median blood loss for DHS surgery was 162 ml (90 to 315 ml) and that for PFN was 95 ml (65 to 180 ml) which was statistically significant ($p<0.05$). In our study

Table - 3

Comparison of post-operative outcome

Pre Operative Measures	Short PFN (n=48)	DHS (n= 48)
Hospital stay (days)	6	11
Infection		
Superficial	1	4
Deep	0	2
Weight bearing (weeks)	9.8	13.5
Varus angulation (degree)	8	10.5
Limb length discripancy (cm)	0.857	1.68

the length of incision used in PFN was; mean- 8.5+/-1.2 cm, while in DHS, length of incision was 16.5 +/- 2.3 cm ($p<0.05$) All PFN were not reamed distally and distal locking was done in all cases of PFN (Table 2).

In the present series, average stay in hospital was 6 days in the PFN group and 11 days in the DHS group ($P<0.05$ - test of proportions). The median radiological union time for trochanteric fracture fixed with DHS was 13.5 weeks (8 - 24 weeks) while with PFN it was 9.8 weeks (6 - 16 weeks) which was statistically significant ($p<0.05$).

After measuring the neck shaft angle on serial follow ups, we found a tendency towards varus angulations in the DHS group (n = 22) with the mean angulation 10.5 , while in the PFN group, less patients (n = 16) were noted with varus angulation with mean of 8 which was a significant difference. In DHS, 23 patients were noted with limb length shortening with mean of 1.68 cm. while in PFN seven patients were noted with limb length shortening with mean of 0.857 cm.

In the DHS group, six patients had postoperative infection of which two had deep infection leading to loosening of implant for which the implant was removed. In PFN only one of the patients had postoperative infection which was superficial and managed with intravenous antibiotics and dressing. We found DHS surgery was associated with more complications such as loss of position of lag screw (n = 20), cut out of lag screw (n = 2), breakage of implant (n = 1), and loosening of lateral cortical screw (n = 1). Complications found after PFN were mostly implant related such as lateral back out of screw from nail (n = 6) and screw cut out from head and neck of femur in one case. Medial migration of hip screw, fracture of femoral shaft close or just distal to the implant, breakage of implant was noted in none of the case of PFN, (Table 3).

Discussion

Currently surgical treatments are the preferred mode for intertrochanteric fractures, as they avoid complications related to prolonged recumbency. Prolonged recumbence complication ultimately ends with surgical treatments. From a biomechanical point of view, the varieties of implants are available. The first one which is a load bearing implant, consists of sliding neck screw connected to a plate in the lateral femoral cortex. In unstable fracture an additional anti-rotational screw is recommended and, in case of several fragments and / or impaired bone quality, a trochanteric stabilization should also be used [9,10]. The other alternative is sliding neck screw that stabilizes head and neck fragments by means of intramedullary nail. This load sharing implant is inserted with the closed reduction technique [11,12,13].

Controversy still exists as to what fixation method should be used in intertrochanteric fractures, particularly in unstable fractures, where complication rates are high. In the present study, in the PFN group, fracture reduction was tried by closed reduction on the fracture table, which was successful in 46 cases. Only two cases needed open reduction, and this is comparable to other series [6,7]

PFN usually takes less operative time than DHS [14] though more technical expertise is required. This may be explained by the PFN being inserted by closed technique with minimum soft tissue dissection. Also, we did not ream the medullary canal and the screws were inserted with the help of a jig. A smaller incision in the PFN group has advantages such as less blood loss, better cosmesis, minimum soft tissue dissection and other close reduction technique related benefits. On the other hand, DHS requires greater exposure and soft tissue dissection leading to drainage of fracture hematoma which is vital for fracture union and high chances of post-operative infection [4]. Knee mobilization was delayed in the DHS group because of pain at incisional site.

The PFN group took comparative lesser time to heal [6,15,16]. This difference with the two modalities of treatment may be due to the fact that PFN is a minimal invasive technique in which closed reduction was performed. In DHS, limb shortening as well as varus deformity was observed more frequently, and with increased severity [17]. In case of PFN with shortening, we found that the fracture was either fixed with some varus angulation intraoperatively, or later on, screw cut out lead to varus angulation and significant shortening. While with DHS we found successive increase in varus angulation with each follow up. This may show the sliding nature of the lag screw of the DHS, which lead to compression at the fracture site and gradual shortening of limb.

In our study, functionally and radiologically, DHS provided excellent to good results in stable type of pattern while PFN provided more frequent excellent to good results, and in both type of fracture patterns. This is because PFN provided stable anatomical fixation of more comminuted fracture without shortening of abductor moment arm or changing proximal femoral anatomy. With the fixation device within the medullary canal, the bending moment on it is considerably less than on standard compression screw and slide plate devices [15,18]. With such results PFN has been becoming a better implant for the unstable type of intertrochanteric fractures [12,13,15,19].

Deep and superficial infection both were higher in DHS group, which could be due to a longer skin incision, extensive tissue dissection and more operative time. Apart from implants, faulty technique and rehabilitation program may lead to complication in either group, like improper screw

positioning. Early unaided weight bearing, shortening, varus deformity and non-union. [19,20].

The higher incidence of screw back outs in after PFN showed that hold of the lag screw was not as good as in DHS. This may be due to the fact that, in PFN, we ream the whole tract with the same diameter of the drill, while in DHS, we use a graded drill with lesser diameter in distal portion and greater diameter in proximal portion. This gives a better hold of the lag screw in the DHS and also better compression at fracture site. This fallacy of PFN devices can be corrected with a modified lag screw system. This is also blamed for collapse or impaction of fracture rather than the migration of the screw [21]. In our study we found that screw is backed out without much fracture site collapse. The fracture collapse was associated with reduction of neck shaft angle but in our study we did not find such significant varus angulation at the fracture site in patients with lateral protrusion of the lag screw. Titanium made nails was also blamed for this lateral protrusion, due to its lower friction coefficient than stainless steel [21]. In our study, despite using PFN made up of 316 L stainless steel, we still encountered a high incidence of lateral protrusion of lag screw with PFN.

The therapeutic effect of DHS and PFN was similar in treating type A1 inter-trochanteric fracture [4], but in type A2 and A3, PFN appeared to be biologically and biomechanically superior.

Conclusion

As we hypothesised, we found that PFN, being a load sharing implant, provides a good biomechanically stable construct for inter-trochanteric fractures of the femur allowing early fracture union and early weight bearing. Due to a shorter lever arm, additional anti-rotational screw, fluting nail tip to decrease stress concentration at the tip of the implant reduces the chances of implant failure. It has all the advantages of closed techniques i.e. preservation of fracture hematoma in situ, minimum soft tissue dissection and periosteal stripping which helps in the fracture healing and less post-operative infections as compared to DHS which requires larger incision and extensive soft tissue dissection. Functional and radiological status of PFN was much better than DHS in unstable type of inter-trochanteric fractures. Postoperative complications were also less with PFN as compared with DHS. As DHS is a low cost implant and lesser fluoroscopic exposure is required, it still remains to be the gold standard for stable type of intertrochanteric fractures.

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