Available online at www.medicinescience.org

ORIGINAL RESEARCH

Medicine Science International Medical Journal

Medicine Science 2019;8(4):887-91

# Treatment of instable intertrochanteric femur fractures: comparison of clinical efficacy and treatment costs of bipolar hemiarthroplasty and proximal femoral nail

**Serkan Akpancar**

*Tokat State Hospital, Clinic of Orthopedics Surgery, Tokat, Turkey*

Received 01 July 2019; Accepted 19 August 2019
Available online 31.10.2019 with doi:10.5455/medscience.2019.08.9104



**Abstract**

The aim of the present study was to compare the cost and effectiveness of bipolar hemiarthroplasty (PBH) and proximal femoral nail (PFN) in the management of instable intertrochanteric femur fractures (ITFF) in geriatric population. A total of 51 patients who were surgically treated for ITFF were included in the study. Group A was treated with PFN (n = 26), while group B was treated with BPH (n = 25) during the same period. Clinical effectiveness was evaluated via Harris Hip Score (HHS) and Visual Analog Scale (VAS) at baseline and 12-month follow-ups. Duration of surgery, amount of blood needed for transfusion, number of patients requiring transfusion, one-year mortality and re-operation rates, time needed for full weight bearing, number of fluoroscopy scans, hospital costs and complications were recorded and compared between groups. VAS and HHS scores of both groups were significantly improved compared to pretreatment values ($p < 0.001$). VAS and HHS scores of PFN group were significantly higher than those of BPH group at the last follow-up ($p < 0.001$ and $p < 0.001$, respectively). Mean operation time was significantly higher in BPH group ($p < 0.001$). Percentage of patients requiring transfusion and the amount of blood needed for transfusion were significantly higher in BPH group ($p = 0.002$ and $p = 0.001$, respectively). One-year mortality rate in BPH group was almost twice that of the PFN group, and reoperation rate in BPH group was almost three times that of the PFN group. Time needed to full weight bearing was significantly lower in BPH compared to PFN group ($p = 0.001$). Number of fluoroscopy scans was significantly higher in PFN than that in BPH group ($p < 0.001$). There was no significant difference between hospital costs in groups ($p = 0.096$). Both PFN and BPH methods are efficacious in treating instable intertrochanteric femur fractures. However, PFN has advantages of shorter skin incision, less transfusion need, higher clinical efficacy and less mortality, while BPH offers advantages of early mobilization and less radiation exposure.

**Keywords:** Femur, fracture, hemiarthroplasty, proximal femoral nail, cost

## Introduction

Geriatric proximal femur fractures are on increase due to osteoporosis and increasing life expectancy [1,2]. Despite advances in implant technology and anesthesia techniques, these fractures still have high mortality and morbidity [2,3]. Because of poor bone quality and instability of these fractures, stabile fixation remains a challenge for surgeons [4]. Bipolar hemiarthroplasty (BPH) and Proximal Femoral Nail (PFN) are two leading technics successfully used in the treatment of intertrochanteric femur fractures (ITFF) [5,6].

There is a controversy in the literature about the preference for the two methods in that both have advantages and disadvantages. Some studies recommended PFN for these fractures since it results in higher resistance to excessive shear forces and carries more load because of short lever arm [7-9]. Others favored BPH due to lower percentages of failure and reoperation [10,11].

The aim of the present study was to compare the cost and effectiveness of PFN and BPH for ITFF in elderly patients.

## Material and Methods

### Research Design and Subjects

This is a retrospective cohort study performed to evaluate the cost effectiveness of two major methods (PFN versus BPH) for treatment of ITFF. The Local Ethics Committee approved the study protocols. An informed consent was obtained from the patients enrolled in the study.

Patients diagnosed with instable intertrochanteric femur fractures according to Evans-Jensen classification were included in the study [12]. Age of the cases varied between 65 and 90. Patients with rheumatic diseases, immune diseases or other systemic

***Coresponding Author:** Serkan Akpancar, Tokat State Hospital, Clinic of Orthopedics Surgery, Tokat, Turkey
E-mail: drserkanakpancar@gmail.com

inflammatory diseases, patients with history of chronic infection around hip joint, osteomyelitis or active infection, patients who had undergone previous operations on hip, patients who had pathological fracture probability, patients with inadequate follow-up period, patients who had bleeding tendency (hereditary or acquired) and pregnant patients were excluded from the study.

**Setting**

In January 2016-January 2018 period, a total of 51 patients operated because of instable ITFF were included in the present study. Twenty-five patients were operated with BPH (BPH Group) while a similar group receiving PFN (PFN Group) was identified during the same period. In order to decrease selection bias, groups were matched by age, gender and fracture type according to AO/ASIF classification and by physical status according to American Society of Anesthesiologists classification system (ASA).

**Surgical technique**

A single surgeon operated all patients. In the PFN group, patients were positioned in the supine position with lateral approach. Under fluoroscopy control, a 3.2 mm guide wire was sent from tip of the greater trochanter intramedullary. A 17 mm reamer was sent through the guide wire for engraving of the intramedullary canal. A proximal femur nail with standard 240 mm height and an appropriate diameter (10-11-12 mm) (Smith-nephew TFN-INTERTAN, USA) was placed for osteosynthesis. Two lag screws were sent to femoral neck and one screw was sent for distal locking. In the BPH group, patients were lied in the lateral decubitus position with posterolateral approach. After removing the femoral head, proximal femur was prepared. Following appropriate carving and scrapping, bipolar hemiarthroplasty (Smith-Nephew CPCS, USA and Stryker Accolade C, USA) was placed for osteosynthesis.

On the first postoperative day, active and passive quadriceps exercises were started. The drain was withdrawn, and compressive dressing was terminated on the second day. When the fracture was fixed successfully and bone quality was satisfactory, full weight bearing was allowed to patients the day after the surgery. Others were allowed partial weight bearing which increased gradually based on their bone healing potential. All patients were recommended to use walker while walking

**Clinical Efficacy**

Pain was evaluated using a visual analog scale where the intensity of pain varied from 0 (painless) to 10 (extreme pain). Harris Hip Score (HHS), a commonly used method for evaluation of hip problems, was employed to assess range of motion, pain, absence of deformity and function. [13]. Follow-up examinations of the patients were performed independently at baseline and min a year (maximum 24 months) after the treatment. Duration of surgery, amount of blood needed for transfusion and number of patients needing transfusion, one-year mortality and re-operation rates, time to full weight bearing, number of fluoroscopy scans, hospital costs and complications of the groups were recorded and compared between groups.

**Statistical Analyses**

Clinical data were expressed as number, percent or mean ± SD. Two-way Chi-square ($\chi 2$) test was used for the assessment of relationship between two categorical variables. Student's t test was used for continuous variables. Analyses were conducted using a commercial software (IBM SPSS Statistics 19, SPSS Inc., an IBM Co., Somers, NY). $p<0.05$ was considered statistically significant.

**Results**

**Study population**

Table 1 shows demographic features of the groups. There was no difference between groups according to gender, fracture side, age, mean ASA score and fracture classification ($p > 0.05$). VAS and HHS scores of both groups were significantly improved compared to pretreatment values ($p < 0.001$). VAS and HHS scores of PFN group were significantly higher than BPH group at the last follow-up ($p < 0.001$ and $p < 0.001$, respectively). Mean operation time was significantly longer in BPH group ($p < 0.001$). The transfusion percentage and the amount blood needed for transfusion were significantly higher in BPH group ($p = 0.002$ and $p = 0.001$, respectively).

After the 12-month follow-ups, six patients in the BPH group and three patients in the proximal femur nail group were died due to general health problems. In the PFN group, three patients underwent revision surgery due to loss of reduction. Two patients received antibiotic therapy because of infection. In the BPH group, one patient had hip dislocation. Hip abduction orthosis was applied to this patient after open reduction. Wound infection occurred in two patients. These patients recovered with antibiotic treatment for two weeks.

One-year mortality rate in BPH group was almost twice that of the PFN group, and reoperation rate in BPH group was almost three times that of the PFN group. However, there was no significant difference for these variables between the groups ($p = 0.125$ and $p = 0.163$, respectively). Time to full weight bearing was significantly shorter in BPH than that in PFN group ($p = 0.001$). Number of fluoroscopy scans was significantly higher in PFN compared to BPH group ($p < 0.001$). There was no significant difference between hospital costs in groups ($p = 0.096$) (Tables 2 and 3).

**Discussion**

Internal fixation methods have been successfully used in the fracture treatment of geriatric fractures [1]. Recently, PFN and BPH are the most popular methods, as they involve higher clinical efficacy. There have been numerous studies conducted to evaluate surgical fixation systems and they reported heterogeneous results. Tang et al. compared PFN and BPH for the treatment of ITFF in 106 patients. In their study PFN resulted significantly higher Harris Hip Scores (90.2) compared to PBH group (79.6) [14]. In another study, Ilgın et al. reported similar HHS of 80.1 in PFN group and 67.0 in BPH group [15]. Different results were obtained in Görmeli et al.'s study where mean Harris Hip Scores of BPH and PFN were similar ($p>0.05$) [6]. In the present study, similar to what was obtained in Tang and Ilgın's study, HHS and VAS scores of PFN group were significantly higher than those of BPH group.

In our study, mean blood loss and operation time were significantly lower in PFN group. These results of the study were in accordance with the literature. BPH had more blood loss and longer operation times in operation ($p<0.005$) [6].

**Table 1.** General characteristics of variables

| Variables | Total | Group | | p |
|---|---|---|---|---|
| | | BPH | PFN | |
| **n** | 51 | 25 | 26 | - |
| **GENDER (Male/Female)** | 19 / 32 | 10 / 15 | 9 / 17 | 0.348 |
| **SIDE (Right/Left)** | 28 / 24 | 14 / 11 | 14 / 13 | 0.337 |
| **AGE (years)** | 73.05 ± 8.48 | 71.68 ± 9.15 | 74.38 ±7.36 | 0.129 |
| **Follow-up (Months)** | 14.92 ±3.79 | 15.12 ±3.9 | 14.73 ±3.75 | 0.359 |
| **Mean ASA score** | 3.19 ± 0.72 | 3.12 ± 0.73 | 3.26 ±0.72 | 0.232 |
| **Fracture classification** | | 3.1 A.1: n=9 (36%) | Grade I (n=11) (42.3%) | |
| | | 3.1 A.2: n=13 (52%) | Grade II ( n=12) (46.1%) | 0.437 |
| | | 3.1 A.3: n=3 (12%) | Grade III (n=3) (11.5%) | |

Data are shown as mean ± standard deviation, frequency or percentage p: Independent samples t test or chi-square test was used.

**Table 2.** VAS and HHS scores of two study groups in different follow-up periods

| Measurements | Group | | p1 |
|---|---|---|---|
| | BPH | PFN | |
| **VAS_0** | 8.4±1.0 | 8.8±0.9 | 0.112 |
| **VAS_12 months** | 2.96±1.0 | 2.03±0.8 | <0.001 |
| **,p2** | <0.001 | <0.001 | |
| **HHS_O** | 53.2±7.3 | 52.6±7.4 | 0.403 |
| **HHS_12 months** | 69.4±11.8 | 77.0±12.3 | <0.05 |
| **p2** | <0.001 | <0.001 | |

p1: Between-subject effect, p2: Within-subject effect. VAS and HHS scores of both groups were significantly improved compared to pretreatment values, and there was a significant difference between the groups at the last follow-up.

**Table 3.** Demographic characteristics of two study groups

| Variables | Group | | p |
|---|---|---|---|
| | BPH | PFN | |
| **Duration of surgery (minute)** | 51.8±12.7 | 30.76±24.7 | <0.001 |
| **Transfused patients (n/%)** | 20 / 80% | 11 / 42.3% | 0.002 |
| **Amount of blood transfusion** | 1.4±0.9 | 0.61±0.8 | 0.001 |
| **Mortality (n/%)** | 6 / 24% | 3 / 11.5% | 0.125 |
| **Reoperation (n/%)** | 3 / 12% | 1 / 3.8% | 0.163 |
| **Time to full weight bearing (days)** | 10.52±15.83 | 35.26±36.75 | 0.001 |
| **Number of fluoroscopy scans** | 0.28±0.84 | 23.7 ±5.8 | <0.001 |
| **Cost (Turkish Liras / US Dollars)** | 5618±1007 / 961±172 | 6170 ±1838 / 1056 ±314 | 0.096 |

Data are shown as mean ± standard deviation or frequency, number, percentage p: Independent samples t test or chi-square test were used.

In our study average number of fluoroscopy scans and, consequently, the radiation exposure were significantly higher in PFN group than those in BPH group. Özyalvaç et al. evaluated 62 patients with ITFF treated with PFN. They declared that they were exposed to fluoroscopy scan for an average of 44.85 ± 21.2 seconds during surgery [16]. In our study we recorded number of fluoroscopy scans needed for the patients. Many cases in PBH group did not require fluoroscopy scan. However, there was too many fluoroscopy requirements during PFN (23.7 ± 5.8). Because of technical requirements fluoroscopy scans is essential in PFN. Higher radiation exposure during PFN is one of the disadvantages this method; therefore personal protective equipment should be used during the implementation of PFN.

Because of advance age, comorbidity and mortality rates are higher in geriatric patients. In the literature mortality rates vary according to treatment methods. Kesmezacar et al. compared Turkish patients operated with BPH and PFN, and they found that mortality rates were higher in BPH group [17]. In a similar study also conducted in Turkey, mortality rates were significantly higher in BPH group. Some other studies reported similar outcomes with the two methods. For example; mortality rates of PFN and BPH were similar in Geiger et al.'s study [18]. In our study mortality rates of BPH was almost twice that of PFN. However, there was no significant difference between groups.

Due to poor bone quality, geriatric patients have higher reoperation percentages. Görmeli et al. declared that 11.7% of the patients operated with PFN and 2.6% of the patients operated with BPH were re-operated ($p < 0.005$) [6]. In our study we obtained similar results with Görmeli et al. (12% in PFN and 3.8% in BPH group).

In our study we also evaluated hospital costs. Higher surgery rates means increased hospital costs. Cost of PFN was higher due to reoperation rates. BPH implants were a bit more expensive than PFN. Higher blood transfusion rates of BPH means increased hospital costs. The costs incurred during hospitalization and the costs incurred due to outpatient follow-up were similar between groups. There was no difference between the total costs of these treatments.

In the literature we have not come across any study evaluating the mobilization of the patients. Time to full weight bearing was significantly lower in BPH than that in PFN group in the present study. BPH is advantageous over PFN because of higher postsurgical compliance, better psychological and general health status of patients and early mobilization which decreases physical dependence [19].

Due to advanced experience and technical developments in BPH and PFN, higher percentages of patients have been successfully treated and have returned to daily lives. The present study and the previous ones showed that PFN is advantageous with its shorter skin incision, less transfusion need, higher clinical efficacy and less mortality. However, in some fracture morphologies stabilization could be difficult in PFN. In the management of femoral head and neck fractures, PFN screw cannot provide complete stabilization of distal fragment. Therefore it is more advantageous to use BPH in these patients. To ensure homogeneity between the groups, we excluded these patients. Therefore, both methods should be well known and practiced by orthopedists.

The present study is the first to evaluate the mobilization, radiation exposure and hospital costs of PFN and BPH methods. In PFN group, failure occurred in two patients and they had revision surgeries. Despite higher revision rates in PFN group, there was no difference for the hospital costs associated with the two methods. Because of shorter skin incision, less transfusion need, higher clinical efficacy and less mortality, PFN is preferable in this group of patients.

## Conclusion

ITFF is one of the most common reasons of disability in the geriatric population, and treatment of this condition is a major challenge for clinicians. In the present study we compared BPH and PFN for the treatment of ITFF, and concluded that PFN is more advantageous than BPH because of higher clinical efficacy, less transfusion need and similar treatment costs associated with this treatment. BPH is more advantageous in terms of early weight bearing time and lower radiation exposure.

**Conflict of interest**
*The authors declare that there are no conflicts of interest.*
**Financial Disclosure**
*All authors declare no financial support.*
**Ethical approval**
*The Local Ethics Committee approved the study protocols.*

*Serkan Akpancar ORCID: 0000-0001-6673-1082*

## References

1. Gül D, Akpancar S . Fractures in Geriatric Cases. Geriatrik Bilimler Dergisi 2019; 2: 14-9
2. Roth T, Kammerlander C, Gosch M, et al. Outcome in geriatric fracture patients and how it can be improved. Osteoporos Int. 2010;21:615-9.
3. Kesmezacar H, Ayhan E, Unlu MC, et al. Predictors of mortality in elderly patients with an intertrochanteric or a femoral neck fracture. J Trauma. 2010; 68:153-8.
4. Seyfettinoğlu F, Ersan O, Kovalak E, et al. Fixation of femoral neck fractures with three screws: results and complications. Acta Orthop Traumatol Turc. 2011;45:6–13.
5. Fichman SG, Mäkinen TJ, Safir O, et al. Arthroplasty for unstable pertrochanteric hip fractures may offer a lower re-operation rate as compared to cephalomedullary nailing. Int Orthop. 2016;40:15-20.
6. Görmeli G, Korkmaz MF, Görmeli CA, et al. Comparison of femur intertrochanteric fracture fixation with hemiarthroplasty and proximal femoral nail systems. Ulus Travma Acil Cerrahi Derg. 2015;21:503-8.
7. Mereddy P, Kamath S, Ramakrishnan M, et al. The AO/ASIF proximal femoral nail antirotation (PFNA): a new design for the treatment of unstable proximal femoral fractures. Injury. 2009;40:428-32.
8. Simmermacher R, Ljungqvist J, Bail H et al. The new proximal femoral nail antirotation (PFNA®) in daily practice: results of a multicentre clinical study. Injury. 2008;39:932-9.
9. Takigami I, Matsumoto K, Ohara A et al. Treatment of trochanteric fractures with the PFNA (proximal femoral nail antirotation) nail system: report of early results. Bull NYU Hosp Jt Dis. 2008;66:276-9.
10. Jones HW, Johnston P, Parker M. Are short femoral nails superior to the sliding hip screw? A meta-analysis of 24 studies involving 3,279 fractures. Int Orthop 2006; 30: 69-78.
11. Palm H, Posner E, Ahler-Toftehøj HU et al. High reliability of an algorithm for choice of implants in hip fracture patients. Int Orthop. 2013;37:1121-6.

12. Jensen J. S. Classification of trochanteric fractures. Acta orthop. Scand. 1980;51:803-10.

13. Harris WH. Traumatic arthritis of the hip after dislocation and acetabular fractures: treatment by mold arthroplasty. An end-result study using a new method of result evaluation. J Bone Joint Surg Am. 1969;51:737-55

14. Tang P, Hu F, Shen J, Zhang L, et al. Proximal femoral nail antirotation versus hemiarthroplasty: a study for the treatment of intertrochanteric fractures. Injury. 2012; 43: 876-81.

15. Ilgın MB, Aydemir AN, Songür M, et al. Comparison of proximal femoral nail and hemiarthroplasty results in unstable intertrochanteric femur fractures Pam Med J. 2018;11:101-5.

16. Osman NÖ, Çiftçi S, Telatar A, et al. Problems About the Use of C-Arm Fluoroscopy in Proximal Femoral Nailing Surgery. Haseki Tip Bulteni. 2018;56:209.

17. Kesmezacar H, Oğüt T, Bilgili MG, et al. Treatment of intertrochanteric femur fractures in elderly patients: internal fixation or hemiarthroplasty. Acta Orthop Traumatol Turc. 2005; 39: 287-94.

18. Geiger F, Zimmermann-Stenzel M, Heisel C, et al. Trochanteric fractures in the elderly: the influence of primary hip arthroplasty on 1-year mortality. Arch Orthop Trauma Surg. 2007;127:959-66.

19. Rogers FB, Shackford SR, Keller MS. Early fixation reduces morbidity and mortality in elderly patients with hip fractures from low-impact falls. J Trauma. 1995;39:261-5.