



## Original Article

# Treatment of stable intertrochanteric fractures of the femur with proximal femoral nail versus dynamic hip screw: a comparative study<sup>☆</sup>



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## ABSTRACT

**Objective:** To evaluate and compare the clinical and radiological outcomes of patients with stable intertrochanteric fractures treated with proximal femoral nail vs. dynamic hip screw. **Methods:** Sixty patients with stable intertrochanteric fractures, aged over 18 years, were randomly divided into the proximal femoral nail and dynamic hip screw groups. Dynamic hip screw with a three-hole side-plate and an anti-rotation screw were used, as well as a modified ultra-short proximal femoral nail for the smaller Asian population. The intra-operative, early and late complications were recorded, and the functional outcome of each group was assessed using the Harris Hip Score.

**Results:** In the dynamic hip screw group, the one-month mean Harris Hip Score was slightly lower than that of the proximal femoral nail group. However, at the three- and six-month monthly follow-ups, the dynamic hip screw group presented higher mean scores than the proximal femoral nail group; at the one-year follow-up, both the groups attained similar scores.

**Conclusion:** Proximal femoral nail provides a significantly shorter surgery with a smaller incision that leads to less wound-related complications. However, the incidence of technical errors was significantly higher in proximal femoral nail when compared with dynamic hip screw as it is a technically more demanding surgery that leads to more implant failures and the consequent re-operations.

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## Tratamento de fraturas intertrocânticas estáveis do fêmur com haste femoral proximal versus parafuso dinâmico de quadril: um estudo comparativo

### R E S U M O

#### Palavras-chave:

Hastes ósseas  
Parafusos ósseos  
Fixação de fratura,  
intramedular/instrumentação  
Fraturas do quadril/cirurgia

**Objetivo:** Avaliar e comparar os resultados clínicos e radiológicos de pacientes com fraturas intertrocânticas estáveis tratados com hastes femorais proximais vs. parafuso dinâmico de quadril.

**Métodos:** Sessenta pacientes com fraturas intertrocânticas estáveis, maiores de 18 anos, foram divididos aleatoriamente em dois grupos, um grupo de hastes femorais proximais e outro grupo de parafuso dinâmico de quadril. Um parafuso dinâmico de quadril com placa lateral de três furos e um parafuso antirotação foram utilizados, bem como uma hastes femorais proximais ultracurtas, modificadas para a população asiática de menor estatura. As complicações intraoperatórias, precoces e tardias foram registradas; o resultado funcional de cada grupo foi avaliado usando o Harris Hip Score.

**Resultados:** No grupo parafuso dinâmico de quadril, o Harris Hip Score foi um pouco menor do que o do grupo hastes femorais proximais. Entretanto, nos seguimentos de três e seis meses, o grupo parafuso dinâmico de quadril apresentou maior média do que o grupo hastes femorais proximais; no seguimento de um ano, ambos os grupos atingiram valores similares.

**Conclusão:** A hastes femorais proximais proporciona uma cirurgia significativamente mais curta, com uma menor incisão e consequentemente menos complicações relacionadas à ferida. Entretanto, a incidência de erros técnicos foi significativamente maior no grupo hastes femorais proximais quando comparada ao grupo parafuso dinâmico de quadril visto que esta é uma cirurgia tecnicamente mais exigente, que apresenta mais falhas de implantes e as consequentes reoperações.

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## Introduction

The incidence of Intertrochanteric fractures has been increasing due to higher longevity and rising incidence of road traffic accidents. Inter-trochanteric fractures account for approximately half of the hip fractures in elderly.<sup>1,2</sup> The goal of treatment of any Intertrochanteric (IT) fracture is to restore early mobility so as to minimize the risk of medical complications and restore the patient to pre-operative status. The dynamic hip screw (DHS) is currently considered as the standard device for comparison of outcomes, especially for the stable intertrochanteric fractures.<sup>3</sup> The proximal femoral nail (PFN), introduced by the AO/ASIF group in 1998, has gained widespread popularity for treatment of trochanteric fractures in recent years. The advantage of Proximal Femur Nailing fixation is that it provides a more biomechanically stable construct by reducing the distance between hip joint and implant.<sup>4,5</sup> Both most of the studies till date have evaluated the outcomes of PFN in unstable fractures and comparison with DHS in stable IT fractures is less studied. The present study was done to evaluate and compare the clinical and radiological outcomes of patients with stable Intertrochanteric fractures treated by PFN and DHS. The hypothesis of the study was that both PFN and DHS provide similar functional outcome in stable IT fractures.

## Materials and methods

This was a prospective interventional study carried out between 2011 and 2015 at a govt. secondary level hospital and included 60 cases of stable Intertrochanteric fractures above 18 years of age. Exclusion Criteria was any case with marrow cavity blocked by another implant, deformed femur/abnormal bowing of femur, narrow marrow cavity (e.g. osteopetrosis), pathological fracture or old complicated fracture. The study was approved by the ethical committee of the hospital, and informed consent was obtained from each patient. Alternate patients who fulfilled the inclusion and exclusion criteria were treated with DHS or PFN respectively. No patient was lost to follow up. All patients were operated by the same surgeon in both the groups. Patients were taken up for surgery as early as possible after relevant investigations, radiographs, anaesthetic evaluation and physician clearance. A standard fracture table was used with the patient in supine position. Since all fractures were of stable type, DHS with a side plate having 3 holes combined with an antirotation screw was used in all cases and in the other group, a modified ultra short PFN [Sharma Surgicals, Chandigarh, India] (18 cm length, diameter of proximal part 14 mm, anti-rotation screw of 6.4 mm and hip screw of diameter 8.0 mm) suited for the smaller Asian population was used. Closed reduction was attempted in all

cases and if not achieved, indirect reduction using percutaneous or mini-open techniques was done before making entry for the PFN and DHS. Postoperatively, all patients underwent similar rehabilitation protocol with dynamic quadriceps and ankle pump exercises being started from the first day, early mobilization with walker as soon as possible with non weight bearing and later partial weight bearing was started depending on the patient's compliance. Patients were advised 1st follow up 4 weeks after discharge from the hospital and then every 6 weeks till the completion of 24 weeks postoperatively. Weight bearing was gradually increased as per the radiological evaluation of the fractured site. Further follow up was advised at 6 monthly intervals for 1 year and then annually.

The intra operative, early (within first month after hip fracture repair), and late complications (after first month) were recorded and clinical outcome for each group was analyzed. Patients were followed up at regular intervals of 4 weeks, 8 week, 12 weeks, 6 months and annually thereafter and functional outcome was assessed with Harris Hip Scores.<sup>6</sup> Data obtained was then assessed statistically using student's t-test for quantitative data like duration, blood loss, Harris hip scores and Z ratio for significance of the difference between two independent proportions for qualitative demographic data. Applying the null hypothesis the observed difference was considered to be significant if the *p*-value was <0.05.

## Results

The present study involved 60 cases of stable intertrochanteric femur fracture of either sex from 2011 to 2014. Out of these, 29 were treated by Dynamic hip screw and 31 cases were treated by Proximal femoral nail. In our study, maximum age was 81 years and minimum was 40 years. Mean length of incision was smaller in PFN group (*p* < 0.01) but radiation exposures were significantly more in PFN group (*p* < 0.01). Duration of surgery was lesser in PFN group which was statistically significant (*p* < 0.01) (Table 1). Average blood was significantly more in DHS group (*p* < 0.01) with 2 patients requiring blood transfusion postoperatively as compared to nil in PFN group. Closed reduction was attempted and successful in all except one case out of the 60 cases in which reduction was achieved by indirect reduction techniques. Mean hospital stay was slightly more in DHS group but this was not found to be statistically significant (Table 1). Average cost of implant for DHS was approximately 55% of the cost of PFN. Mean duration of allowing full weight bearing was slightly longer in DHS group but it was not significant on statistical analysis. Early and late complications were noted and compared in both the groups. Incidence of technical errors was higher in PFN group (9.67% as compared to 3.48% in DHS group) but prolonged drainage and superficial infections were commoner in DHS group (Table 2); although the difference in incidence of these complications was not statistically significant. No case of iatrogenic fracture, DVT, deep infections, nonunion or malunion was noted. Mortality rate was similar in both groups (one death in each group), was not related to any surgery related cause and occurred after three months post-operatively. Incidence of loss of reduction and implant failure and subsequently re-operation was higher in PFN group (Table 2), but not of significance when analyzed

**Table 1 – Showing preoperative and intraoperative observations.**

Observations	DHS (n=29)	PFN (n=31)	p value
Mean age (range)	62.27 yrs (44–81)	60.67 yrs(40–80)	0.53
Sex ratio (M:F)	65.51%	60.67%	0.93
Mean age of fracture at surgery(in days)	4.5	4.1	0.34
Mean length of incision (in cm)	7.9	4.9	<0.01
Mean radiation exposures (in no.)	48.7	71	<0.01
Mean duration of surgery (incision to fixation + fixation to closure)	69.7 min (39.5 + 30.2)	56.9 min (37.3 + 19.6)	<0.01
Average blood loss (in mL)	221 mL	109 mL	<0.01
Patients requiring blood transfusion	1	0	0.29
Failure to achieve closed reduction	0	1	0.29
Mean hospital stay (in days)	10.1	9.29	0.13
Mean duration of full weight bearing	7.8 wks	7.2 wks	0.412

**Table 2 – Showing early and late complications.**

Complications	DHS (n=29)	PFN (n=31)	p value
<b>Early</b>			
Iatrogenic fracture	0	0	
Technical errors	1 (3.48%)	3 (9.67%)	0.33
Prolonged drainage	2 (6.89%)	0	0.13
Superficial infection	1 (3.48%)	0	0.29
DVT	0	0	
<b>Late</b>			
Loss of reduction	1 (3.48%)	2 (6.44%)	0.59
Implant failure	1 (3.48%)	3 (9.67%)	0.33
Second surgery	1 (3.48%)	3 (9.67%)	0.33
Mean shortening	5.5 mm	5.3 mm	0.60
Non union	0	0	
Mal union	0	0	
Deaths	1 (3.48%)	1 (3.22%)	0.96

**Table 3 – Showing mean Harris hip scores.**

Average Harris hip scores at	D.H.S group	P.F.N group	p value
1 month	24.8	26.1	0.10
3 month	53.4	47.6	<0.01
6 month	88.7	82.2	<0.01
2 years	94.2	94.0	0.79

statistically. Mean shortening was similar in both the groups at final follow up. Functional results were assessed in all patients using Harris hip score at the one month, three months, six months & one yearly follow ups. In the D.H.S group, the one month mean hip score was slightly less than that of the P.F.N group, though not statistically significant (*p* value > 0.05) (Table 3). However at three monthly and six monthly follow ups, the DHS group had higher mean scores than PFN group

( $p < 0.01$ ), but at one year both the groups attained similar scores ( $p$  value  $> 0.05$ ).

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## Discussion

In the last few decades treatment of intertrochanteric fractures has evolved significantly. Various methods of fixation devices have come and gone. The treatment still merits the type of fracture and quality of bone. DHS has been the considered the gold standard of intertrochanteric fracture fixation for a long time, especially for the stable fracture types.<sup>3</sup> The PFN was designed to overcome implant-related complications of DHS and facilitate the surgical treatment of unstable intertrochanteric fractures as it, being an intramedullary implant, imparts a lower bending moment, compensates for the function of the medial column and acts as a buttress in preventing the medialization of the shaft.<sup>7</sup> However, in stable IT fractures, whether all these characteristics aid in improving the outcome as compared to the DHS, is still a matter of debate.

In the present study, we compared intraoperative observations, complications and functional outcome of two groups of patients matched for demographic and preoperative variables and treated with DHS and PFN respectively. The mean length of incision 60% smaller in the PFN group compared to the DHS group. This was comparable to the findings in various other studies like those by Pan et al.<sup>8</sup> and Zhao et al.<sup>9</sup> Duration of surgery was shorter in PFN group by a mean of 12.8 min; although the duration of implant fixation was almost similar in both the groups, time required for wound closer was significantly longer in DHS group probably due to larger incision and extensive dissection as compared to the percutaneous technique of PFN. Similar findings were noted by Pan et al.,<sup>8</sup> Saudan et al.,<sup>10</sup> Shen et al.<sup>11</sup> and Zhao et al.<sup>9</sup> Average blood was more in DHS group but was not so much clinically significant as to require blood transfusion as it was needed in only 1 patient in DHS group required blood transfusion. Mean duration of hospital stay and duration of allowing full weight bearing were both slightly less in PFN group. Early complications included superficial infections and prolonged discharge from wound in DHS group which were not noted in PFN group which resolved with regular dressings. These were probably due to the longer incision and extensive dissection in DHS cases, though no case of deep infection was noted. Incidence of technical errors was higher in PFN group (3 i.e. 9.67%) as compared to one case i.e. 3.48% in PFN group. These included varus angulation at fracture site (1 in each group), distal translation of the head and neck fragment due to it being pushed distally by the nail at entry point, opening up of the fracture site in one case after insertion of nail when fracture was located at the entry point itself and protrusion of the nail at the entry point due to mismatch between direction of neck screws and neck shaft angle. Thus these errors were typically related to the entry point and trajectory of the nail. These further led to higher incidence of loss of reduction, implant failure and re-operation rate in PFN group. This was comparable to the observations in various other studies.<sup>12,13</sup> Implant failure included two cases of superior cut out (one in each group) and two cases of Z-effect type of failure in PFN group. Loss of

reduction was seen in the form of varus collapse in three of these cases of implant failure (one in DHS group, two in PFN group). Out of these three cases had to be re-operated and in one case (PFN), the laterally impinging screws were removed under local anaesthesia after fracture consolidation. Mean shortening at final follow up was comparable in both the groups. This was different from most other studies probably because in our study all cases were of stable type Intertrochanteric fractures which were reduced intraoperatively and thus not much scope was left for the sliding mechanism of DHS to take place to cause any shortening. Mean Harris hip scores were calculated at one month, three months, six months and yearly follow up and compared in both the groups. Initially these functional scores were slightly lower for the DHS group, but at three and six months follow ups, it was noted that the DHS patients fared slightly better than the PFN group. This was probably due to abductor lurch while walking and slightly decreased range of abduction in PFN group as compared to DHS patients. However, at annual follow ups, the scores in both the groups were similar, probably due to regaining of abductor strength with progressive physiotherapy. Thus a similar final clinical outcome could be achieved by the DHS at a much affordable price as compared to the PFN as noted by Giraud et al.<sup>14</sup>

A probable limitation of this study was smaller size of the study. Some observations like incidence of technical errors, implant failure, second surgery etc. which were not found to be statistically significant in our study, but are noted in many other studies is probably due to the smaller size of this study.

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## Conclusion

The PFN has recently gained tremendous popularity for the treatment of unstable intertrochanteric fractures. But controversy still remains whether, for stable fractures, it is better than DHS. Although advocates of PFN state that it provides the advantages of better biomechanical strength, shorter duration of surgery, lesser extensive surgery and earlier weight bearing, many recent studies have shown that there is an increased incidence of post-operative implant related complications and reoperation rate. In the present study we also obtained similar results that PFN provides a significantly shorter surgery with a smaller incision that leads to less wound related complications. But incidence of technical errors was slightly more with PFN as it is a technically more demanding surgery and this further leads to more implant failures and thus re-operations. The dual screws of PFN also do not provide any additional hold in the head as compared to the DHS as incidence of superior cut out was similar in both. The PFN is a significantly costlier implant than the DHS with almost similar final outcome. In stable IT fractures, the PFN also does not fair any better than the DHS in terms of shortening at final follow up. Though the final functional outcome is similar with both the implants, initial abductor lurch for many months is a significant drawback in PFN.

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## Conflicts of interest

The authors declare no conflicts of interest.

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