

# Comparison of external fixation and intramedullary nailing in geriatric patients with intertrochanteric fractures of the femur

## Geriatrik femur intertrokanterik kırıklarında, eksternal fiksator ile intramedüller çivilerin karşılaştırılması

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### Abstract

**Aim:** The healing time of femoral intertrochanteric fractures in the elderly population is prolonged due to the presence of osteoporosis. However, mortality is high because of major causes such as embolism due to long-term bed rest. It is particularly important that these patients be operated and given the freedom to move in the early postoperative period. In this study, we aimed to compare the clinical outcomes of Proximal Femoral Nail (PFN) and External Fixation (EF) in older patients with intertrochanteric fractures of the femur (ITFF).

**Methods:** This study included 72 patients aged 65 years or older who were diagnosed with ITFF and underwent PFN (n=38) or EF (n=34) between 2011 and 2017. Patient data including demographic characteristics, preoperative ASA score, surgical technique, postoperative complications, and functional outcomes at final follow-up, Harris Hip Score (HHS) and Mean Mobility Score (MMS) scores were recorded for each patient.

**Results:** The results indicated that both PFN and EF provided equally satisfactory functional outcomes in the patients. EF was found to have major advantages including significantly lower operative times, lower intraoperative blood loss, and administration of sedation only in high-risk patients. PFN was also found to have remarkable advantages such as lower reoperation risk, reduced mortality, and lower risk of superficial wound infection.

**Conclusion:** Although both PFN and EF were found to have remarkable advantages, PFN seems to be more advantageous in terms of complications. Meaningfully, PFN could be more reliable and effective in the treatment of extracapsular ITFF in old-age patients.

**Keywords:** External fixation, Femur intertrochanteric fracture, Harris Hip Score, Mortality, Proximal femoral nail

### Öz

**Amaç:** Yaşlı popülasyonda intertrokanterik femur kırıklarının (ITFK) iyileşme süresi osteoporoz varlığı nedeniyle uzar. Bununla birlikte bu hastalarda uzun süreli yatak istirahati sonucu emboli gibi başlıca nedenlerden dolayı ölüm oranı yüksektir. Bu hastaların erken dönemde ameliyat edilmesi ve hareket verilmesi çok önemlidir. Bu çalışmada, ITFK olan yaşlı hastalarda uygulanan Proksimal femoral çivi (PFÇ) ve Eksternal fiksator (EF) yöntemlerin klinik sonuçlarını karşılaştırmayı amaçladık.

**Yöntemler:** Çalışmaya 2011-2017 yılları arasında ITFK nedeniyle ameliyat edilen 72 hasta alındı. Bu hastalardan 38 tanesine proksimal femoral çivi, 34 tanesine eksternal fiksator uygulandı. Hastaların demografik verileri, ameliyat öncesi ASA skoru, cerrahi teknik, ameliyat sonrası komplikasyonlar, final fonksiyonel sonuçlar, Harris kalça skoru ve ortalama kalça hareket skorları her bir hasta için kaydedildi.

**Bulgular:** Her iki grubun fonksiyonel sonuçları tatminkar olup EF uygulanan grupta ameliyat süresinin daha kısa ve kan kaybının daha az olması, sedasyonla müdahale edilmesi başlıca avantajlardır. PFÇ yapılan grupta ise tekrar opere edilme ve mortalite riskinin daha az olması, yüzeysel cilt enfeksiyonlarının olmaması başlıca avantajları olarak görüldü.

**Sonuç:** PFÇ ile EF'nin karşılaştırıldığı bu çalışmada, PFÇ uygulamasında komplikasyonların daha az olduğu ve bu nedenle ekstrakapsüler ITFK' da Proksimal femoral çivi yönteminin daha güvenli ve daha etkili bir tedavi olduğu kanaatindeyiz.

**Anahtar kelimeler:** Eksternal fiksator, Femur intertrokanterik kırık, Harris Kalça skoru, Mortalite, Proksimal femoral çivi

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## Introduction

Intertrochanteric fractures of the femur (ITFF) are a leading cause of morbidity and mortality in the elderly population. With increasing life expectancy and rising elderly population, ITFF are likely to become a more important public health problem in future [1]. The ITFF patients accompanied by age-related systemic diseases are at increased risk for complications associated with poor prognosis and mortality, including prolonged postoperative hospital stay, deep vein thrombosis, pulmonary embolism, pneumonia, uremia, urinary tract infections, and pressure ulcer [2]. In such patients, the primary goal of treatment is to achieve prompt and lasting union of the fracture and full function of the injured limb with rapid rehabilitation of the patient [3,4]. On the other hand, the primary goal of surgical treatment is to achieve anatomic reduction of the fracture, stable fixation, low mortality, and early mobilization [5,6]. However, achieving and maintaining a stable fixation in geriatric patients can be highly difficult due to osteoporotic bone [7]. Common surgical techniques used in the treatment of ITFF include dynamic hip screw (DHS), PFN, bipolar hemiarthroplasty (BPH), and EF [8]. However, the treatment of ITFF is a gradually increasing problem worldwide and there is still no consensus on an ideal method for the treatment of hip fractures in the elderly population.

To our knowledge, there are a limited number of studies comparing the effectivity of PFN and EF in the treatment of ITFF. In this study, we aimed to compare PFN and EF in the treatment of elderly ITFF patients with regards to functional outcomes, complications, and morbidity and mortality rates.

## Materials and methods

Our study included 72 patients aged 65 years or older who were diagnosed with ITFF, underwent PFN (n=38) or EF (n=34) between 2011 and 2017 and had regular follow-up for one year. Patients with incomplete medical records, irregular follow-up, a history of osteoarthritis in hip joint, malignancy-related fractures, chronic kidney failure or metabolic bone diseases, patients that underwent treatment methods other than PFN and EF, and patients aged below 65 years were excluded from the study. The study was conducted in accordance with the Declaration of Helsinki and approved by the local Ethics committee (no: 2019/16-03).

Preoperative patient characteristics including age, gender, anesthetic technique, preoperative waiting period, preoperative ASA score, and fracture type were recorded for each patient in both groups. Postoperative characteristics including follow-up period, complications, and reoperation were also recorded for each patient. Hip functions were evaluated using Harris Hip Score (HHS) and the scores were classified as 'Excellent', 'Good', 'Fair', and 'Poor'.

All the surgical procedures were performed in the same hospital by experienced surgeons. Following surgery, the patients in both groups were prescribed low-molecular-weight heparin and antibiotic prophylaxis. On the first postoperative day, bedside radiography was performed, and patients started strength training of the hip, knee, and ankle. On the second day, the patients practiced weight-bearing activities including weight

shifting and short-distance walking. On discharge, the patients were advised to follow up every two weeks and a radiographic examination was performed at each follow-up visit. At 6 months postoperatively, the patients started walking with a full load on the damaged extremity. After achieving adequate bone healing, the external fixator was removed in the outpatient clinic.

Among 72 patients included in the study, 57 patients (33 patients in the PFN group and 25 patients in the EF group) had a final follow-up visit in our clinic (Figure 1 and 2), during which evaluation and scoring were performed. Mean mobility score (MMS) and HHS were used in these evaluations, which included the assessment of walking capacity, pain and physical examination findings [9,10]. On the other hand, 14 out of 72 patients were found to have died before the final follow-up.

## Statistical analysis

Data were analyzed using IBM SPSS 22.0 (IBM SPSS Statistics for Windows, Armonk, NY: IBM Corp.). Descriptives were expressed as mean (Standard Deviation [SD]). Normal distribution of data was analyzed using the Shapiro-Wilk test. Qualitative variables were compared with the Chi-square test. The group means were compared using Paired Samples t-test and Unpaired Samples t-test. Correlations were determined using Spearman's Correlation Coefficient. A *P*-value of <0.05 was considered significant.

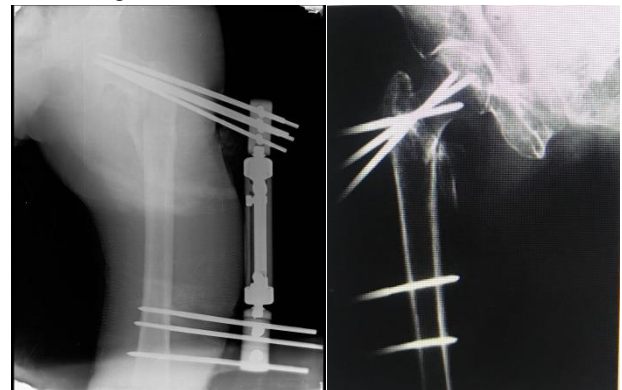


Figure 1: Postoperative X-ray image (EF group)



Figure 2: Postoperative X-ray image (PFN group)

## Results

Seventy-two patients, including 38 patients who underwent PFN and 34 patients who underwent EF, met the inclusion criteria. No significant difference was found between the two groups with regards to the distribution of demographic characteristics, MMS score before fracture as indicated in the patient history obtained from family members, ASA score measured by the anesthesiologist, and time from injury to surgery (*P*>0.05 for all) (Table 1).

During the intraoperative period, PFN group had significantly more blood loss compared to the EF group ( $P<0.05$ ). No blood transfusion was required in any patient. Table 2 presents the surgical characteristics of the patients.

An analysis of postoperative complications indicated that the EF group had significantly higher results compared to the PFN group in terms of requirement of reoperation and one-year mortality ( $P<0.05$  for both). Deep tissue infection occurred in 2 patients in the EF group and in no patient in the PFN group. Additionally, the EF group had significantly higher incidences of superficial wound infection and pin-tract infection compared to the PFN group ( $P<0.05$ ). No heterotopic ossification or avascular necrosis of the femoral head was observed in any of the patients (Table 3).

Length of hospital stay was defined as the time in days from initial presentation to hospital discharge. Mean length of hospital stay was 11.2 (2.3) and 10.8 (2.5) days in the PFN and EF groups, respectively, and no significant difference was found between the groups ( $P>0.05$ ). In addition, no significant correlation was found between patient ages, ASA scores, operative times, and HHS scores ( $P>0.05$ ).

No significant difference was found between the groups regarding HHS and MMS scores ( $P>0.05$ ). One-year mortality was 14.3% in the PFN group and 26.4% in the EF group, which was significantly higher ( $P<0.05$ ). Table 4 presents the functional outcomes assessed at final follow-up.

Table 1: Preoperative characteristics

	PFN group Mean (SD)	EF group Mean (SD)
Number of patients	38	34
Mean age in years (SD)	72.2 (8.1)	73.1 (7.9)
Female / Male distribution (%)	16/22 (42.1/57.9)	14/20 (41.1/58.9)
Mean mobility score before fracture (SD)	4.2 (1.8)	4.1 (1.9)
Mean ASA score (SD)	2.97 (0.87)	2.82 (0.76)
Mean time (hours) from injury to surgery (SD)	37 (9.5)	35 (10.4)

SD: Standard deviation

Table 2: Surgical characteristics

	PFN group Mean (SD)	EF group Mean (SD)	P-value
Number of patients	38	34	0.216
Operation with spinal anesthesia (%)	26 (68.2)	25 (73.5)	0.313
Mean operation time in minutes (SD)	68.2 (10.7)	47.5 (9.8)	<0.001
Intraoperative blood loss in ml (%)	152 (34.3)	25 (10.2)	<0.001
Number of patients receiving blood transfusion (%)	0	0	0.412

SD: Standard deviation

Table 3: Postoperative complications and mortality rates

	PFN group Mean (SD)	EF group Mean (SD)
Reoperation (%)	2 (5.2)	8 (23.5)
One-year mortality (%)	5 (14.3)	9 (26.4)
Thromboembolic complications	2	3
Superficial wound infection	1	9
Deep wound infection	0	1
Pneumonia	1	0
Neurological complication	1	2
Pressure ulcer	2	6

SD: Standard deviation

Table 4: Functional outcomes at final follow-up

	PFN group Mean (SD)	EF group Mean (SD)
Number of patients	33	25
Harris Hip Score	76.3 (10.2)	70.5 (9.3)
Mean Mobility Score	2.2 (1.32)	1.9 (1.14)
Length of follow-up period in months	13.2 (8.1)	15.3 (8.9)

SD: Standard deviation

## Discussion

Hip fractures are likely to become a more important public health problem in the future due to increasing life expectancy. In geriatric patients with osteoporosis, mortality is

the second most important complication following hip fractures. Meaningfully, in patients with no risk of mortality, the primary goal of treatment is to restore hip function. However, patients with failed hip function restoration are at increased risk for morbidity and mortality within the first year after surgery due to systemic diseases and reduced joy of life. The treatment of ITFF is mostly achieved using internal and external fixation techniques. Moroni et al. [11] suggested that ideal osteosynthesis technique and materials for osteoporotic pertrochanteric fractures of the femur should achieve good stability and control fracture impaction. Ozdemir et al. [12] and Atici et al. [13] proposed that the ideal surgical technique for the treatment of ITFF should be simple, time-efficient, and effective, leading to minimal trauma and blood loss. In this regard, external fixation or intramedullary nailing following closed reduction is a biological fixation technique that covers all the above-mentioned features and does not affect the fracture hematoma [14]. In this study, we compared two biological fixation techniques which have been rarely compared in the literature.

Literature reviews indicate that there are very few studies comparing PFN and EF. Moreover, there also a limited number of studies comparing other internal and external fixation techniques. In a previous meta-analysis, Parker et al. revealed that there have been only two studies in the literature comparing the clinical outcomes of internal fixation (plate-screw) and EF, and that these two studies reported that the incidence of surgical trauma was lower in the EF group while functional outcomes were similar in both groups [15]. He et al. compared the therapeutic effects of three treatment methods including EF, PFN, and DHS on ITFF and reported that although no significant difference was found among the three groups regarding the union of fracture time and complications, the EF, PFN, and DHS groups provided the best, moderate, and worst outcomes in terms of blood loss, respectively [16]. Wang et al. compared the effectivity of Richard nail, PFN, and EF in a cohort of 321 patients and reported that EF provided the best outcomes regarding complications while PFN yielded the best results in terms of functional outcomes. Moreover, the authors included young-age patients in addition to older patients, which is likely to have contributed to the findings of the study [17]. In our study, the PFN group had better mortality outcomes and pre- and post-operative pin-tract infections compared to the EF group. We consider that the clinical outcomes obtained in the EF group could be associated with the administration of an external fixator that leads to restricted mobility and reduced quality of life in the patients postoperatively.

Functional outcomes following the treatment of ITFF are often unsatisfactory, as shown in numerous studies [18]. These outcomes can be measured using a wide range of scoring systems; therefore, it is often difficult to compare functional outcomes of the patients across different studies. Nevertheless, the primary criteria in the assessment of functional outcomes in old-age patients include restoration of mobility and returning to pre-fracture mobility [12]. To the best of our knowledge, there is no study in the literature comparing the functional outcomes in patients undergoing PFN and EF. However, Pajarinen et al. [19] compared PFN and other internal fixation techniques and reported that the PFN group regained their preoperative walking

ability significantly more rapidly than those treated with other techniques. Ekström et al. [20] also reported that walking ability was significantly better in the patients treated with PFN compared to the patients treated with the other technique. However, both Pajarinen et al. [19] and Ekström et al. [20] revealed that PFN yielded similar functional outcome results with the other treatment techniques. Ozdemir et al. [21] assessed the functional outcomes of patients that underwent external fixation due to ITFF using Foster's criteria and reported that 80% of the patients had anatomically excellent results. Uzun et al. [22] administered PFN in the patients with ITFF and reported that 82% of the patients had good results according to HHS. In this study, early functional outcomes were better in the PFN group compared to the EF group. HHS scores at the 12<sup>th</sup> postoperative month were higher in the PFN group (76% vs. 70%), although no significant difference was established between the two groups.

### Limitations

Our study was limited due to a small patient population and a relatively short follow-up period. It is tempting to consider that conducting longitudinal clinical studies in geriatric patients is often impossible due to their low life expectancy. Another limitation was that all the surgical procedures were not performed by the same surgeon, which is likely to have affected the results of the study. Nevertheless, the use of the same type of implant in all the patients and the single-center nature of the study constitute the major strengths of our study.

### Conclusion

The results indicated that both PFN and EF provided equally satisfactory functional outcomes in the patients. EF was found to have major advantages including significantly lower operative times, lower intraoperative blood loss, and administration of sedation only in high-risk patients. PFN was also found to have remarkable advantages such as lower reoperation risk, reduced mortality, and lower risk of superficial wound infection. Depending on these findings, we consider that PFN could be more reliable and effective in the treatment of extracapsular ITFF in old-age patients. Further studies are needed to effectively compare PFN and EF.

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