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A comparative study of 30 cases of intertrochanteric fracture femur in elderly patients treated with Proximal Femoral Nailing Anti Rotation-2(PFNA-2) and Proximal Femoral Nailing (PFN)

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ABSTRACT:
Increased life expectancy has led to a considerably increased incidence of proximal femoral fractures. The standard of peritrochanteric fracture treatment is stable fixation, which allows early full weight-bearing mobilization of the patient. A prospective, observational and randomized study was carried out with a total of thirty patients with intertrochanteric femur fractures admitted in Govt. Medical College and Rajindra Hospital Patiala after fulfilling the inclusion criteria and were treated with osteosynthesis with proximal femoral nailing anti-rotation-2 (PFNA-2) and proximal femoral nailing (PFN) after dividing them into two groups randomly i.e. Group A and Group B with 15 cases in each. Harris Hip Score was used as criteria for evaluation of results and functional outcome was graded accordingly. The authors conclude that PFNA2 gives better results than PFN in intertrochanteric fractures in terms of the amount of blood loss during surgery, duration of surgery, postoperative complications. However, there is no difference between the two modalities in terms of duration of hospitalization, fracture union, and early rehabilitation (mortality and morbidity).
Keywords: Intertrochanteric fracture, Proximal femoral nail, PFNA, PFNA2.

I. INTRODUCTION

Intertrochanteric fracture is one of the most common fractures of the hip especially in the elderly. The incidence of intertrochanteric fracture is rising because of the increase in the number of elderly population superadded with osteoporosis. By 2040 the incidence is estimated to be doubled, in India, the figures may be much more[1]. The standard of intertrochanteric fracture treatment is stable fixation, which allows early full weight-bearing mobilization of the patient.

The choice of surgical treatment is determined in part by whether the fracture is judged stable or unstable. Rapid patient mobilization following surgical stabilization of the fracture lessens the frequency of life-threatening complications such as cardiopulmonary failure and thromboembolic disease. There are various modalities of fixation of intertrochanteric fractures. The basic principles and procedure in almost all the varieties of internal fixation devices are the same, only the exact technique and instrumentation varies, depending upon the device used. For many years, the sliding hip screw and plate had been the gold standard in treating trochanteric fractures. Nowadays, there is an increasing interest in intramedullary nailing. Intramedullary devices, although technically difficult, seem to have a biomechanical advantage over laterally fixed side plates. Intramedullary devices such as proximal femoral nail (PFN), are more stable under loading with a shorter lever arm, so the distance between the hip joint and the nail is reduced compared with that for a plate, thus diminishing the deforming forces across the implant. These are load-sharing devices; so early weight-bearing can be allowed. Although the PFN overcomes many of the disadvantages of the conventional intramedullary nails and plates but still it is associated with the following complications like proximal screw cutting, intraoperative distal locking screw insertion difficulties, remote locking screw stress concentration caused by vegetation breaking into the matter, the Z effect, iliotibial tract irritation, anterior thigh pain, and others[2]. The AO/ASIF improved the design of the PFN and introduced the PFNA system in 2003. The main change in the PFNA involves the end of the helical screw blade, which gradually increases the diameter to allow for compression of the bone around the femoral head, thereby stabilizing the femur and facilitating anti-rotation and compression. Comparison of helical blades and ordinary lag screws for fixation of the femoral head by biomechanical methods in neck mechanic experiments has shown that the stability of reamers is better than that of ordinary lag screws. The only drawback of the helical blade is that it cannot withstand fracture pressure as can ordinary lag screws; thus, surgeons should emphasize good fracture reduction. Although the PFNA has a substantial number of advantages, again many papers have reported complications during its clinical use, especially in Asian patients. First, the anatomical features of the PFNA do not match the femoral geometry of Asian patients. The standard length of a PFNA nail is about 200 mm, and the shortest is 170 mm. The stature of Asian patients is shorter than that of European patients, and the anterior arch of the physiological femoral curvature is relatively large; thus, the tops of the main staples of the PFNA easily tip over the anterior arch of the femoral curvature, resulting in femoral fracture. If a full pre-surgical assessment is not performed to ensure that the diameter of the PFNA nail matches the patient's anatomy, the risk of hip fracture during insertion may increase. Second, the proximal nail of the PFNA may be longer in patients with a short stature so that walking induces friction between the nail and soft tissue of the thigh, causing pain. Finally, the outer sidewall of the proximal PFNA is circular, which is associated with lateral cortex impingement that causes lateral cortex fracture and fracture displacement during insertion[3]. The round profile of the nail creates pressure to the lateral wall and the head-neck fragment (Fig.A), thus damaging the lateral wall and causing loss of reduction and varus of the head-neck fragment, a complication that decreases stability and increases the risk to cut out[3]. Because of the above-mentioned shortcomings in the previous PFNA, The AO/ASIF improved the design and launched the PFNA-II. The PFNA-II exhibits some improvements in the design. First, the outer angle of the PFNA-II staples has been decreased from 6° to 5°, to ensure that the canal is located in the middle of the distal nail and reduces the risk of the distal nail impacting the femur. The positioning of the intramedullary device close to the weight-bearing axis of the femur reduces forces on the implant. Second, the distance of the proximal of the PFNA nail with

the spiral blade and the tail cap of the spiral blade is longer, the proximal nail of the PFNA-II has been shortened to 45 mm, and the length of the helical screw end cap has been reduced to 2.5 mm. This reduces friction between the nail and soft tissue and decreases activity-induced hip pain, which arises from the friction of the nail with soft tissue. Third, the proximal end of the outer wall of the PFNA-II improved the nail from a round to a graphic design, thereby reducing stress caused by the nail impacting the medial femoral cortex and reducing the probability of fracture reduction loss when the PFNA nail is inserted into the femoral canal. The primary innovation of the proximal femoral nail anti-rotation (PFNA, AO/ASIF) design is the helical neck blade that reduces the risk of bone loss and offers improved purchase in the femoral head as a result of compaction of cancellous bone around the blade during insertion. Rotation of the head-blade combination as a whole is prevented by an intrinsic locking mechanism. Furthermore, given controlled impaction of the metaphyseal fracture zone, immediate full weight-bearing is allowed. Also, its mediolateral angle is reduced to 5°, allowing a slightly more lateral entry point through the tip of the greater trochanter. Furthermore, it has a more flattened lateral surface that theoretically decreases the length of the region of impingement on the lateral cortex, reducing the risk of fracture during insertion. Thus PFNA2 appears to be better suited to Asian patients who have small femur. Lv C et al[4] recently reported that proximal femoral nail antirotation for unstable trochanteric fractures in Asian patients provided an anatomic fit in the proximal femur with a 95% ideal position of the nail and eliminated complications related to fixation. Tyagiet al[5] analyzed the geometric discrepancies between the proximal femur and two types of PFNA (PFNA and PFNA II) using CT-based analysis in Asian patients. They concluded the morphological incompatibility between the proximal femur and PFNA and also found the flat lateral shape of PFNA II lessened impingement between the lateral side of the proximal femoral nail and the lateral cortex of the proximal femur. PFNA is proximally rounded in contrast to PFNA II that has a more flattened lateral surface. The mediolateral angle of PFNA II is decreased to 5°. In this study, the clinical results were compared between proximal femoral nailing anti-rotation-2 (PFNA-2) and proximal femoral nailing (PFN) groups of 15 patients each as per criteria and methods.

II. Material & Methods

The present study was conducted on 30 cases of intertrochanteric fractures femur above the age of 50 years, admitted in the department of orthopedics, Rajindra Hospital Patiala, attached to Government Medical College, Patiala. Patients were divided randomly into two groups of 15 patients each. The first group was managed with proximal femoral nailing-2(PFNA-2) while the second group was treated with proximal femoral nailing (PFN). The fractures were classified as per AO/OTA classification. Inclusion Criteria for Study was adults above 50 years of age, isolated intertrochanteric fractures, normal opposite limb, time of fracture less than 2 weeks, intertrochanteric fracture with or without distal extension. Exclusion Criteria for Study was any open injury, associated neurovascular injury, polytrauma patient, pathological fractures except associated with osteoporosis, patients having re-injury at the old intertrochanteric fracture site, nonunion or implant failures, pre-existing neuromuscular disease, and local sepsis. After operative management in the form of PFNA or PFNA2, patients were followed up at monthly intervals and in addition to history and physical examination, patients were subjected to radiological evaluation at each follow-up to ascertain union, implant position, and any sign of implant loosening. for six months. The radiological union was defined as the presence of bridging callus and fracture was considered to be healed when the patients were having a

radiological union and were able to bear weight without any pain. Any complications if encountered were recorded and Results were evaluated as per Harris Hip Score. Clinico-radiological assessment of the patient was done and comparison was made in terms of the duration of surgery, the total amount of blood loss during surgery, the duration of hospital stay, the timing of early mobilization and full weight-bearing, the assessment of mobility at the end of 3 months and 6 months (Wheelchair-bound/walking frame/ stick/ no aide), radiological assessment for callus formation and bony union, Harris hip score for clinical and radiological assessment at end of 6 months. The result of the study was compared using standardized statistical tests for different variables, P-value <.05 was considered significant.

SCORE	INTERPRETATION
LESS THAN 70	POOR
71-79	FAIR
80-89	GOOD
90-100	EXCELLENT

Table 1.Grading for the Harris Hip Score.

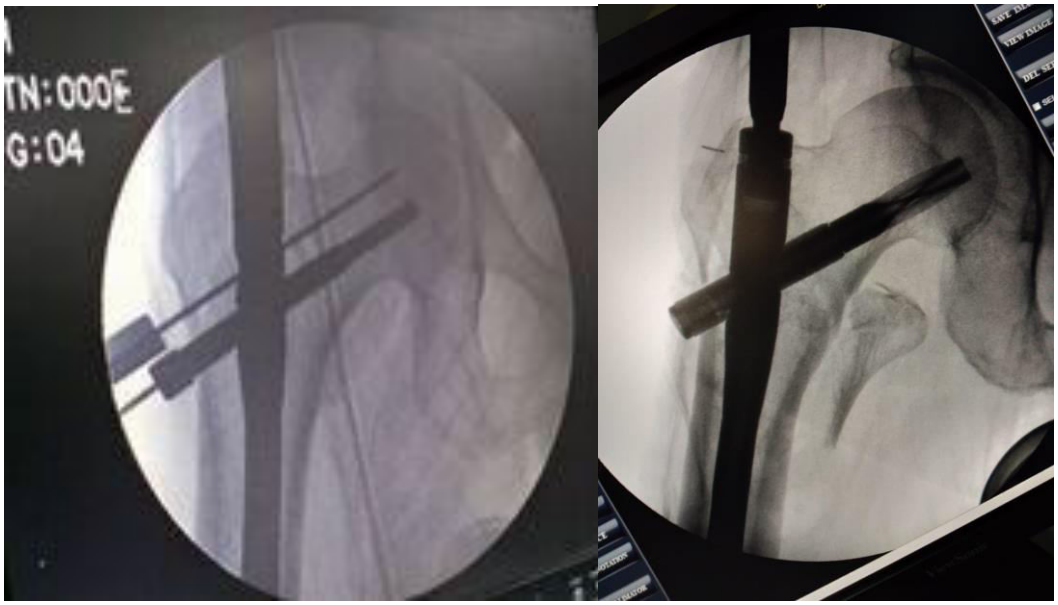

Figure 1.Intraoperative image showing PFNA and PFNA2.

III. Results

A total of 30 subjects were included in the study, out of which, 15 underwent PFN treatment while the remaining 15 underwent PFNA2 treatment. Among the subjects of the PFN group, in 11 patients (55%), complete union occurred in 10 to 14 weeks, while in 9 patients (45%), complete union occurred in 14 to 18 weeks. Among the subjects of the PFN group, in 14 patients (73.6%), and 5 patients (26.4%), complete union occurred in 10 to 14 weeks and 14 weeks to 18 weeks respectively. No significant difference was obtained while comparing the complete union cases between the PFN group and the PFNA2 group (P-value > 0.05). In the PFN group, the 'Z' effect was observed in 1 (6.7%) of patients and the Reverse 'Z' effect was observed in 1 (6.7%) of patients, while in the PFNA2 group no complication was observed. Mean blood loss among the subjects of the PFN group and the PFNA2 group was found to be 123.33 and 86.33 ml

respectively. Significant results were obtained while comparing the mean blood loss between the PFN and PFNA2 groups (P-value < 0.05). The mean duration of surgery in the patients of the PFN group and the PFNA2 group were found to be 51.07 and 38.67 minutes respectively. Significant results were obtained while comparing the mean duration of surgery between the subjects of the PFN group and the PFNA2 group (P-value < 0.05). The mean duration of hospital stay in the patients of the PFN group and PFNA2 group were found to be 10.40 and 9.47 days respectively. Non- significant results were obtained while comparing the mean duration of hospital stay between the subjects of the PFN group and PFNA2 group (P-value > 0.05). Meantime of early mobilization with toe-touch weight-bearing in the PFN group and the PFNA2 group were found to be 7.40 and 5.87 respectively. Non-Significant results were obtained while comparing the meantime of early mobilization till weight-bearing in between PFN group and PFNA2 group (P-value > 0.05). The mean time of partial weight-bearing in the PFN group and the PFNA2 group were found to be 5.27 and 4.73 respectively. Non-Significant results were obtained while comparing the meantime of partial weight-bearing in between PFN group and PFNA2 group (P-value > 0.05). The mean time of full weight-bearing in the PFN group and the PFNA2 group were found to be 13.64 and 13.13 respectively. Non-Significant results were obtained while comparing the meantime of full weight-bearing in between PFN group and PFNA2 group (P-value > 0.05). Mean HHS among the patients of the PFN group and the PFNA2 group were found to be 86.40 and 89.87 respectively. No Significant results were obtained while comparing the mean HHS between the PFN group and the PFNA2 group (P-value > 0.05).

DESCRIPTIVE PARAMETERS	Group	N	Mean	Std. Deviation	P-value
Age	PFN	15	59.47	7.170	.295
	PFNA2	15	64.67	17.447	
Duration of surgery in minutes	PFN	15	51.07	9.881	.001
	PFNA2	15	38.67	8.764	
The total amount of blood loss in ml	PFN	15	123.33	26.095	.000
	PFNA2	15	86.33	11.255	
Duration of hospital stay after surgery	PFN	15	10.40	2.197	.284
	PFNA2	15	9.47	2.475	
Toe touch weight-bearing in days	PFN	15	7.40	3.376	.136
	PFNA2	15	5.87	1.885	
Partial weight-bearing in weeks	PFN	15	5.27	1.534	.283
	PFNA2	15	4.73	1.100	
Full weight-bearing in weeks	PFN	14	13.64	1.550	.370
	PFNA2	15	13.13	1.457	
Harris hip score at 6 months	PFN	15	86.40	7.872	.135
	PFNA2	15	89.87	3.739	

Table 2. Mean value, std. deviation and p-value of various descriptive parameters among subjects of PFN and PFNA2 groups.

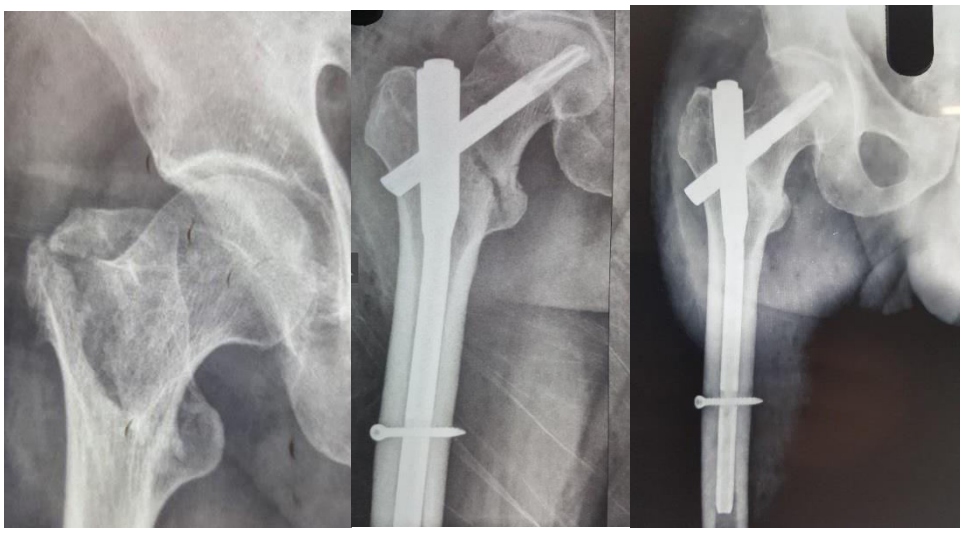

Figure 2. Images showing hip radiographs of the patient managed with PFNA2 (right to left) preoperative, immediate postoperative, and postoperative at 6 months follow up.

Figure 3. Images showing hip radiographs of the patient managed with PFNA (right to left) preoperative, and postoperative at 6 months follow up.

IV. Discussion

Trochanteric fracture of the femur has always been recognized as a major challenge by the orthopedics community not only for achieving fracture union but also for restoration of optimal function in the shortest possible time and with minimal complications. Intertrochanteric fractures are more common in the elderly (above 70) years due to osteoporosis. Unless operated on early they have high morbidity and mortality[6]. DHS and plate fixation was the gold standard in treatment until the advent of PFN[7]. Intramedullary nails act as internal splints and help in indirect healing. These devices cause minimal trauma to the vascular supply of the bone. To improve the rotational and angular stability using a single element the AO/ASIF group came out with PFNA in 2003. PFNA nail has advantages like short incision with less blood loss, less operative time, and early rehabilitation with decreased morbidity. After the invention of the new design of PFN-(PFNA 2) claims have been made of its superiority. The innovative helical blade design provides better compaction of cancellous bone, there will be increased contact area between implant and

the femoral head, better hold on both compact bone and cancellous bone[8]. PFNA2 improves the fixation stability by decreasing reaming of the bone stock which will be done in PFN. There is no need for another derotation screw and it has been biomechanically proven to have better purchase in osteoporotic bones. Biomechanically PFNA2 has greater resistance to cut out better rotational stability achieved with one single element large surface and increased core diameter guarantee the maximum compaction and optimal hold in bone[6]. It has shown improved resistance to varus collapse resistance to femoral head rotation, longer fatigue life[9]. The 11.0 mm helical blade reduces the amount of bone removed in the neck. The tip of the PFNA is flexible which reduces the stress on the bone at the tip and therefore, there will be less implant failure (distal nail breakage and distal locking screw breakage). In PFN, 2 screws are used for the neck the larger screw is the lag screw to take the load. Smaller screw for rotation stability if the length of the smaller screw increases vertical force and induces the cutout causing effect "Z"-effect or reverse "Z"-effect[10]. As evident in our study, both PFN and PFNA2 are equally effective for the treatment of osteoporotic intertrochanteric fractures in the elderly as they allow short incision, less blood loss, and showing equally good functional outcomes after fracture union. Based on observations made in our study, we can safely conclude that PFNA2 gives better results than PFNin intertrochanteric fractures in terms of the amount of blood loss during surgery, the duration of surgery, postoperative complications, less incidence of screw cut-outs. However, there is no difference between the two modalities in terms of the duration of hospitalization, fracture union, early rehabilitation (mortality and morbidity). But as this study involved a small number of patients (n=30), so its results cannot be projected to the general population, for which a trial involving a large number of cases is required. The study had the limitations of the absence of long-term follow-up in terms of restoration of pre-injury ambulatory status, mortality, and secondary arthritis may not be possible. The ethnicity of the result found in this study cannot be stated to be correct as sample size i.e. 15 cases of PFN and 15 cases of PFNA2. However, if a sample of study large i.e. 200 cases each then carry home message can be given.

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