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Original Article

Orthopaedics Section

Impact of the Nail Length (Short PFNA2 and Long PFNA2) in Surgical Treatment of Intertrochanteric Femur Fractures: A Randomised Clinical Study

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ABSTRACT

Introduction: Intertrochanteric (IT) femur fractures account for nearly 50% of all proximal femur fractures. Currently, both short and long Proximal Femoral Nail Antirotation (PFNA2) are used for the treatment of IT femur fractures. There is no consensus in the literature on which option is better for treating IT femur fractures.

Aim: To assess the impact of the nail length of short PFNA2 and long PFNA2 in the surgical treatment of IT femur fractures.

Materials and Methods: This randomised clinical study was conducted in the Department of Orthopaedics at Kalpana Chawla Government Medical College (KCGMC), Karnal, Haryana, India, from July 2021 to July 2023. A total of 52 IT femur fractures were included in the study. All patients were divided into two groups using simple randomisation: Group A (Short PFNA2) and Group B (Long PFNA2), consisting of 26 patients in each group. Variables such as duration of hospital stay, duration of surgery, blood loss, union time and complications were noted. All patients were followed-up at six weeks, three months and six months and functional outcomes were assessed using the MHHS. Statistical analysis was performed using IBM Statistical Package for the Social Sciences (SPSS) Statistics {version 29.0.1.0 (171)}. The Independent Student's t-test and Chi-square test were used for continuous and categorical variables, respectively. A p-value of 0.05 or lower was considered statistically significant.

Results: The mean duration of surgery for the short PFNA2 group was 60.23±2.76 minutes, while for the long PFNA2 group, it was 73.23±4.07 minutes, with a significant p-value of 0.001. The mean blood loss in the short PFNA2 group was 94±1.12 mL and in the long PFNA2 group, it was 131±21.29 mL, also with a significant p-value of 0.001. A total of 11 complications were observed in the short PFNA2 group, while only two were noted in the long PFNA2 group, which was statistically significant with a p-value of 0.013. The mean Modified Harris Hip Score (MHHS) at 6 months was 70.76±7.62 in the short PFNA2 group and 79.98±9.72 in the long PFNA2 group (p-value 0.119).

Conclusion: Surgery with the short PFNA2 was associated with less blood loss and shorter operative time (resulting in less anaesthesia time), providing an advantage for older patients. Union time and functional outcomes were similar in both groups. A full-length femur X-ray should be taken to assess the anterior bowing of the femur. In such cases, the long PFNA2 should be used to protect the femur from fractures. Overall, the long PFNA2 is beneficial compared to the short PFNA2 in reducing the risks of complications in IT fractures.

Keywords: Modified harris hip score, Operative time, Proximal femoral nail antirotation

INTRODUCTION

The IT femur fracture accounts for nearly 50% of all proximal femur fractures and is a major cause of disability in the elderly. The incidence of IT femur fractures varies demographically [1]. The number of hip fractures is increasing, with the total expected to surpass six million by the year 2050 [2,3]. PFNA was introduced by Arbeitsgemeinschaft für Osteosynthesefragen O) in 2003 [4]. Currently, both short and long PFNA nails are used for the treatment of IT femur fractures [5]. The theoretical advantages of both lengths are still debatable. Short nails offer lower rates of blood loss and shorter operative times [6-8]. Problems associated with short PFNA include periprosthetic fractures, postoperative anterior thigh pain and inadequate diaphyseal fixation in cases with subtrochanteric extension of the fracture [6]. However, long nails provide full femur length protection [7-9]. The PFNA2 implant is generally smaller than the PFNA and has been shown to be more suitable for individuals of Asian ethnicity with smaller femurs [10]. The peak medial stress of femur fixation was significantly reduced with long PFNA in unstable IT fractures [11]. Patient anatomy also plays a definitive role in the selection of the PFNA used for IT femur fractures. In patients with increased anterior bowing of the femur shaft, such as in Asian populations [12], IT femur fractures should be fixed with the long bowed PFNA for better fixation [13]. However, studies are still lacking to clearly demonstrate the benefits of using short PFNA2 or long PFNA2 in the management of IT femur fractures.

The present research was undertaken to study the impact of nail length for short PFNA2 and long PFNA2 in the surgical treatment of IT femur fractures.

MATERIALS AND METHODS

The present randomised clinical study was conducted in the Department of Orthopaedics at Kalpana Chawla Government Medical College, Karnal, Haryana, India, from July 2021 to July 2023, after receiving approval from the Institutional Ethical Committee (order no: KCGMC/IEC/2021/186). Informed written consent was obtained from all patients.

Sample size calculation: The minimum sample size for the present randomised study was 22 for each group, calculated based on the mean blood loss difference between the two groups (μ1-μ2) of 169 mL and a pooled standard deviation (ó) of 175.2 from a previous study [14], with a level of significance set at 5% and power at 80% for two tails, using the formula below.

$$n=\{(Z\alpha/2+Z\beta)^2\times(2(ó)^2)\}/(\mu1-\mu2)^2$$

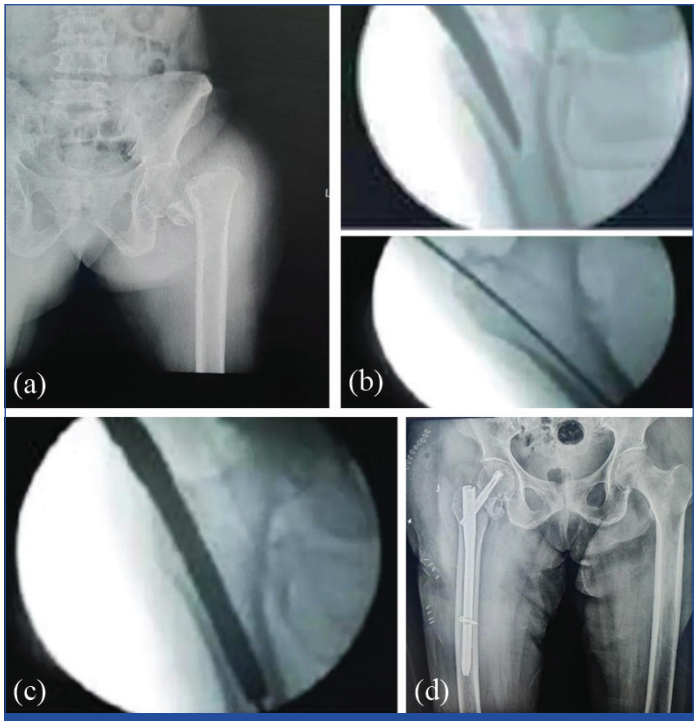
where Zα/2 and Zβ represent the values of the standard normal variate at the 5% level of significance and 80% power, respectively.

Inclusion and Exclusion criteria: Patients who were skeletally mature, over 18 years of age and had closed IT femur fractures were included in the study. Patients with open fractures, pathological fractures, non ambulatory status before surgery, or multiple fractures were excluded from the study.

Study Procedure

Out of 75 IT femur fractures that presented in the Emergency Department, 52 IT femur fractures were included in the study. The AO classification was used to classify the fractures based on preoperative Anteroposterior (AP) and lateral radiographs [15]. Demographic data were collected for age, gender and the mode of injury causing the fracture. All patients were divided into two groups using simple randomisation (a computer-based table of random numbers): Group A (Short PFNA2) and Group B (Long PFNA2), consisting of 26 patients in each group.

Short PFNA2 was available in lengths ranging from 180 mm to 250 mm, while long PFNA2 was available in lengths from 340 mm to 420 mm. All patients were operated on an orthopaedic fracture table in a supine position by the same surgical team (operating surgeon and assisting surgeon). Preoperative, intraoperative and postoperative images of the fracture were taken and are shown in [Table/Fig-1a-d]. Operative time was noted from the start of the incision. Wound inspection was performed 48 hours postoperatively. Patients were called on the 12th postoperative day for suture removal. Variables assessed included the duration of hospital stay, duration of surgery, blood loss, union time and complications. All patients were followed-up at six weeks, three months and six months. Functional outcomes were assessed using the modified Harris Hip Score (mHHS). A total score of <70 was considered a poor result; 70-79 was considered fair; 80-89 was good; and 90-100 was an excellent result [16].



[Table/Fig-1]: a) Preoperative image of the fracture; b) Intraoperative image; c) Intraoperative image; d) Postoperative image of short PFNA.

STATISTICAL ANALYSIS

Data were analysed using IBM SPSS Statistics software (version 29.0.1.0 (171)). Qualitative data were presented as frequency (percentages) and quantitative data were expressed as mean±SD. Quantitative variables between the two groups were compared using an Independent t-test, while the Chi-square test was used to compare categorical variables between the two groups. A p-value <0.05 at two tails was considered significant.

RESULTS

Out of the 52 IT femur fractures, the majority of patients, i.e., 39 (75%), were in the age group of 71-80 years, with no statistical difference between the two groups (p-value=0.939) [Table/Fig-2]. The male-to-female ratio was 1.73:1, with a statistically significant difference (p-value=0.773) [Table/Fig-3].

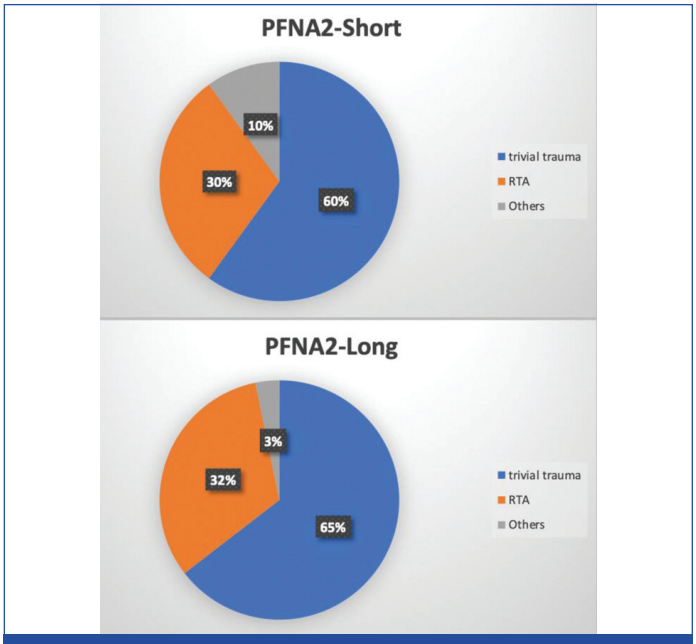
Age (years)	PFNA2-Short (n=26)	PFNA2- Long (n=26)	n (%)	p-value
<60	1	1	2 (3.8)	0.939
61-70	4	3	7 (13.5)	
71-80	19	20	39 (75)	
>80	2	2	4 (7.7)	

[Table/Fig-2]: Age-wise distribution of patients among two groups. Chi-square test; Significant: p<0.05

Sex	PFNA2-Short n=26	PFNA2- Long n=26	n (%)	p-value
Male	17	16	33 (63.5)	0.773
Female	9	10	19 (36.5)	

[Table/Fig-3]: Gender-wise distribution of patients among two groups. Chi-square test; Significant: p<0.05

The majority of patients, 37 (72%), belonged to AO type 31A2, followed by AO type 31A1, which included 10 patients (20%). The modes of injury for the majority of patients in both groups were due to trivial trauma (such as trivial falls at home or in the workplace) [Table/Fig-4]. Postoperative comparisons between the two groups in terms of duration of stay, duration of surgery, blood loss, union time and mHHS are shown in [Table/Fig-5]. The mean duration of stay in the short PFNA2 group was 5.73±0.919 days, while in the long PFNA2 group it was 6.15±1.11 days, with a p-value of 0.143, which was not significant. The mean duration from skin incision to wound closure for the short PFNA2 group was 60.23±2.76 minutes and for the long PFNA2 group, it was 73.23±4.07 minutes, with a p-value of 0.001, which was statistically significant. The mean blood loss in the short PFNA2 group was 94±1.12 mL and in the long PFNA2 group, it was 131±21.29 mL, with a p-value of 0.001, which was statistically significant. None of the patients in either group required a blood transfusion. The mean union time was 16.04±2.58 weeks in the short PFNA2 group and 14.73±2.29 weeks in the



[Table/Fig-4]: Mode of injury.

long PFNA2 group, which was not statistically significant (p-value 0.069) [Table/Fig-5]. The mean mHSS at six weeks and three months was not statistically significant, with a similar p-value of 0.145 at both six weeks and three months [Table/Fig-6a,b]. The mean mHSS at six months was 70.76±7.62 in the short PFNA2 group and 79.98±9.72 in the long PFNA2 group, which was not statistically significant (p-value 0.119). In the short PFNA2 group, 3 patients (11.5%) had excellent outcomes, followed by 11 patients (42.3%) who had good outcomes, 2 patients (7.7%) who had fair outcomes and 10 patients (38.5%) who had poor outcomes. In the long PFNA2 group, 3 patients (11.5%) had excellent outcomes, 15 patients (57.7%) had good outcomes, 7 patients (27.0%) had fair outcomes and 1 patient (3.8%) had a poor outcome [Table/Fig-6c].

S. No.	Variables	PFNA2- Short (Mean±SD)	PFNA2- Long (Mean±SD)	p-value
1.	Duration of stay (days)	5.73±0.919	6.15±1.11	0.143
2.	Duration of surgery (minutes)	60.23±2.76	73.23±4.07	0.001**
3.	Blood loss (mL)	94±1.12	131±21.29	0.001**
4.	Union time (weeks)	16.04±2.58	14.73±2.49	0.069
5.	mHHS at 6 weeks	73.32±10.54	80.54±7.32	0.145
6.	mHHS at 3 months	73.32±10.54	80.54±7.32	0.145
7.	mHHS at 6 months	70.76±7.62	79.98±9.72	0.119

[Table/Fig-5]: Postoperative comparison among two groups.
unpaired t-test; *significant: p<0.05; **highly significant p<0.01

Variables	PFNA2- Short group n=26	PFNA2- Long group n=26
Excellent	3 (11.5%)	3 (11.5%)
Good	11 (42.4%)	16 (61.5%)
Fair	3 (11.5%)	6 (23.2%)
Poor	9 (34.6%)	1 (3.8%)

[Table/Fig-6a]: Result interpretation of mHHS at six weeks follow-up.

Variables	PFNA2- Short group n=26	PFNA2- Long group n=26
Excellent	3 (11.5%)	3 (11.5%)
Good	11 (42.4%)	16 (61.5%)
Fair	3 (11.5%)	6 (23.2%)
Poor	9 (34.6%)	1 (3.8%)

[Table/Fig-6b]: Result interpretation of mHHS at 3 months follow-up.

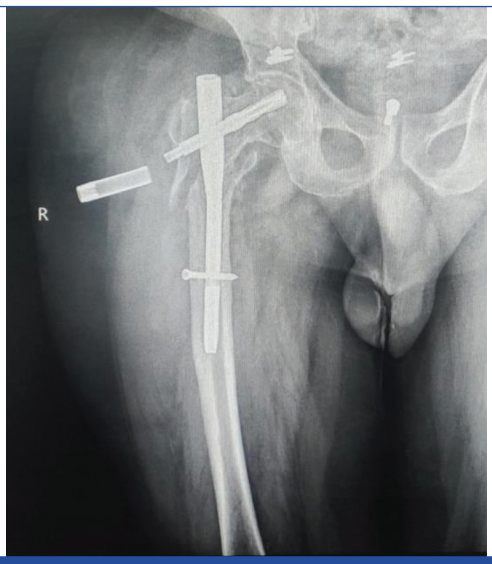
Variables	PFNA2- Short group n=26	PFNA2- Long group n=26
Excellent	3 (11.5%)	3 (11.5%)
Good	11 (42.3%)	15 (57.7%)
Fair	2 (7.7%)	7 (27.0%)
Poor	10 (38.5%)	1 (3.8%)

[Table/Fig-6c]: Result interpretation of mHHS at final follow-up at 6 months.

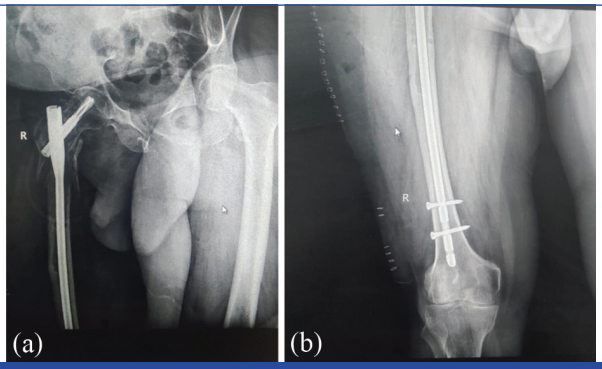
A total of 11 complications [Table/Fig-7] were observed in the short PFNA2 group, of which three patients had screw cutouts, three had anterior thigh pain and one had screw backout [Table/Fig-8]. Four patients had fractures, while two complications were observed in the long PFNA2 group: one had a screw cutout and another had a wound infection. The p-value was 0.034, which was statistically significant. The patient with screw backout in the short PFNA2 group [Table/Fig-8] was treated with a long PFNA2 [Table/Fig-9a,b].

Complications	PFNA2- Short	PFNA2- Long
Screw cut-out	3	1
Wound infection	0	1
Anterior thigh pain	3	0
Screw back out	1	0
Fracture	4	0

[Table/Fig-7]: Complications among two groups.
Chi-square test p-value 0.013*; *significant: p<0.05



[Table/Fig-8]: Screw back out in short PFNA2.



[Table/Fig-9]: a) Patient with screw backout in short PFNA2 subsequently treated with long PFNA2; b) Patient with screw backout in short PFNA2 subsequently treated with long PFNA2.

DISCUSSION

The goal of surgery for any elderly patient with osteoporotic fractures should be secure fixation, early rehabilitation and early functional recovery. Nowadays, intramedullary fixation of IT fractures has become the treatment of choice. The mode of fracture was trivial trauma or fall in the majority of the patients. In the present study, the duration of surgery was longer in the long PFNA2 group and blood loss was greater in the long PFNA2 group. Neither implant showed a significantly superior outcome compared to the other in terms of functional outcomes measured by mHSS at the final six-month follow-up and complications were observed more frequently in the short PFNA2 group. In the present study, there was no statistically significant difference between the two groups regarding the duration of hospital stay. A study by Khoori M et al., also showed similar findings [4].

In the present study, the reason for the longer duration of surgery was the increased time required for femoral canal preparation. Similar findings were observed in a study by Rosenblum SF et al., which stated that long nails had a significantly longer operative time, likely due to the extended preparation and reaming time required for long nails [17]. In this study, blood loss was greater in the long PFNA2 group, which correlates with the findings of a study by Hou G et al., [18]. It has been shown that intramedullary fixation procedures lead to larger blood loss because proximal reaming and the insertion of a longer nail increase the opening of the medullary canal, resulting in increased blood loss [18].

Functional outcomes were assessed using mHSS. In the present study, neither implant demonstrated a significantly superior outcome

compared to the other in terms of functional outcome (mean mHSS at the final six-month follow-up was 70.76±7.62 in the short PFNA2 group and 79.98±9.72 in the long PFNA2 group). Li Z et al., found similar results in their research, with means of 79.98 in the short nail group and 76.16 in the long nail group [19]. At the final follow-up, Ocku G et al., found an average HHS of 74 in the short PFNA group and 79 in the long PFNA group [20]. In the long PFNA2 group, good to excellent scores were found in 18 patients (69.2%) compared to 14 patients (53.8%) in the short PFNA2 group, which may be attributed to fewer complications seen in the long PFNA2 group, such as the incidence of anterior thigh pain and screw-related complications.

Complications were observed more frequently in the short PFNA2 group, including a higher incidence of fractures. A study by Norris R et al., also showed that short nails have a higher incidence of secondary femoral fractures compared to long nails [21].

Theoretically, a short nail causes a stress riser just distal to the end of the nail, while a long nail provides a protective effect to the entire femur, which could affect the results in patients with osteoporotic bone [22]. This correlation is especially evident in the Asian population, who have a higher incidence of anterior femoral bowing. This results in the distal tip of short nails abutting the anterior femoral cortex, leading to a higher chance of fractures. This also explains the anterior thigh pain in the Short PFNA2 group. The Asian population has increased anterior bowing of the shaft and therefore there is a preference for fixing IT femur fractures in Asian populations with the long bowed PFNA [23].

Patients with increased anterior bowing of the shaft should be treated with the long PFNA2. The short PFNA2 was responsible for anterior thigh pain and continuous impingement of the implant on the anterior cortex of the femur may cause fractures and implant failure in such patients. These patients were treated with the Long PFNA2. In the present study, there were three cases of screw cutout in the short PFNA group and one case of screw cutout in the long PFNA2 group. In all these cases, the placement of the neck screw was not centered in both the AP and lateral views on X-ray. This could be the reason for the screw cutout in these cases. One patient who experienced an infection in the long PFNA2 group had a long operative time (200 minutes).

Limitation(s)

A longer follow-up is needed to determine the long-term consequences, such as ischaemic necrosis of the head of the femur, which may change the overall functional score.

CONCLUSION(S)

Surgery with short PFNA2 was associated with less blood loss and shorter operative time (resulting in less anaesthesia time), hence providing an advantage for older patients. Full-length femur X-rays should be taken to assess the anterior bowing of the femur. In these cases, the long PFNA2 should be used to protect the femur from fractures and to reduce the incidence of anterior thigh pain. Therefore, full-length femur X-rays should be routinely performed in all cases of IT femur fractures to avoid complications.

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- Manual Googling: Nov 02, 2024
- iThenticate Software: Nov 05, 2024 (18%)

ETYMOLOGY: Author Origin

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