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ORIGINAL STUDY

The treatment of intertrochanteric fractures comparison of PFN and hemiarthroplasty 3-year mortality study

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Intertrochanteric fractures in elderly patients can increase mortality due to complications and negative functional results. The aim of this study is to retrospectively compare the follow-up and mortality rates among patients given a proximal femoral nail (PFN), the current routine treatment for these types of fractures, with those given hemiarthroplasty.The study retrospectively investigated 202 patients over the age of 60 who completed at least 3 years of follow-up after hemiarthroplasty or PFN for intertrochanteric fractures between 2007 and 2012. While 132 patients underwent cemented hemiarthroplasty, 70 had PFN. The monitoring duration for those with PFN surgery was 31.25±1.3 months while the duration of follow-up for those with hemiarthroplasty surgery was 20.0±1.2 months. At the end of 3 years of monitoring of the 202 patients, 99 were deceased. There was a statistically significant difference found in terms of patient life expectancy between those with PFN and those with hemiarthroplasty; Cox regression analysis identified that the mortality rate of those with hemiarthroplasty was 5.1 times greater.As a result, patients undergoing hemiarthroplasty should be carefully chosen and if possible, PFN should be preferred.

Keywords : Proximal femoral nail (PFN) ; hemiarthroplasty ; mortality ; intertrochanteric femoral fracture.

INTRODUCTION

Intertrochanteric femoral fractures are an important cause of increased mortality and morbidity in elderly patients *(9,11)*. The treatment aim for these types of fractures, frequently encountered in the advanced age group, is to ensure the mobility of the patient in the shortest time possible, to allow a return to activities performed before the fracture, and to prevent the development of complications linked to the lack of mobility that may result in death *(9,11,20)*. The facts that bone quality may not be good in these patients and that there are often accompanying systemic diseases lead to controversy about the choice of appropriate treatment (*20*). For this type of fracture, intramedullary fixation equipment, called proximal femoral nail antirotation (PFNA), was developed by

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the Arbeitsgemeinschaft für Osteosynthesefragen/ Association for the Study of Internal Fixation (AO/ ASIF) in 2004 (*13*).

Biomechanical studies have shown that for these fractures, intramedullary fixation methods are more appropriate as they carry more load due to the short lever arm, and they can control excessive shear (*12,16,18,21*). Additional clinical studies have proven the effectiveness of PFNA (*17,18*).

In addition to intramedullary fixation devices to treat intertrochanteric fractures, the alternative treatment of hemiarthroplasty is not yet accepted as a primary treatment (*19*). However, varus displacement and excessive collapse of the fracture area is a common problem with sliding femoral nails, especially in elderly women, who often suffer from osteoporosis and poor bone quality (*16*). For this reason, primary arthroplasty was proposed by some authors (*2,6,15*). Many clinical studies have not found proof that hemiarthroplasty is more effective than and superior to intramedullary (apart from PFNA) or extramedullary fixation (*2,6,8,15*). In addition, there are virtually no studies in the literature showing that PFN is superior and effective compared to hemiarthroplasty**.**

For this purpose, we aimed to retrospectively investigate at least 3 years of follow-up records and to compare mortality rates after hemiarthroplasty, which is more frequently used for intertrochanteric fractures in the advanced age group, with the alternative current treatment of PFN in patients of similar age groups.

SUBJECTS AND METHODS

Patients above the age of 60 years who underwent hemiarthroplasty or PFN for intertrochanteric fractures between 2007 and 2012, and had at least 3 years of follow-up, were retrospectively investigated. Patients with inability to walk, poor cognitive function, an age over 90, or cemented hemiarthroplasty were excluded from the study. Permission was granted by the local ethics committee.

Of a total of 202 patients, 132 had cemented hemiarthroplasty surgery while 70 had PFN. Generally, the parameters affecting treatment choice included the preference of the senior surgeon, the physiological age of the patient, and the current treatment on the date of the operation.

Follow-up information from at least 3 years of monitoring after the surgery was collated. Demographic information, metabolic diseases, blood transfusions during the hospital stay, and complications developed after the surgery were recorded from the population registration system and files.

The patients with hemiarthroplasty and PFN were investigated in terms of age, gender, side of injury, mechanism of injury, AO fracture classification, and metabolic diseases (Table I). The general situation of the patients was evaluated according to ASA scores. Additionally, patients with hemiarthroplasty and PFN were investigated in terms of duration of hospital stay, time to operation, blood transfusions, and complications after surgery (Table II).

Each PFN (Trigen Intertan®; Smith & Nephew) was used according to the manufacturer's instructions. The PFNs were inserted with the patient in the supine position after closed reduction of the fracture accompanied by scope with minimally invasive methods. For hemiarthroplasty, a standard cemented stem and a bipolar head (Tıpsan®, Turkey) were used. Hemiarthroplasty was performed through a lateral incision with the patient in the supine position. All femoral stems were performed with the third-generation cementing technique (*1*).

Living and deceased patients were compared in terms of age, gender, side of fracture, trauma mechanism, ASA score, AO/OTA (Orthopedic Trauma Association) fracture classification, metabolic diseases, duration of hospital stay, time to operation, and blood transfusions (Table IV).

Statistical analysis

SPSS version 19.0 was used for data entry and analysis. Variables were tested for normal distribution with the Kolmogorov–Smirnov test. Descriptive data are presented as mean, standard deviation, frequency, percentage, and minimum and maximum values. During data analysis to assess the differences between the groups for variables without normal distribution, the Mann–Whitney U test was used. For univariate analysis of dependent and

independent variables, the chi-square test was used. The Kaplan–Meier analysis of patients was assessed in terms of duration of monitoring (months), type of surgery, and patient loss. To evaluate the factors affecting patient loss, the Cox regression analysis was used. For Cox regression analysis, patient loss was taken as the dependent variable with time as patient loss duration (month). The independent variables were age, sex, type of operation, duration of hospital stay, hospital stay before surgery, fracture type, ASA score, hypertension, diabetes, cardiovascular disease and chronic pulmonary disease. A backward conditional LR model was used for the analysis. For statistical tests, $p<0.05$ was accepted as statistically significan

Table I. — The comparison of basic characteristics between hemiarthroplasty and PFN

Characteristics	Hemiarthroplasty (n =132, %70)	PFN (n =70 , %30)	
	mean±ss (min-max)	mean±ss (min-max)	p
Age (years)	78,6±5,5 (66-87)	75,7±8,6 (60-89)	0,050
	n (%)	n (%)	p*
Gender			
Female	80 (60,6)	32 (45,7)	0,043
Male	52 (39,4)	38 (54,3)	
Side of fracture			
Left side	63 (47,7)	32 (45,7)	0,785
Right side	69 (52,3)	38 (54,3)	
Mechanisms of injury			
Low energy trauma	124 (93,9)	69 (98,6)	0,120
High energy trauma	8 (6,1)	1 (1,4)	
ASA grading (N)			
1	0 (0,0)	2 (2,9)	
2	25 (18,9)	16 (22,9)	0,289
3	71 (53,8)	34 (48,6)	
4	36 (27,3)	18 (25,7)	
AO/OTA fracture classification (N)			
A1	52 (39,4)	27 (38,6)	
A2	44 (33,3)	25 (35,7)	0,939
A3	36 (27,3)	18 (25,7)	
Metabolic illness (N)			
Hypertension	45 (34,1)	35 (50,0)	0,028
Cardiovascular disease	70 (53,0)	25 (35,7)	0,019
Diabetes	34 (25,8)	13 (18,6)	0,250
Chronic pulmonary disease	66 (50,0)	16 (22,9)	<0,001
Cerebro vascular disease	10 (7,6)	12 (17,1)	0,038
Neurological disease	6 (4,5)	4 (5,7)	0,716
The other chronic disease	5 (3,8)	9 (12,9)	0,016

p: Mann-Witney U test, p*: chi-square test, percent: percentage column

Table II. — The comparison of hospitalisation and distribution of the postoperative complications between PFN and hemiarthroplasty

Characteristics	Hemiarthroplasty (n =132% 65,3)	PFN (n =70% 34,7)	Significance (P)
	mean±ss (min-max)	mean±ss (min-max)	
Average duration of stay in hospital	14,1±5,9 (1-30)	5,1±2,2 (2-19)	<0,001
Average time from injury to operation	7,3±5,1 (1-27)	2,2 ±1,1 (1-6)	<0,001
Average blood transfusion during hospitalisation (ml)	1,5±1,3 (0-5)	0,5±1,1 (0-6)	<0,001
Postoperative complications	n (percent)	n (percent)	p*
Failure/Cut out	0 (0,0)	5 (7,1)	0,005
Dislocation	2 (1,5)	0 (0,0)	0,545
Lokal pain	7 (5,3)	5 (7,1)	0,405
DVT	3 (2,3)	0 (0,0)	0,277
Deep infection	2 (1,5)	1 (1,4)	0,724
Short more than 3cm	5 (3,8)	2 (2,9)	0,540

DVT: Deep vein thrombosis, p: Mann-Whitney U test, p*: chi-square test, percent: percentage column

Table III. — The factors affecting the loss of patient odds ratio (95%) to be examined with Cox regression analysis

Variables	Regression coefficient (B)	OR	%95 Confidence Interval	P*
surgery type (1) hemiarthroplasty	1,643	5,170	1,790-6,932	<0,001
ASA skoru 0 ve 1				<0,001
ASA Skoru 2 (1)	0,714	2,042	1,063-3,923	0,032
ASA Skoru 3 (2)	1,295	3,651	1,857-7,17	<0,001

*Backward Stepwise (Conditional) cox regresyon analizi, OR: Odds ratio

RESULTS

A total of 202 patients with intertrochanteric fractures underwent surgery. According to the AO/OTA classifications, 79 patients (39.1%) were categorized as A1, 69 patients (34.1%) were A2, and 54 patients (26.7%) were A3 (Table I).

The mean monitoring duration of those with PFN was 31.25±1.3 months, while those with hemiarthroplasty were monitored for 20.0±1.2 months. There was a statistically significant difference found between patients with PFN and those with hemiarthroplasty in terms of life expectancy ($p<0.001$) (Fig. 1).

In the hemiarthroplasty group, the mean age was 78.6±5.5 (range 66–87) years, while in the PFN group, it was 757±8.6 years (range 60–89). While there was no difference in terms of age and male gender, there was a significant difference between the two groups in terms of female gender ($p=0.043$). There were no statistically significant differences between the two groups in terms of side of injury, trauma mechanism, ASA score, or AO/OTA classification. When metabolic diseases were

investigated in the two groups, there was no difference in terms of diabetes or neurological diseases. However, there was a statistically significant difference observed in terms of hypertension (p=0.028), cardiovascular disease (p=0.019), chronic pulmonary disease (p<0.001), cerebrovascular disease (p=0.038), and other chronic diseases (p=0.016). Baseline characteristics are shown in Table I.

There was a statistically significant difference observed between the hemiarthroplasty and PFN groups in terms of hospital stay and time to operation (p<0.001) (Table II). Blood transfusions during the hospital stay were observed to be fewer in the PFN group (p<0.001).

Monitoring of the 202 patients found that 32 (15.8%) had complications. Of these, 19 (9.4%)

Table IV. — Comparing both groups of factors affecting mortality

Characteristics	Living (n=103) mean±ss (min-max)	Dying (n=99) mean±ss (min-max)	p
Age (years)	79,4±5,4 (66-89)	75,9±7,5 (60-88)	0,002
Gender	n(%)	n (%)	p*
Female	50 (48,5)	62 (62,6)	0,044
Male	53 (51,5)	37 (37,4)	
Side of fracture			
Left side	46 (44,7)	49 (49,5)	0,491
Right side	57 (55,3)	50 (50,5)	
Mechanisms of injury			
low energy trauma	98 (95,1)	95 (96,0)	0,525
high energy trauma	5 (4,9)	4 (4,0)	
ASA grading (N)			
1-2	32 (31,1)	11 (11,1)	
3	54 (52,4)	51 (51,5)	<0,001
4	17 (16,5)	37 (37,4)	
AO/OTA fracture classification (N)			
A1	40 (38,8)	29 (39,4)	0,885
A2	34 (33,0)	35 (35,4)	
A3	29 (28,2)	25 (25,3)	
Metabolic illness (N)			
Hypertension	41 (39,8)	39 (39,4)	0,534
Cardiovascular disease	45 (43,7)	50 (50,5)	0,332
Diabetes	17 (16,5)	30 (30,3)	0,020
Chronic pulmonary disease	31 (30,1)	51 (51,5)	0,002
Cerebro vascular disease	14 (13,6)	8 (8,1)	0,209
Neurological disease	3 (2,9)	7 (7,1)	0,150
The other chchronic disease	5 (4,9)	9 (9,1)	0,182
Average duration of stay in hospital	9,3±6,9 (1-30)	12,8±5,7 (3-28)	<0,001
Average time from injury to operation	4,6±4,9 (1-27)	6,4±4,5 (1-23)	<0,001
Average blood transfusion during hospitalisation (ml)	0,8±1,1 (0-6)	1,4±1,4 (0-5)	0,002

p: Mann-Whitney U test, p*: chi-square test, percent: percentage column

were in the hemiarthroplasty group while 13 (6.4%) were in the PFN group (Table II). While complications of local pain were observed in both groups, 5 patients developed cut-out after PFN (Fig. 3). It was found that patients in the PFN group had fewer major complications compared to the hemiarthroplasty group (Table II).

Cox regression analysis identified that patient loss in those with hemiarthroplasty was 5.1 times greater (p<0.001, 95% GA: 1.790–6.932). The conclusion was reached that an ASA score of 2 increased patient loss by 2 times, while an ASA score of 3 increased patient loss by 3.6 times (p=0.032, 95% GA: 1.063–3.923; p<0.001, 95% GA: 1.857–7.17, respectively) (Table III).

Kaplan–Meier analysis found that there was a statistically significant difference between those with PFN and those with hemiarthroplasty in terms of life expectancy (p<0.001) (Fig. 1).

At the end of 3 years of monitoring of the 202 patients, 99 were deceased (Table IV). Those living (n=103) and those deceased (n=99) after 3 years of monitoring are compared in Table IV. The mean age of living patients was 79.4±5.4 years (range 66–89), while the mean age of the deceased patients was 75.9±7.5 years (range 60–88) (p=0.002). In terms of metabolic diseases, diabetes (p=0.020) and chronic pulmonary disease (p=0.002) were observed to be statistically significantly higher in the deceased patients. A statistically significant difference was observed in terms of duration of hospital stay and time to surgery for the deceased patients (p<0.001). It was observed that blood transfusions in the deceased patients during their hospital stays were statistically significantly higher (p=0.002).

Death rates among females and males was greatest in the 80–89-year-old age group (p=0.042 and p=0.024, respectively) (Fig. 2).

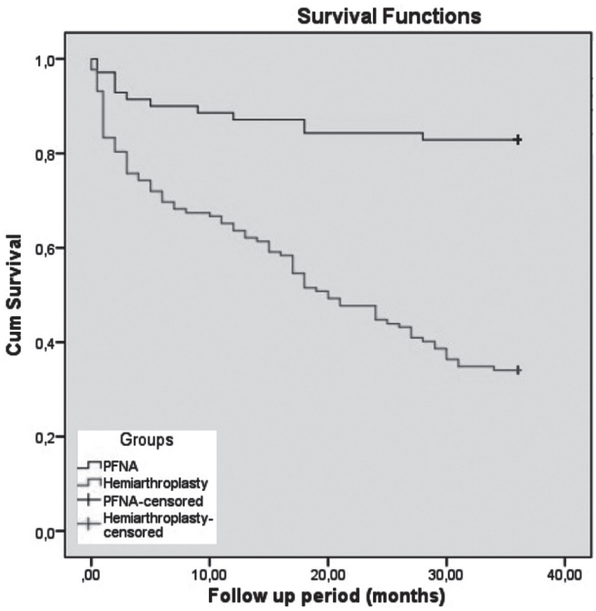

Fig. 1. — Hemiarthroplasty and PFN surgery with Kaplan-Meier analysis of the follow-up status of patients.

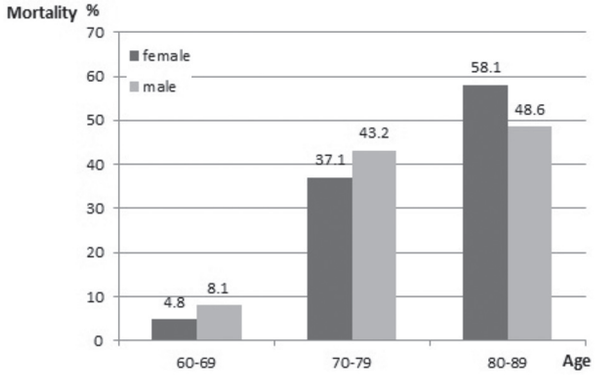

Fig. 2. — Death rates of the men and women

DISCUSSION

The aim of intertrochanteric fracture treatment is to return the patient to the same functional level as before the fracture and to prevent disability and medical complications in the long term (*5,7,19*). The choice of implant is important for minimally invasive operation techniques, for applying a full load after surgery, and for low complication rates (*18*). Successful surgery is not linked to successful functional results (*19*). The aim of internal fixation methods is to protect the patient's hip joint, thus avoiding complications related to prostheses. The advantage of hemiarthroplasty in select cases of intertrochanteric fracture is that patients can be on their feet quickly and systemic complications linked to immobility are prevented (*7*). In our study, which compared hemiarthroplasty and PFN patients

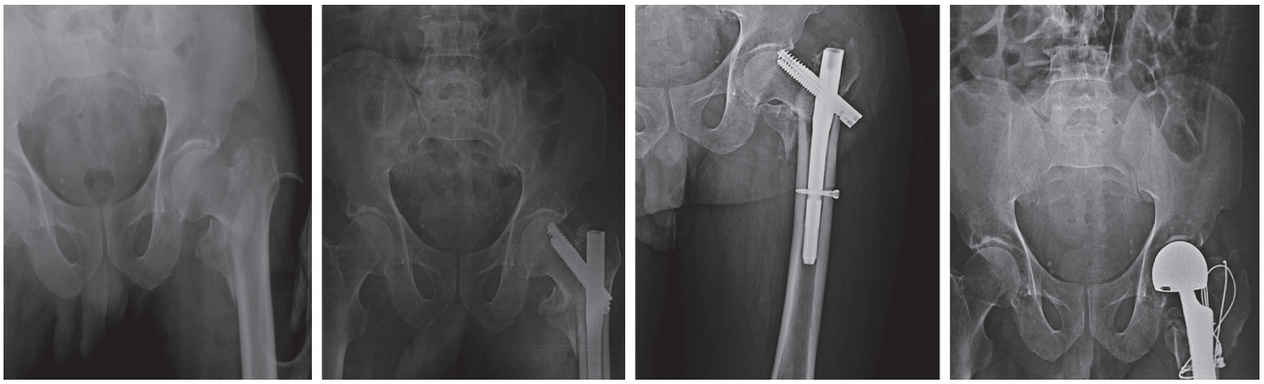

Fig. 3. — Hemiarthroplasty and PFN surgery with Kaplan-Meier analysis of the follow-up status of patients.

in many ways but most importantly their mortality, those who underwent hemiarthroplasty could apply loads earlier but life expectancy was longer for those who underwent PFN.

Another study emphasized that after hip fractures, the only variable risk factor in surgery was the fixation method (*3*). One of the fixation methods, PFN, is a reliable method with good union rates in all femur trochanteric fractures and low rates of major complications (*10*). As a result, we have recently planned and continue to plan and perform PFN on patients, taking into account their physiological age and bone density, if available, as much as possible. Cut-out and failure is the most important problem after PFN. In our study, 5 patients with PFN were observed to have cut-out/failure. An interesting detail is that of the patients who developed cut-out, 2 died in the early period after hemiarthroplasty (these patients were not included in the hemiarthroplasty group). As a result, to reduce the rates of cut-out and failure, each patient's bone density should be measured in the preoperative period.

A study investigating the yearly mortality after PFN found that mortality risk was highest in the first 3 months for patients who were male, above the age of 80 years, and with ASA scores of 4 and above (*4*). In our study, similarly, the highest death rates were observed in patients over the age of 80 and with high ASA scores in both groups.

Studies comparing the two techniques are few, and there are no 1-year or longer mortality studies. Generally in the literature, internal fixation is emphasized for intertrochanteric femoral fracture treatment in the elderly, but there are different opinions. Short-term results show that hemiarthroplasty is not an advantageous alternative treatment to internal fixation; in fact, there is short survival after surgery and mortality rates are high. Osteosynthesis appears to be the primary choice to treat intertrochanteric femoral fractures in elderly patients (*5,7*). According to our experience and our mortality studies, we state that PFN should be the first choice, if possible.

A randomized prospective study with a low number of patients obtained more successful clinical results in the PFN group but found no difference in terms of functional results (*8*). Some studies in the literature have reported opinions in favor of hemiarthroplasty. A retrospective study of a total of 73 patients defended the claim that the bipolar femoral head was appropriate due to it being an easy procedure for senile unstable intertrochanteric fractures, with a short duration of surgery, less blood loss, and early ambulation (*22*). Another study supported this idea and showed that arthroplasty was a good treatment, with up to 75% satisfactory results for unstable intertrochanteric fractures and low postoperative complications (*6*). There are those who defend the usefulness of PFN for unstable intertrochanteric fractures (*12,18,14*). In conclusion, without a full reduction of advanced-degree unstable intertrochanteric fractures, PFN fixation may cause more complications and secondary operations than application of hemiarthroplasty. Our consideration is that PFN may be applied to both stable and unstable fractures because in our study, 18 patients with A3 fractures were treated in this way. If the advan-

tage of early mobility allowed by hemiarthroplasty is considered, the general situation of the patient is important, independent of the surgical method (*7*). We believe that cases should be carefully chosen, as both the general situation and the physiological age of the patient are important.

The limitations of the present study may be that it is retrospective and that although the groups were similar, the patients were not randomized and hip scores were not completed. Additionally, these patients could have been divided into subgroups. However, as subgroups may show differences depending on the observer, we chose not to use them.

In conclusion, PFN is significantly superior to hemiarthroplasty in the treatment of intertrochanteric fractures in elderly patients. The most important difference is that the life expectancy of patients with PFN is longer. As a result, it is necessary to carefully choose patients for hemiarthroplasty. Perhaps in the future, a cut-off value can be determined for the bone density of patients due to undergo PFN, to reduce cut-out and failure rates, and more studies are required in order to be more precise about the choice of treatment method.

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