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Original Research Article

Analysis of Short and Long Term Outcomes with Proximal Femoral Nail (PFN) and Proximal Femoral Nail Anti-Rotation (PFNA)

Sachin Gopalrao Saoji

M. S. Ortho, Associate professor, Prasad Institute of Medical Sciences, Lucknow

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Corresponding author: Sachin Gopalrao Saoji
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Abstract

Introduction: Femoral fractures cause major deaths and morbidity in the elderly. Surgical management has become the acknowledged procedure of choice for achieving appropriate decrease as well as engaging in regular exercise in the elderly osteoporotic participant. Dynamic Hip Screw (DHS) was thought that it was the standard method among most intertrochanteric fractures, but it didn't work in reverse oblique fractures or unstable IT femur fractures with a weak lateral wall.

DHS referred to an extra medullary implant system. FN was an intramedullary system with a compression screw and an anti-rotation screw that performed admirably in unstable IT fractures. PFNA, a single helical blade with a locking system, was designed to minimize implant-related complications. PFNA improves angular and rotational stability in osteoporotic related bone, enabling involvement as well as muscle mass carrying on the injured area.

Aims and Objectives: To find out the efficacy and safety profile of managements of femur fractures by using Proximal Femoral Nail (PFN) and Proximal Femoral Nail Anti-rotation (PFNA).

Methods: A retrospective study was conducted on patients who came to the orthopedics department of our hospital. A total of 75 intertrochanteric fracture patients were included in the study. All intertrochanteric fracture cases that met the AO classification criteria as well as skeletally mature patients of either gender who had either PFN or PFN-A treatment were required to meet the inclusion criteria. The patients were classified as PFN or PFN-A patients and was determined for baseline characteristics and the respective outcome. These were statistically analyzed.

Results: The majority of the patients (53.3%) were between the ages of 61 and 80, with 20 patients older than 80 and 22.6% younger than 61. More men than women are present. 77.3% of the patients who had pretreatment radiographs were in the unstable group (AO 31-A2.2 to A3.3), while 22.7% of the patients were in the stable group (AO 31-A1.1 to A2.1). The mean score for the PFN group was 79.89, whereas the mean score for the PFN-A group was 80.12. Parker Palmer Mobility Scores following surgery were compared between the two groups. Its mean value was 8.02 in the PFN group and 7.75 in the PFN-A group. Complication rates for the PFN group were 7.5%, whereas those for the PFN-A group were 3.5%.

Conclusion: The study has concluded that PFN-A has shown to be effective procedure as compared to PFN in terms of loss of blood, procedure time and the rate of complication.

Keywords: Proximal Femoral Nail Anti-rotation, Proximal Femoral Nail, femur fractures, intertrochanteric.

Introduction

Intertrochanteric (IT) femur fractures are becoming more common as the elderly population grows [1]. IT fractures cause major deaths and morbidity in the elderly. Surgical management has become the acknowledged procedure of choice for achieving appropriate decrease as well as engaging in regular exercise in the elderly osteoporotic participant [2]. Conservative treatment of an intertrochanteric femoral fracture frequently results in poor therapeutic outcomes, and surgical fixation is absolute necessary [3]. Dynamic Hip Screw (DHS) was thought that it was the standard method among most intertrochanteric fractures, but it didn't work in reverse oblique fractures or unstable IT femur fractures with a weak lateral wall.

DHS referred to an extra medullary implant system [4,5]. Various intramedullary systems have been developed to overcome the system's flaws and achieve adequate rotational and angular stability. The Gamma nail was introduced, which resulted in late complications that required revision surgeries [6,7]. PFN was an intramedullary system with a compression screw and an anti-rotation screw that performed admirably in unstable IT fractures. Despite the fact that PFN was demonstrated to be better compared to extra-medullary gadgets for un-displaced injuries, screw cut-out, back out, varus collapse, as well as rotational instability stayed main components in postoperative complications, especially in lateral wall deficient fractures, up to 31% comorbidities found in the literature [8].

PFNA, a single helical blade with a locking system, was designed to minimize implant-related complications. PFNA improves angular and rotational stability in osteoporotic bone, enabling muscle mass carrying on the injured area (limb) [9, 10]. Due to the compaction of cancellous bone around it, biomechanical studies have demonstrated that the helical blade has excellent protection to spinning as well as varus implode [11]. The perfect implant for the therapies of peritrochanteric injuries is a simple intra-medullary application that lets constrained obstruction all across fracture zone whilst also trying to prevent fracture location spinning [12]. DHS inserts cannot survive far elevated static as well as recurring loading than intra-medullary implants. In 1998, the proximal femoral nail (PFN) was introduced, along with a proximal de-rotation screw as well as a distal lag screw. Although PFN fixation was superior to extra-medullary equipment fixation, problems, including screw cut out, varus collapse, screw migratory, as well as Z effect were observed [13].

The AO/ASIF firm established the proximal femoral nail anti-rotation (PFNA) as a modern generation intramedullary nail in 2004. This implant is distinguished by the inclusion of a solitary helical blade with a larger surface area rather than a screw. When compared to a screw, the implanted blade accomplishes a perfect match across bone compression as well as necessarily requires fewer bone withdrawal. The helical blade improves femoral head purchase and reduces cut-outs caused by varus difference as well as inversion. The whole characteristic gives excellent alignment as well as consistency, especially once implanted in to the osteoporotic bone, and has been demonstrated in biomechanical studies to hinder spinning as well as varus collapse [14]. According to biomechanical research

findings, PFNA is among the newer therapies for peritrochanteric femur fractures [15-17].

The gold standard for many peritrochanteric fractures is a proximal femoral nail. It is theoretically superior to DHS because it is a load bearing device and intramedullary implant. The main concern for varus collapse of fixation is lateral wall integrity. Many PFNA-induced lateral wall blow outs were reported in recent studies. To avoid these complications during insertion, PFNA II was modified. PFN also has numerous complications such as the z effect, screw cut-out, migration and reverse z effect, in addition to varus collapse in a deficient lateral wall. As a result, we carried out this study to compare the efficacy of PFN vs PFNA II in lateral wall deficient unstable intertrochanteric fracture.

Materials and Methods

Study design

A retrospective study was conducted on patients who came to the orthopedics department of our hospital. A total of 75 intertrochanteric fracture patients were included in the study. A detailed medical history of the patients was taken and examined and diagnosed. According to the anesthesia record sheet, preoperative and postoperative hemoglobin levels were noted, and the operation time was calculated.

Inclusion and exclusion criteria

All intertrochanteric fracture cases that met the AO classification criteria as well as skeletally mature patients of either gender who had either PFN or PFN-A treatment were required to meet the inclusion criteria. Patients who visited the hospital's outpatient department completed the study protocol and provided informed consent were included in the study.

Patients who were not mobile prior to the injury and those who had hip osteoarthritis were excluded. Patients who did not follow the study protocol did not finish it, or did not provide consent were not included in the study.

Statistical analysis

AO categorization, age, and sex-specific patient counts were assessed using proportions. The mean and standard deviation were used to assess the number of patients in each group (PFN and PFN-A) and the length of the operation. The Chi-square test was performed to assess the type of implant utilized in accordance with AO classification and the type of decrease in both groups. Using an independent t-test, the neck shaft angle, TAD, Cleveland index, HHS, PPS, and complications in both groups were assessed. A 0.05 p-value was seen as being significant. Using the Mann-Whitney U test, the difference in hemoglobin values between the two groups was compared. For all measurements, SPSS Statistics 21.0 (IBM Corp, Armonk, USA) was utilized.

Ethical approval

The patients were given a thorough explanation of the study by the authors. Required consent was obtained from each patient. The patients' permissions have been gotten. The concerned hospital's ethical committee has accepted the study's methodology.

Results

The study comprised a total of 75 individuals with stable and unstable intertrochanteric fractures. 30 patients received PFN-A treatment, whereas 45 received PFN treatment. The majority of the patients (53.3%) were between the ages of 61 and 80, with 20 patients older than 80 and 22.6% younger than 61. (Table 1). More men than women are present. 77.3% of the patients who had pretreatment radiographs were in the unstable group (AO 31-A2.2 to A3.3), while 22.7% of the patients were in the stable group (AO 31-A1.1 to A2.1). While 76.7% of patients in the PFN-A group

were in the unstable group, 80% of patients in the PFN group were in the unstable group.

Table 1: Baseline characteristics of all patients in this study

Variables	**Count**	**%**
Age group		
<40	6	8
41-60	17	22.6
61-80	40	53.3
>80	15	20
Sex		
Male	42	56
Female	34	45.3
AO		
31-A1.1	1	1.3
31-A1.2	2	2.7
31-A1.3	6	8
31-A2.1	8	10.7
31-A2.2	15	20
31-A2.3	17	22.7
31-A3.1	12	16
31-A3.2	11	14.7
31-A3.3	3	4
Total	75	
Type of implant used		
AO	**PFN**	**PFN-A**
31-A1.1	0 (0%)	1 (3.3%)
31-A1.2	2 (4.4%)	0 (0%)
31-A1.3	3 (6.7%)	3 (10%)
31-A2.1	4 (8.9%)	3 (10%)
31-A2.2	8 (17.8%)	7 (23.3%)
31-A2.3	10 (22.2%)	7 (23.3%)
31-A3.1	8 (17.8%)	4 (13.3%)
31-A3.2	7 (15.5%)	5 (16.6%)
31-A3.3	3 (6.7%)	0 (0%)
Total	45	30

In table 2 the bilateral hip radiographs were used to evaluate the neck-shaft angle in the pelvis immediately following surgery (AP view). Using an independent t-test to compare the values of the two groups, it was determined that there was no statistically significant difference. Both groups' reduction types were contrasted. 60% of patients in the PFN group and 66.7% of patients in the PFN-A group experienced a favorable decrease. 22.2% of patients in the PFN group and 23.3% of patients in the PFN-A group experienced a neutral reduction. 17.8% of patients in the PFN group and 10% of patients in the PFN-A group showed a negative decrease. The Chi-square test was used to compare the results, and the outcome was found to be inconsequential. The Harris Hip Score was compared between the two groups after a 9-month follow-up. The mean score for the PFN group was 79.89, whereas the mean score for the PFN-A group was 80.12. Parker Palmer Mobility Scores

following surgery were compared between the two groups. Its mean value was 8.02 in the PFN group and 7.75 in the PFN-A group. The mean operating time for the PFN group was 46.89 minutes, compared to 37.04 minutes for the PFN-A group. 48.9% of the PFN group and 40% of the PFN-A group had center-center (C-C) placement. Centre-Inferior (C-I) placement was observed in 44.4% of PFN participants and 53.3% of PFN-A participants. The PFN group had a total of seven cases, including one each of the reverse z effect and screw back out, in addition to five cases of the z effect. Two issues occurred in the PFN-A group: one implant breakage case and one wound infection case. Complication rates for the PFN group were 7.5%, whereas those for the PFN-A group were 3.5%.

Table 2: The parameters of outcome assessment in each group of this study

Outcome	**PFN N=45**			**PFN-A N=30**			**P- value**
Neck shaft angle (degrees) (mean ± SD)	131.5 ± 2.78			131.5 ± 2.05			
Reduction							
Positive	27 (60%)			20 (66.7%)			
Negative	8 (17.8%)			3 (10%)			
Neutral	10 (22.2%)			7 (23.3%)			
Harris hip score (mean ± SD)	79.89 ± 4.57			80.12 ± 4.45			
Post-op Parker Palmer mobility score (PPS)	8.02 ± 0.78			7.75 ± 1.03			
Operative time min	46.89 ± 9.75			37.04 ±9.26			
Cleveland Index							
C-C	22 (48.9%)			12 (40%)			
C-I	20 (44.4%)			16 (53.3%)			
C-S	3 (6.7%)			2 (6.7%)			
	Median	Q1	Q3	Median	Q1	Q3	
Reduction in Hb	0.43	0.32	0.51	0.23	0.12	0.43	<0.05
% reduction of Hb	3.45	2.73	4.01	1.85	0.94	3.25	<0.05
Complications							
Implant breakage	0 (0%)			0 (0%)			
Screw back out	2 (4.4%)			0 (0%)			
Reverse z effect	2 (4.4%)			0 (0%)			
Z effect	4 (8.9%)			0 (0%)			
Wound infection	0 (0%)			0 (0%)			
None	37 (82.2%)			30 (100%)			

C-C: Centre-Centre; C-I: Center-Inferior; C-S: Center-Superior; Hb: hemoglobin

Discussion

Janardhan and Japatti (2021) investigated a prospective interventional research involved 50 cases with intertrochanteric fractures and a weakened lateral wall was reported. From 2017 to 2019, our institution conducted research. Using computer-based randomization, patients were divided into two groups of 25 to be allowed to treat with PFN or PFNA-II. The average time to radiological union for the PFN and PFNA-II groups was 25.2 weeks and 20.18 weeks, respectively. At the end of the study, the mean HHS accounted for 85.64 in the PFN team as well as 88.45 in the PFNA-II team. In reported research, 12 patients had outstanding HHS, 8 patients

had good HHS, 3 patients had fair HHS, in addition to 2 patients had underprivileged HHS in the PFN group, whereas 14 patients had excellent HHS, 9 patients had good HHS, 1 patient had fair HHS, as well as 1 patient had poor HHS in the PFNA-II group. Two patients in PFN established surgical place contagion as well as 2 patients underwent varus collapse as well as screw removal. One patient had a helical blade cut through after PFNA II. Patients who had failed implants underwent revision surgery. The ability of a single helical blade to create visible compression and impaction at the fracture site has a clear advantage over PFN, which requires two screws to be passed through a deficient lateral wall. The use of an end cap with a locking helical blade within the nail prevents it from back out and reduces complications. In lateral wall deficient intertrochanteric femur fractures, PFNA II outperforms PFN [18].

Onta et al., (2021) studied and evaluated the clinic-pathologic outcomes of people who underwent PFNA for a peritrochanteric fracture. The 37-patient study was performed at the Manipal Teaching Hospital from Oct. , 2019 to Sept. 30, 2020. The mean age of the participants in this study was 64 years (45-88 years). The procedure took a median of 62.49 minutes (45-75 minutes), with a loss of blood of 129.32 ml (65-210 ml). Entire Massive weight impact started at an overall mean of 14.43 weeks, so although weight of the load impact started at an overall mean of 8.57 weeks (6-12 weeks) (10-20 weeks). Fracture union occurred at an average of 11.41 weeks (8-18 weeks). The average Harris Hip rating there at the last followed up was 84.73 (65.8-95.0), with 35.1% awesome, 45.9% excellent, 13.5% acceptable, as well as 5.4% poor functional status. In peritrochanteric fractures, proximal femoral nail anti-rotation is an effective method of fixation. The procedure is straightforward, with minimal surgical intervention as well as exposure to radiation. When tried to compare to DHS or plate fixation, blood loss is minimal since this is a minimally invasive technique. Immobilization complications could be avoided if the patient was relocated from the bed earlier. As a result, the findings strongly support the use of PFNA for hip peritrochanteric fractures [19].

Li et al. (2014) studied and reported on the initial effectiveness and safety of the anti-rotation-Asia proximal femoral nail in older Chinese patients with intertrochanteric fractures. For the outcome analysis, 108 patients with intertrochanteric fractures were included in the study. During an average of 299 months of early follow-up, 4 patients (4%) died, as well as 6 patients (6%) died inside 6 months for reasons unrelated towards the crack. All patients had fatigue crack union, and 83 (85%) had a good or outstanding result. The Harris Hip Score was 85.27.5 on average. Mechanical failures, such as the implant bending or breaking, were not observed, nor were cut-outs. According to the findings, proximal femoral nail anti-rotation-Asia is a safe and efficient remedy for intertrochanteric fractures in elderly Chinese patients [20].

PFN implant system with two proximal locking bolts was introduced to achieve adequate compression and anti-rotation. Implant difficulties embrace crosswise screw protrusion, screw cut through, Z or opposite Z outcome, as well as fracture of the lateral trochanteric wall [21]. Along with the posteromedial and medial wall fractures, lateral wall fractures add to the instability at the fracture site and may result in a collapse, implant failure, and redo procedure. According to Palm H et al. [22], patients with lateral wall fractures required revision surgery. When the oblique facade is affected, the femoral head's internal strength can only withstand medial deformation of the material forces. Varus collapse arises in all situations of implant failure so because lateral wall fails

to support the implant adequately [23]. PFNA-II, on the other hand, has been shown in studies to perform better in IT fractures as well as lateral wall fractures [24, 25,26].

Conclusion

The study has concluded that PFN-A has shown to be effective procedure as compared to PFN in terms of loss of blood, procedure time and the rate of complication. The outcome among the patients with intertrochanteric fracture and osteoporosis, had shown to be clinically efficient. With a single helical blade and the ability to create visible compression and impaction at the fracture site, PFNA clearly brings better outcome as compared to PFN, which requires two screws to be passed through a deficient lateral wall. The use of an end cap with a locking helical blade within the nail prevents it from back out and reduces complications. In lateral wall deficient intertrochanteric femur fractures, PFNA results in better outcome than PFN. Hence, PFN-A can be chosen over PFN for obtaining significantly better clinical outcome. However, this current study has limitation like it has been performed in single center and this study has not considered co-morbidities of the patients. So, the authors suggest that there is a necessary to conduct more similar studies considering the other co-morbidities for more clinically effective outcome.

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