Original Article

Comparison of Dynamic Hip Screw (DHS) And Proximal Femoral Nail (PFN) Fixation For Unstable Intertrochanteric Femoral Fractures, On Basis Of Collapse

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Article info.
Received: 12/2/2018
Accepted: 16/8/2019

Funding Source: *Nil*

Conflict of Interest: *Nil*

Abstract

Introduction: Proximal femoral nail (PFN) is an intramedullary device for fixation of intertrochanteric femoral fracture and has shown promise in unstable intertrochanteric fractures, which have been treated with dynamic hip screw (DHS) till recently.

Objectives: To compare the frequency of collapse in the early postoperative period between fixation with DHS versus PFN in unstable intertrochanteric femoral fractures.

Patients and methods: This randomized controlled trial was conducted at CMH Rawalpindi in 2017. A total of 310 male and female adult patients between 18 to 75 years in age, with unstable intertrochanteric fractures were included. Patients having pathological fractures, renal disease and open fracture were excluded. The patients were assigned randomly to one of the two groups. Group A was treated with DHS and Group B was treated with PFN. The collapse was measured initially on standard x-rays taken on the zero postoperative day. Patients were allowed to bear partial weight at 4 weeks and second measurement for collapse was done after 6 weeks postoperatively.

Results: The mean age of patients in group A was 51.27 ± 11.54 years and in group B was 53.75 ± 12.28 years. Collapse was seen in 26 (16.77%) patients in group A (DHS) and 07 (4.52%) patients in group B (PFN) with p-value of 0.0001. Age has a bearing on the rate of collapse while BMI does not.

Conclusion: The frequency of collapse in early postoperative period is less after treatment with proximal femoral nail as compared to dynamic hip screw in unstable intertrochanteric fractures.

Keywords: Intertrochanteric femoral fractures; Unstable intertrochanteric fracture; proximal femoral nail; dynamic hip screw; sliding hip screw; collapse.

Introduction

Due to osteoporosis, intertrochanteric (IT) fracture of femur is one of the commonest fractures in elderly population. With increasing average age of population, the incidence is expected to rise.[1]

These fractures are associated with numerous complications including atelectasis, DVT and pressure sores mainly as a result of inability to mobilize the patient early. Primary aim of treatment is early stabilization of fracture so that patient can be mobilized out of bed.

The intertrochanteric fracture typically extends between the greater trochanter to the lesser trochanter. A stable IT fracture is the one with this typical orientation and obliquity. The fracture is labeled as unstable if it extends into the medial calcar, or when the fracture line courses in a reverse direction laterally.[2]

Unless contraindicated, the standard treatment is surgical fixation. Nonsurgical treatments practiced in the past were associated with prolonged immobilization leading to complications like pressure sores, pneumonia and deep vein thrombosis. Although the appropriate time for fixation is debatable, there is a consensus that delayed surgery has a higher mortality rate.[2] It is not clear from literature if this association is because patients with more comorbidities tend to undergo delays in fixation. The appropriate course is to perform surgery as soon as the condition of the patient is optimized.[2]

Method of fixation depends on the pattern of the fracture. Three options that are used as standard currently are: the dynamic hip screw also called sliding hip screw; intramedullary nail with a fixed screw; or fixed-angle plate with screws. A sliding hip screw has been traditionally used to fix stable intertrochanteric fractures. The sliding screw in this implant helps in impaction of the fracture, ensuring that non-union does not take place because of a gap between fracture fragments. A lateral plate with fixed-angle screws does not allow for this impaction but prevents unwanted shortening due to compression.[2]

Dynamic hip screw (DHS) has long been considered the gold standard in stable IT fractures, as it allows controlled collapse at the fracture site which leads to compression at the fracture site, initiating fracture union. However in unstable IT fractures, DHS fixation presents with various modes of failure like screw cut out and varus collapse.[3] Varus collapse is particularly debilitating as it predisposes to cut out or in case of union, shortening of femoral neck, decreasing the mobility of the patient.[4]

The proximal femoral nail (PFN) is a short intramedullary nail used to fix IT fracture and has shown promise in unstable IT fractures. In recent studies comparing PFN with DHS in unstable IT fractures, besides some other benefits of PFN over DHS like less bleeding, smaller incision and less duration of surgery, a statistically significant advantage has been reported in varus collapse with PFN.[5,6] Another study shows the ability of PFN to maintain anatomical reduction till fracture union.[7]

The problem of collapse related to both modes of fixation have been investigated in various studies but a comparative and randomized analysis of the collapse rates between the PFN and DHS in *unstable* IT fractures has not been sufficiently documented. This randomized controlled trial was conducted to compare the frequency of collapse in early postoperative period between fixation by DHS and PFN in unstable intertrochanteric fractures.

Material and Methods

This randomized controlled trial was conducted in Department of Orthopaedics, Combined Military Hospital, Rawalpindi, from January 2017 to December 2017 after approval from Institutional Review Board. Sample size of the study was 310 patients with 155 patients in each group. Non-probability, consecutive sampling was used for randomization. All male and female adult patients, 18 to 75 years of age, with unstable IT fractures, who were mobile before the fracture, were included in the study. Those with pathological fractures or open fractures, those undergoing revision surgery, those with renal disease or those who did not consent to participate in the study were excluded.

Unstable intertrochanteric (IT) hip fracture was defined as IT fracture in which there is comminution of posteromedial cortex. Type II, III and IV of Boyd and Griffin classification are unstable fractures.[8]

Collapse was defined as the difference of distance between the last thread of the lag screw and the medial edge of the nail in case of PFN, or the medial tip of the barrel in case of the DHS, as measured on immediate and six weeks postoperative radiographs (Figure 1). A difference of this distance in these two radiographs of less than 1 cm was considered as low collapse, 1 to 2 cm as moderate, and more than 2 cm as severe collapse. Periprosthetic fractures were included in severe collapse.

Group A comprised of patients treated with DHS and Group B was treated with PFN. Random assignment to these two equal groups was done by a person not involved in the study by using sealed envelopes to contain patient labels.

Once enrolled, BMI was calculated and the patient was operated within one or two days. The collapse was measured initially on standard x-rays taken on the zero postoperative day. Patients were allowed to bear partial weight at 4 weeks and second measurement for collapse was done after two weeks of allowing weight bearing – at 6 weeks after surgery.

The data was entered and analyzed using SPSS version 22. Comparison of groups A and B was done for collapse by employing chi-square test, with a 95% confidence interval. Data was stratified for age, gender and BMI. Stratified groups were compared for collapse separately.

Result

Age range in this study was from 18 to 75 years with mean age of 52.41 ± 11.87 years. Majority of the patients (85.25%) were between 41 to 75 years of age as shown in Table 1.

Out of the total 310 patients, 195 (62.90%) were male and 115 (37.10%) were female with ratio of 1.2:1. Mean BMI was 30.32 ± 2.64 kg/m^2 (Table 2).

Out of a total of 155 patients in Group A, 16.77% (n=26) suffered collapse, as compared to 4.52% (n=7) in Group B. The difference in patients showing collapse in groups A and B was statistically significant with p-value of 0.0001.

Stratification of collapse with respect to age of patients and gender is shown in Table 3 and 4 respectively. Table 5 shows the stratification of collapse with respect to BMI.

Table 1: Age distribution in Groups A and B

Age (years)	Group A (n=155)		Group B (n=155)		Total (n=310)	
	No. of patients	%	No. of patients	%	No. of patients	%
18-40	25	16.13	24	15.48	49	15.81
41-75	130	83.87	131	84.52	261	84.19
Mean ± SD	51.27 ± 11.54		53.75 ± 12.28		52.41 ± 11.87	

Table 2: Distribution of patients according to BMI

BMI (kg/m^2)	Group A (n=155)		Group B (n=155)		Total (n=310)	
	n	%	n	%	n	%
≤30	70	45.16	71	45.81	141	45.48
>30	85	54.84	84	54.19	169	54.52
Mean ± SD	30.25 ± 2.67		30.39 ± 2.58		30.32 ± 2.64	

Table 3: Stratification of collapse with respect to age of patients

Age of patients (years)	Collapse in Group A (n=155)		Collapse in Group B (n=155)		P value
	Yes	No	Yes	No	
18-40	4.0% (n=1)	96% (n=24)	8.33% (n=2)	91.67% (n=22)	0.527
41-75	19.23% (n=25)	80.77% (n=105)	3.82% (n=5)	96.18% (n=126)	0.0001

Table 4: Stratification of collapse with respect to gender

Gender	Collapse in Group A (n=155)		Collapse in Group B (n=155)		P value
	Yes	No	Yes	No	
Male	14.14% (n=14)	85.86% (n=85)	0% (n=0)	100% (n=96)	0.0001
Female	21.43% (n=12)	78.57% (n=44)	11.86% (n=7)	88.14% (n=52)	0.0167

Table 5: Stratification of collapse with respect to BMI

BMI (kg/m^2)	Collapse in Group A (n=155)		Collapse in Group B (n=155)		P value
	Yes	No	Yes	No	
≤30	7.14% (n=5)	92.86% (n=65)	0% (n=0)	100% (n=71)	0.022
>30	24.71% (n=21)	75.29% (n=64)	8.33% (n=7)	91.67% (n=77)	0.004

Figure 1: Reduced distance between the barrel of DHS and last thread of lag screw

Figure 2: Collapse in a case treated with DHS

Discussion

Intertrochanteric femoral fractures are frequently treated by either DHS or PFN fixation. The selection of implant for a stable IT fracture is still being debated in literature. Quite a few clinical trials have shown no statistically significant difference between these two implants in short-term radiographic and functional outcomes after treatment of stable IT fractures.[9] However, there is a rising trend of favouring PFN over DHS.[10] The literature is deficient on evidence for choice of implant in unstable IT fractures. Unstable IT femoral fractures are extra-articular fractures sustained after minor trauma, with a high incidence in the elderly.[11] This randomized controlled trial demonstrates a statistically significant advantage of using PFN over DHS (p=.0001) in terms of short term collapse after fixation. These findings are in agreement with a study by Jonnes C et al that found PFN to be better than the traditional sliding screw implant in Type II IT fracture of femur.[12] They also reported less blood loss, shorter procedure time, early mobilization, and decreased risk of infection by PFN fixation. At one-year follow up, the PFN fixation has been reported to have good outcome after assessment using Harris hip score.[13,14] However, Mavrogenis et al reported poorer functional results with PFN (n=1288) as compared to DHS (n=6355) in fixing stable IT fractures. They also reported more radiographic complications with PFN fixation.[15] These findings were not in agreement with our study. Similarly, Mereddy et al reported more frequent requirement of revision surgery in the first year after fixation with PFN.[16] These last two studies included all cases of IT fractures, both stable and unstable and were retrospective.

The lever for hip abduction is impaired by collapse of IT fracture. Shortening of more than 2 cm results in impaired functional outcome.[4] This clinical trial shows that DHS is associated with significantly more frequent collapse (Figure 2). Our results show collapse in 19.23% (n=25) patients treated with DHS fixation as opposed to 3.82% (n=5) patients in those treated with PFN fixation. This was statistically significant in population more than 41 years (p=.0001)(Table 3). In subjects 40 years or less in age, this difference was not found to be significant (p=.527). This can be explained on the fact that elderly subjects have osteoporotic bones that are more prone to fracture collapse than in younger subjects.

Fracture collapse was stratified in relation to gender (Table 4). 14.14% (n=14) males suffered collapse with DHS fixation as compared to 0% with PFN (p=.0001). The difference was less stark in females but nevertheless, statistically significant (p=.0167).

Fracture collapse was also stratified against two groups of subjects in relation to BMI (Table 5). DHS fixation resulted in more fracture collapse than the PFN group. The difference was statistically significant in those with BMI of 30 or less (p=.022) as well as in those with BMI more than 30 (p=.004). These results suggest that BMI does not have any bearing on the rate of fracture collapse like age does.

This study is a first attempt to objectively quantify the difference in short term outcomes after treatment of unstable intertrochanteric fractures with DHS and PFN. The main strength and relevance of this trial is that it focused on unstable fractures only as compared to all previous studies that were either retrospective or included all types of intertrochanteric fractures. The trial could have been extended in duration to record long term outcomes as well. That was not possible as most of our patients are lost to follow up after full mobilization. Future studies are needed to explore outcomes of fixation with various types of intramedullary implants like proximal femoral nail anti-rotation (PFNA) and cephalo-medullary nail (InterTAN).[17]

Conclusion

This study demonstrates that frequency of collapse in the early post-operative period is less after proximal femoral nail as compared to dynamic hip screw in unstable intertrochanteric fractures. We recommend proximal femoral nail fixation should be used as a first line fixation device for unstable intertrochanteric fractures in order to reduce the morbidity of these patients

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