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Original Research Article

A comparative study of proximal femoral fracture fixation with proximal femoral nail and dynamic hip screw and plating

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ABSTRACT

Background: Trochanteric fractures are one of the commonest injuries sustained predominantly in patients over sixty years of age. They are three to four times more common in women. These usually occur through bone affected by osteoporosis; trivial fall being most common mechanism of injury Approximately 10-30% of patients die within one year of an intertrochanteric fracture.
Methods: A prospective study comprising of patients identified for surgical treatment of fracture in the intertrochanteric region of femur admitted to Sri Siddhartha Medical College, Tumkur from 2016 to 2017 where 30 patients with 30 intertrochanteric fractures of femur were selected with equal distribution of 15 dynamic hip screw devices and 15 intramedullary devices.
Results: The purpose of the present study is to verify theoretical advantages of intramedullary device over the dynamic hip screw devices and also whether it actually alters the eventual functional outcome of the patient. Excellent results were seen in 2 patients (13.3%) in the DHS group and in 6 patients (40%) in the PFN group. The overall functional outcome of patients treated with the PFN was significantly better than those treated with DHS (p=0.037). However when we compared the stable and unstable fractures separately, we found that there was no significant difference in the outcomes of the stable fractures in the two groups (p=0.198).
Conclusions: We conclude that in stable intertrochanteric fractures, both the PFN and DHS have similar outcomes. However, in unstable intertrochanteric fractures the PFN has significantly better outcomes in terms of earlier restoration of walking ability as it is an intramedullary implant which can tolerate higher cylindrical loading when compared to DHS type of implants. In addition, as the PFN requires shorter operative time and smaller incision, it has distinct advantages over DHS even in stable intertrochanteric fractures. Hence, in our opinion, PFN may be the better fixation device for most intertrochanteric fractures.

Keywords: Inter trochanteric fractures, Osteoporosis, Dynamic hip screw, Proximal femoral nail

INTRODUCTION

Trochanteric fractures are one of the commonest injuries sustained predominantly in patients over sixty years of age. They are three to four times more common in women than in men. These usually occur through bone affected by osteoporosis; trivial fall being the most common mechanism of injury.[1]

For many, this fracture is often a terminal event resulting in death due to cardiac, pulmonary or renal complications. Approximately 10 to 30% of patients die within one year of an intertrochanteric fracture.[2] The goal of treatment of an intertrochanteric fracture must be restoration of the patient to his or her pre-injury status as early as possible. This led to recommendations for internal fixation of these fractures to increase patient comfort, facilitate nursing care, decrease hospitalization and reduce complications of prolonged recumbency.[3]

The greatest problems for the surgeon providing this treatment are fracture instability and the complications of fixation that result from instability. In trochanteric fractures, stability refers to the capacity of the internally fixed fracture to resist muscle and gravitational forces around the hip that tend to force the fracture into a varus position. Intrinsic factors like osteoporosis and comminution of the fracture and extrinsic factors like choice of reduction, choice of implant and technique of insertion, contribute to failure of internal fixation.

The type of implant used has an important influence on complications of fixation. Sliding devices like the Dynamic Hip Screw have been extensively used for fixation. However, if the patient bears weight early, especially in comminuted fractures, these devices can penetrate the head or neck, bend, break or separate from the shaft.

Intramedullary devices like the proximal femoral nail have been reported to have an advantage in such fractures as their placement allowed the implant to lie closer to the mechanical axis of the extremity, thereby decrease the lever arm and bending moment on the implant. They can also be inserted faster, with less operative blood loss and allow early weight bearing with less resultant shortening on long term follow up.

The purpose of the present study is to verify the theoretical advantages of the intramedullary device over the dynamic hip screw devices and also whether it actually alters the eventual functional outcome of the patient.

METHODS

The study was conducted in Sri Siddhartha Medical College, Tumkur from 2016 to 2017 where 30 patients with 30 intertrochanteric fractures of femur were selected.

Methods used in the study

A prospective study comprising of patients identified for surgical treatment of fracture in the intertrochanteric region of femur admitted to Sri Siddhartha Medical College.

All patients in the study after undergoing routine clinical examination would be subjected to following battery of investigations.

Complete haemogram with ESR, chest X ray PA view, electrocardiogram, 2D echocardiogram, AP and lateral X-ray of pelvis with both hip joints and proximal half femur.

Aims and objectives

To compare the surgical treatment of peritrochanteric fractures of the femur with the intramedullary device (Proximal femoral nail) and Dynamic Hip Screw device, with respect to:

Duration of surgery, fracture union, functional outcome, fluoroscopic time

Inclusion criteria

Inclusion criteria were peritrochanteric fractures; fractures in adults.

Exclusion criteria

Exclusion criteria were intracapsular fractures; pathological fractures except osteoporosis; compound injuries; previous hip surgeries.

All the patients were initially evaluated as to their general condition, hydration and corrective measures were undertaken. The pre-injury walking ability was recorded as per the classification of Sahlstrand.[4] Anteroposterior and lateral radiographs of the affected hips were taken.

The fractures were classified as per Jensen and Michealsen's modification of Evans classification of intertrochanteric fractures.[5,6] Type I and type II were considered as stable fractures and type III, IV and V were considered as unstable fractures. No open fractures were encountered in this series. Patients were taken up for surgery as soon as their general condition permitted. Adequate blood transfusion, thromboprophylaxis and other supportive measures were given depending on the pre-operative condition of the patient and also post-surgery based on the blood loss during surgery.

The fractures were fixed with either dynamic hip screw device (DHS) or an intramedullary device. In this study the intramedullary device used was the proximal femoral nail (PFN). Of the 30 patients in the study, 15 were treated with DHS and 15 with PFN. The length of the incision, duration of surgery and fluoroscopy time was recorded intraoperatively

Statistical analysis

The collective data was analyzed by the Z-Test, Student T-test, Chi-square test, Wilcoxon Signed Rank Sum test and the Mann Whitney-U test using SPSS software to evaluate the results.

RESULTS

The most common age group was in the range of 61 – 80, with a mean of 72.23 years (Table 1). Majority (60%) of the patients were females with males constituting only 40% of the patients (Table 2). The most common mode of injury was a trivial fall (93%) (Table 3). Injuries to both the hips were of equal incidence. There were 17 stable fractures and 13 unstable fractures (Table 4).

Table 1: Age distribution.

Age (years)	Method of fixation		Total (%)
	DHS (%)	PFN (%)	
21-40	0 (0)	0 (0)	0 (0)
41-60	1 (6.66)	1 (6.66)	2 (6.66)
61-80	11 (73.33)	12 (80)	23 (76.66)
81-100	3 (20)	2 (13.33)	5 (16.66)
Total	15 (100)	15 (100)	30 (100)

Table 2: Sex distribution.

	Method of fixation		Total (%)
	DHS (%)	PFN (%)	
Female	9 (60)	9 (60)	18 (60)
Male	6 (40)	6 (40)	12 (40)
Total	15 (100)	15 (100)	30 (100)

Table 3: Mode of injury.

	Method of fixation		Total (%)
	DHS (%)	PFN (%)	
Fall from a height	0 (0)	1 (6.66)	1 (3.33)
RTA	1 (6.66)	0 (0)	1 (3.33)
Trivial fall	14 (93.33)	14 (93.33)	28 (93.33)
Total	15 (100)	15 (100)	30 (100)

Table 4: Type of fracture.

Type of fracture	Method of fixation		Total (%)
	DHS (%)	PFN (%)	
T1	1 (6.7)	0 (0.0)	1 (3.3)
T2	7 (46.7)	9 (60.0)	16 (53.3)
T3	5 (33.3)	3 (20.0)	8 (26.7)
T4	2 (13.3)	3 (20.0)	5 (16.7)
T5	0 (0.0)	0 (0.0)	0 (0.0)
Total	15 (100.0)	15 (100.0)	30 (100.0)

All fractures were classified as per Jensen and Michealsen's modification of Evans classification.[5,6]

T1: type 1 fracture ; T2: type 2 fracture ; T3: type 3 fracture ; T4: type 4 fracture ; T5: type 5 fracture

The pre-injury walking ability of the patients was classified as per grades described by Sahlstrand.

Grade 1– Walk without support; Grade 2– Walk with a cane or minimal support; Grade 3 – Walk with 2 canes, crutches or living support; Grade 4 – Confined to bed or wheel chair

Table 5: Length of the incision.

Method	N	Mean	Standard deviation	Comparison
PFN	15	16	1.06904	Z=4.716; p=0.001
DHS	15	6	1	

Table 6: Duration of surgery.

Method	N	Mean (min)	Std. deviation	Comparison
DHS	15	66.667	13.84437	Z=3.07200; p=0.02 hs
PFN	15	52.0000	8.61892	

Table 7: Fluoroscopy time.

Method	N	Mean (sec)	Std. deviation	Comparison
DHS	15	48.60	6.174	Z=4.631 P=0.001 vhs
PFN	15	72.60	11.488	

Table 8: Post operative complications.

	Method of fixation		Total (%)
	DHS (%)	PFN (%)	
Malunion	2 (13.33)	0 (0)	2 (6.66)
Screw cut out	2 (13.33)	1 (6.66)	3 (10)
Wound infection	0 (0)	0 (0)	0 (0)

Pre-injury walking ability was similar in both the groups. Patients treated with PFN required a significantly smaller skin incision (Table 5). Proximal femoral nailing required 14.67 per cent less operative time as compared to Dynamic hip screw fixation (Table 6). Dynamic hip screw fixation required 24 per cent less fluoroscopic time as compared to proximal femoral nailing (Table 7).

Postoperative variables

Malunion was seen in 14% of the patients in the DHS group while there was no non malunion in the PFN group. Hip screw cut out was seen in 2 patients in the DHS group and 1 in PFN group. No wound infection was seen in any group (Table 8). In the DHS group only 2 patients were pain free, whereas 6 patients were pain free in the PFN group at sixth month of follow up. Patients in the PFN group regained their pre-injury walking ability at the fourth month of follow up as compared to only five in the DHS group.

Significantly less limb length shortening was seen in the PFN group as compared to the DHS group with a mean of 1.2533 cm in the DHS group and 0.6333 cm in the PFN group. The patients treated with PFN recovered 74.6667 per cent of their hip range of movement as compared to those treated with DHS who recovered only 57 per cent of their hip range of movement (Table 9). All the fractured united at a mean of 12 weeks.

Table 9: Postoperative range of movement.

Method		N	Mean	Std. deviation	Comparison
% of normal range of motion	DHS	15	57.0000	15.90148	Z=3.10600
	PFN	15	74.6667	9.90430	p=0.002 hs

Table 10: Functional outcome.

	Method of fixation		Total (%)
	DHS (%)	PFN (%)	
Excellent	2 (13.33)	6(40)	8 (26.66)
Good	5 (33.33)	7 (46.66)	12 (40)
Fair	4 (26.66)	2 (13.33)	6 (20)
Poor	4 (26.66)	0 (0)	4 (13.33)
Total	15 (100)	15 (100)	30 (100)

Excellent results were seen in 2 patients (13.3%) in the DHS group and in 6 patients (40%) in the PFN group (Table 10). The outcomes of stable fractures treated with either DHS or PFN were similar.

Unstable fractures treated with PFN had a significantly better outcome with all the patients having good outcomes as compared to those treated with DHS.

DISCUSSION

The goal of this study was to compare the functional outcomes of patients with intertrochanteric fractures treated by two different fixation devices, the extramedullary dynamic hip screw and the intramedullary proximal femoral nail. Our study consisted of 30 patients with 30 intertrochanteric fractures out of which 15 were treated with DHS and 15 with PFN.

The average age for trochanteric fractures is reported to be 65-75 years. In our series, the highest number of patients was in the 61-85 years age group. All the fractures that occurred in patients younger than 55 years were either due to a fall from height or a road traffic accident.

Our series consisted of 17 stable and 13 unstable intertrochanteric fractures as classified according to Jensen and Michealsen's modification of Evans classification.[5,6] The distribution of stable and unstable fractures in both groups was similar. Out of the 17 stable fractures, 8 were in the DHS group and 9 in the PFN group. Out of the 13 unstable fractures, 7 were in the DHS group and 6 in the PFN group.

The pre-injury walking ability was similar in both groups of patients treated with DHS or PFN. 80 per cent of patients in the DHS group and 73.3 per cent of the patients in the PFN group were walking without support prior to the injury.

The length of the incision in the DHS group ranged from 14 cm to 18 cm with a mean of 16 cm as compared to a mean of only 6 cm in the PFN group. The smaller incision in the PFN group meant that there was less intraoperative blood loss.

The duration of surgery in the DHS group ranged from 40 minutes to 90 minutes with a mean of 66.66 minutes. The duration of surgery in the PFN group ranged from 40 minutes to 75 minutes with a mean of 52 minutes. The difference in the operative times in both the groups was found to be highly significant and we attributed this difference to the smaller incisions in the PFN group. Baumgaertner et al also found that the surgical times were 10 per cent higher in the DHS group in their series.[7] Saudan and colleagues found that there was no significant difference between the operative times in the two groups in their series.[8]

The fluoroscopy time in the PFN group (average 72.60secs) was significantly higher as compared to that of the DHS group (average 48.60 secs). This was similar to the series by Baumgaertner and associates who also found a significant difference in the fluoroscopic times in their series, with 10 per cent higher times for the PFN group.[7] However in their series Saudan et al found no difference between the fluoroscopy times in both the groups.[8]

The occurrence of femoral shaft fractures does not seem to be a major problem with the PFN due to a narrower distal diameter as compared to other intramedullary nails.[9] Also, rotational control is inherent in the nail design and is not dependent on multiple parts that are likely to increase the risk of mechanical failure. Due to the smaller diameter lag screws in these intramedullary nails, the proximal aspects of the nail do not need to be flared to prevent mechanical failure of the nail and hence requires less reaming of the proximal femur, thereby reducing the risk of iatrogenic proximal femoral fracture.[10] In our study, both intraoperatively and postoperatively, there were no instances of femoral shaft fractures or extension of the original fracture. This was similar to the findings of Saudan et al in their series.[8] Other studies have also reported femoral shaft fracture rates of 0-2.1 per cent.[11-12] We did not encounter any intraoperative complication in this study.

The only complications we encountered in this series were malunion and hip screw cut out. There was no significant difference between the two groups with regards to time of fracture union as all fractures united at a mean of 12 weeks. Two patients (13%) in the DHS group had a malunion whereas there was no malunion in the PFN group with all the fractures uniting with less than ten degrees of varus angulation, which was statistically significant (p=0.018). Three patients (10%) in our study had a hip screw cut out. Two were seen in the DHS group and one in PFN group involving an unstable intertrochanteric fracture. However two patients were relatively mobile and hence re-operation was necessary in only one patient in the DHS group. In this series the average limb length shortening of patients in the DHS group was 1.25 cm as compared to 0.63 cm in the PFN group which was highly significant (p=0.009). This could be due to the increased sliding of the lag screw in the DHS group, allowing greater fracture impaction, as compared to the PFN.[13] Four of the patients in the DHS group with poor results, all had 2 cm or more of shortening. Three of these patients had malunion of the fractures. The patients in the PFN group neither had a shortening of more than 1cm nor a malunion.

The average range of motion of the hip joints was 57 per cent of normal in the DHS group and 74.67 per cent of normal in the PFN group at sixth month of follow up. Hence, in our study, the patients in the PFN group regained a significantly better range of motion as compared to those in the DHS group (p=0.002).

The overall functional outcome of patients treated with the PFN was significantly better than those treated with DHS (p=0.037). However when we compared the stable and unstable fractures separately, we found that there was no significant difference in the outcomes of the stable fractures in the two groups (p=0.198). While comparing the unstable fractures in the two groups we found that the functional outcome of the patients in the PFN group was significantly better than the outcome of the patients in the DHS group with good results for all the unstable fractures treated with PFN compared to only fair and poor results for the unstable fractures treated with. We also found that patients in our study treated with a PFN regained their pre-injury walking ability at four months significantly more often than those treated with a DHS. In our series, only five of the fifteen patients (33.33%) in the DHS group regained their pre-injury mobility level as compared to eight of the fifteen patients (53.33%) in the PFN group at the fourth month of follow up. Similar findings were also seen in a series by Pajarinen et al. comparing the postoperative rehabilitation of patients treated with DHS and PFN.[13] This suggests that the use of a PFN may favor better restoration of the function in the elderly population compared with the use of a DHS.

The smaller incisions, shorter operative times, relatively less blood loss and less postoperative pain with the PFN indicate that the PFN has an advantage over the DHS even in the treatment of stable intertrochanteric fractures where the functional outcomes are similar. In addition, with unstable intertrochanteric the PFN has a definite advantage over the DHS in terms of less limb length shortening, earlier restoration of pre-injury walking ability and a better overall functional outcome

CONCLUSION

We conclude that in stable intertrochanteric fractures, both the PFN and DHS have similar outcomes. However, in unstable intertrochanteric fractures the PFN has significantly better outcomes in terms of earlier restoration of walking ability as it is an intramedullary implant which can tolerate higher cylindrical loading when compared to DHS type of implants. In addition, as the PFN requires shorter operative time and a smaller incision, it has distinct advantages over DHS even in stable intertrochanteric fractures. Hence, in our opinion, PFN may be the better fixation device for most intertrochanteric fractures.

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