


# Bipolar Hemiarthroplasty should not be selected as the primary option for intertrochanteric fractures in elderly patients aged 85 years or more

Wen-Le Tan, BA<sup>a</sup>, Yan-Xin Shi, BA<sup>b</sup>, Jing-Yi Zhang, BA<sup>b</sup>, Chan-Rui Tang, BA<sup>a</sup>, Qing-Bin Guan, BA<sup>a,\*</sup>, Jian-Ji Tan, BA<sup>a,\*</sup> 

## Abstract

This study aimed to compare the early outcome of proximal femoral nail antirotation (PFNA) and bipolar hemiarthroplasty (BPH) in elderly intertrochanteric fractures (ITFs) patients aged 85 years or more.

This is a prospective cohort study, and we analyzed 120 elderly patients aged 85 years or more presented with ITFs who underwent BPH and PFNA between January 2017 and July 2018. 84 patients treated with PFNA were set as Group A, and 36 patients treated with BPH were set as Group B. Data such as gender, age, period of follow-up, fracture classification (according to Evans-Jensen classification), preoperative ASA (American Society of Anesthesiologists) physical status, interval between injury and operation, method of anaesthesia, duration of operation time, blood loss during surgery, time of weight bearing after operation, incidence of complications 2 weeks after operation, mortality rates and Harris Hip Score 12 months after operation were recorded and compared.

There are no statistically significant differences when compared general data in patients from group A and B ( $P > .05$ ). Operation time in Group A is less than Group B (103.33, 40–230 min vs 122.64, 75–180 minute,  $P < .01$ ). Blood loss during surgery in Group A is less than Group B (70.24, 50–100 mL vs 194.44, 100–500 mL,  $P < .01$ ). Time of weight bearing after operation in Group A is longer than Group B (50.70, 7–100 days vs 6.67, 4–14 days,  $P < .01$ ). Incidence of complications 2 weeks after operation in Group A is less than Group B (14.12% vs 36.11%,  $P < .01$ ). Mortality rates 12 months after operation in Group A is similar with Group B (13.10% vs 19.44%,  $P > .05$ ). Harris Hip Score 12 months after operation in Group A is similar with Group B (64.64, 0–91 points vs 64.41, 0–90 points,  $P > .05$ ).

Although BPH and PFNA have similar functional outcome and mortality rates 12 months after operation, BPH has more postoperative complications in elderly patients aged 85 years or more with ITFs, Bipolar Hemiarthroplasty should not be selected as the primary option for ITFs in elderly patients aged 85 years or more.

**Abbreviations:** ASA = American Society of Anesthesiologists, BPH = Bipolar hemiarthroplasty, ITFs = Intertrochanteric fractures, PFNA = Proximal femoral nail antirotation.

**Keywords:** bipolar hemiarthroplasty, early outcome, elderly patients, intertrochanteric fractures, proximal femoral nail antirotation

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<sup>a</sup> Department of Orthopedics, Luoding People's Hospital, Luoding, <sup>b</sup> Department of Lower Extremity Orthopedics, Zhengzhou Orthopedic Hospital, Zhengzhou, Henan, P.R.China.

\* Correspondence: Qing-Bin Guan, BA, Department of General surgery, Luoding People's Hospital, 34 lingyuan road, Luoding, 527200, China (e-mail: guanqb1023@163.com); Jian-Ji Tan, Department of Orthopedics, Luoding People's Hospital, 34 lingyuan road, Luoding, 527200, China (e-mail: TJJQWER@163.com).

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## 1. Introduction

Intertrochanteric fractures (ITFs) in the elderly are still a big challenge for orthopaedic surgeons due to the multitude of comorbidities associated with them.<sup>[1]</sup> An ideal surgical technique for elderly ITFs patients should have the least intra and post operative morbidity. Although early surgical treatment has been accepted as the optimal strategy for managing ITFs in elderly,<sup>[2]</sup> the debate on the superiority of intramedullary (nails) and extramedullary (screws or plates) fixations,<sup>[3]</sup> internal fixation and arthroplasty arises again in recent years.<sup>[4]</sup> Whilst proximal femoral nail antirotation (PFNA) has been selected by most of surgeons for elderly ITFs patients,<sup>[5,6]</sup> failures of PFNA have also been reported in elderly ITFs patients due to osteoporosis, extensive comminution or long bedridden duration.<sup>[7]</sup> As a result, bipolar hemiarthroplasty (BPH), which permits early full-weight bearing, avoids the failures of osteosynthesis, was first chosen as the primary treatment for elderly ITFs patients by Green et al in 1987<sup>[8]</sup> and subsequently been advised as an alternative method for elderly ITFs patients by lots of researchers.<sup>[9–11]</sup> Unfortunately, papers also show that BPH takes longer operation time and much more blood loss than PFNA, and recommend that BPH should be undertaken with caution in carefully selected patients.<sup>[12–15]</sup> So, until now, there is still no consensus whether BPH should be selected as the primary treatment for elderly patients especially patients aged 85 years or more presented with ITFs.<sup>[14]</sup>

The purpose of this retrospective study was to compare the early outcome of BPH and PFNA in elderly patients aged 85 years or more presented with ITFs and understand whether BPH should be selected as the first option for elderly ITFs. In order to understand this question, we retrospectively analyzed the clinical outcome of BPH and PFNA in elderly ITFs patients aged 85 years or more, and found that BPH should not be selected as the primary treatment for ITFs in elderly patients aged 85 years or more.

## 2. Materials and methods

### 2.1. Data source

Clinical data of ITFs patients treated with PFNA and BPH within 3 weeks after injury from department of Orthopedics in Zhengzhou Orthopedics Hospital and Luoding People's Hospital from January 1, 2017 to July 31, 2018 were retrospectively analyzed. The ethics committee of Luoding People's Hospital and Zhengzhou Orthopedics Hospital approved the use of these data. All patients in our study signed written informed consent.

### 2.2. Study patients

Inclusion criteria:

- (1) patients with ITFs aged 85 years and more;
- (2) patients with a fracture that occurred after a low energy trauma.

Exclusion criterion includes: patients with

- (1) pathologic fractures;
- (2) fractures associated with polytrauma;
- (3) concomitant pelvic fracture;
- (4) immobility or walking difficulties before fracture;
- (5) preexisting ipsilateral femoral implant;
- (6) infection in the hip or pelvic area or sepsis;
- (7) mental illness or acute confusion without a history of dementia;
- (8) preoperative ASA physical status: grade IV;
- (9) malignant tumors.

### 2.3. Variables

Patients enrolled in this study were grouped as follows: Group A: patients treated with PFNA; Group B: patients treated with BPH. Record gender, age, period of follow-up, fracture classification (according to Evans-Jensen), preoperative ASA physical status, interval between injury and operation, method of anaesthesia, duration of operation time, blood loss during surgery, time of weight bearing after operation, incidence of complications 2 weeks after operation, mortality rates and Harris Hip Score 12 months after operation. Patient demographics are presented in Table 1.

### 2.4. Surgical technique

Operations were performed under spinal anaesthesia or general anaesthesia.

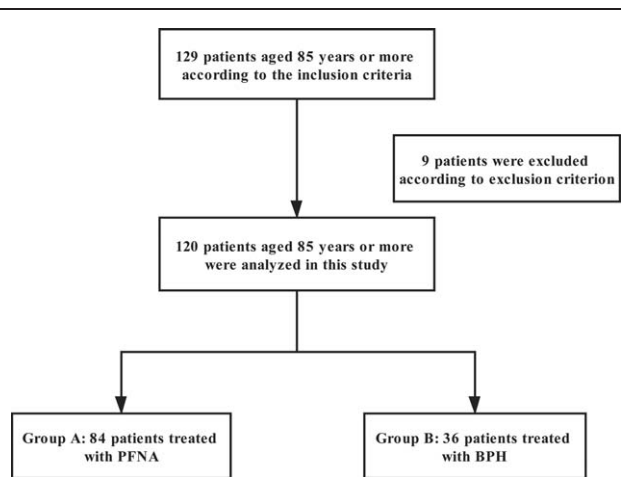
BPH was performed through lateral approach with the patient in a lateral decubitus position and the affected hip was uppermost. First, fracture fragments including the femoral head, neck, calcar (posteromedial fragment) and lesser trochanter were removed; Second, femoral canal was prepared using a broach and a Wagner SL cementless distal fixation femoral stem (Zimmer, USA) was inserted into the femoral canal; Third, displaced greater trochanter fracture fragments were reduced and fixed by wire as a '8' shape; Fourth, trial reduction was performed and appropriate neck length and bipolar head diameter were selected; Fifth, reattach the capsule and the short external rotators to the

**Table 1**

**Comparison of general data between patients from bipolar hemiarthroplasty and proximal femoral nail antirotation group.**

Group	Age (yr)	Gender		Evans-Jesen classification					Follow-up duration(mo)	Pre-operative ASA classification		Method of anaesthesia		Interval between injury and operation (d)
		Male	Female	I	II	III	IV	V		2	3	Intraspinal anaesthesia	General anaesthesia	
A	88.73±3.13	24	60	3	4	29	5	43	20.10±8.00	34	50	78	6	7.87±5.34
B	89.33±3.69	12	24	2	3	6	6	19	17.93±8.73	18	18	29	7	7.44±5.39
Statistic	t=-0.922 p=0.359	χ <sup>2</sup> =2.272 p=0.602		χ <sup>2</sup> =6.676 p=0.154					t=1.322 p=0.189	χ <sup>2</sup> =0.931 p=0.335		χ <sup>2</sup> =2.777 p=0.096		t=0.398 p=0.691

ASA=American Society of Anesthesiologists.



**Figure 1.** The workflow of patients in this study. BPH = bipolar hemiarthroplasty, PFNA = Proximal femoral nail antirotation.

posterior border of the gluteus medius muscle; Sixth, close the wound in layers.

PFNA (Synthes) was performed on traction tables in a supine position under C-arm fluoroscopy. First, perform the closed reduction of the fracture fragments; Second, insert the nail from the lateral aspect of the greater trochanter; Third, insert the column screw until its tip as close as 5 mm to the subchondral bone; Forth, fix the locking bolt and the end cap; Fifth, close the wound in layers.

**2.5. Peri-operative protocol**

Antibiotic prophylaxis was used within 30–60 min before incision and within the first 24h postoperatively in the two groups. Low molecular weight heparin was used daily and continued until check out. Aspirin was used after checking out for another 1 month.

For the BPH group, patients were permitted weight bear standing on second day after surgery and encouraged to use a walker until the patients had adequate muscle strength and balance. Excessive hip flexion (>90°) and adduction were not allowed within the first 6 weeks after surgery.

For the PFNA group, patients were encouraged to sit halfway and exercise lower extremities in bed on the first day after operation. Time of weight bearing standing was decided depending on the reduction of bone structures and the position of the fixation.

Patients were followed up at 6 weeks, 3 months, half and year, 1 year, and annually thereafter for clinical and radiological

examinations. If the patient can't come to our department personally, the clinical outcomes were evaluated by telephone, and the radiological outcomes were evaluated by X-ray films which obtained at their local hospitals.

**2.6. Statistical analysis**

Quantitative data were expressed as mean ± standard deviation, and counting data are presented as percentage. t-test was used for the comparison of measurement data, while Chi-square test ( $\chi^2$ ) was used to compare the counting data among groups. P value less than .05 was considered as significant difference. All statistical analyses were performed using IBM SPSS Statistics (version 19, IBM SPSS Software).

**3. Results**

**3.1. Comparison of general data in patients from the 2 groups before operation**

A total of 129 ITFs patients were reviewed, 9 patients were excluded for there were 3 pathologic fractures, two patients with walking difficulties before fracture, 2 fractures associated with poly-trauma and two patients were lost due to failed followed up. Finally, 120 patients were followed up successfully, which contains 84 patients treated with PFNA (Group A) and 36 patients treated with BPH (Group B). The flow chart of the study was shown in Figure 1. As shown in Table 1, there were no significant differences between the groups in terms of gender, age, fracture classification according to Evans- Jensen, follow-up duration, pre-operative ASA physical status classification, method of anaesthesia and interval between injury and operation.

**3.2. Comparison of operative statistics between the two groups**

When compare operative statistics (Table 2) such as duration of operation time (103.33 ± 40.54 min in Group A and 122.64 ± 33.86 min in Group B), blood loss during surgery (70.24 ± 28.33 ml in Group A and 194.44 ± 102.66 ml in Group B) between patients from the 2 groups, the difference are significant.

**3.3. Comparison of postoperative data between the 2 groups**

And for the incidence of complications 2 weeks after operation (Table 3), 12 patients (14.12%) in Group A is much less than 13 patients (36.11%) in Group B. However, when functional outcome (Harris Hip Score 12 months after operation) and

**Table 2**

**Comparison of duration of operation time, blood loss during surgery, time of weight bearing after operation, incidence of complications 2 weeks after operation, mortality rate and Harris Hip Score 12 months after operation between patients from Group A and B.**

Group	Duration of operation time(min)	Blood loss during surgery(mL)	Time of weight bearing after operation (d)	Incidence of complications 2 wk after operation (percentage)	Mortality rate 12 mo after operation (percentage)	Harris Hip Score 12 mo after operation (points)
A	103.33 ± 40.54	70.24 ± 28.33	50.70 ± 30.25	14.12%	13.10%	64.64 ± 30.01
B	122.64 ± 33.86	194.44 ± 102.66	6.67 ± 3.54	36.11%	19.44%	64.41 ± 32.96
Statistic	t = -2.506 P = .014	t = -10.264 P = .000	t = 8.689 P = .000	$\chi^2 = 7.462$ P = .006	$\chi^2 = 0.797$ P = .372	t = 0.037 P = .971

**Table 3****Complications 2 weeks after operation in patients from Group A and Group B.**

Complications	Group A	Group B
Pulmonary infection	5	4
Urinary infection	1	
Gastrointestinal dysfunction	5	2
Cut through of screws	1	
Acute cerebral infarction		2
Heart failure		2
Cholangitis		1

mortality rate in Group A (13.10%, 7 for gastrointestinal dysfunction, 1 for urinary infection, two for pulmonary infection and 1 for pulmonary embolism) is similar with Group B (19.44%, 3 for acute cerebral infarction, 2 for heart failure, 1 for pulmonary infection and 1 for gastrointestinal dysfunction).

#### 4. Discussion

Due to the aging of the population and rapid development of society, the number of elderly patients with ITFs is increasing year by year. Although multiple operation methods: dynamic hip screws, Medoff sliding plate, percutaneous compression plating, less invasive stabilization system, Gamma nail and PFNA, can be used for fixation in elderly ITFs, intramedullary fixation especially PFNA is considered as the gold standard for elderly ITFs treatment.<sup>[9,16,17]</sup> But, due to failures of PFNA have also been reported in elderly ITFs patients,<sup>[7]</sup> lots of researchers tried BPH as the primary treatment option for elderly ITFs patients, however, the conclusion of BPH as the primary option for elderly ITFs patients differs in different papers.<sup>[4-7]</sup> In this study, we as the first study to investigate clinical data of elderly ITFs patients aged 85 or more treated with PFNA or BPH, and found that although BPH and PFNA have similar functional outcome and mortality rates 12 months after operation, BPH has more postoperative complications in elderly patients aged 85 years or more with ITFs, BPH is not a good primary treatment for ITFs in elderly patients aged 85 years or more.

The goals of treatment of ITFs in the elderly are to regain preoperative ambulatory status with the lowest rate of medical and surgical complication.<sup>[18]</sup> Similar with published data,<sup>[12]</sup> in this study, we also find that PFNA and BPH have similar functional outcome, which means in the term of functional recovery, either PFNA or BPH is accepted for elderly ITFs patients.

Consistent with previous results,<sup>[19,20]</sup> we also found that PFNA has shorter duration of operation time and less blood loss during surgery than BPH, which implies that PFNA does less surgical injury to patients. However, different from the hypothesis that longer bed-ridden leads to a high rate of general complications, our data incidence of complications 2 weeks after operation in Group A is much lower than Group B. From our perspective, first, for the elderly patients underwent surgical treatment, surgical treatment itself is the second trauma to the patients, so less trauma (PFNA) will bring less post-operative complications. Second, although the time of weight bearing after operation in Group A is much longer than in Group B, patients in Group A could exercise their lower extremities and sit halfway in bed on the first day after operation, which is totally different from

**Table 4****Death reasons within 12 months after operation.**

Reasons	Number	Percentage
Gastrointestinal dysfunction	8	44.44%
Acute cerebral infarction	3	16.67%
Pulmonary infection	3	16.67%
Heart failure	2	11.11%
Urinary infection	1	5.56%
Pulmonary embolism	1	5.56%

the preoperatively unable to exercise due to pain. Third, although patients in Group B have early time of weight bearing after operation, due to the physical and psychological injury by the fracture, they dare not exercise as normal persons to avoid falling down again and just stand around the bed, flex and extend knee and hip joints mildly. So, to some extent, the benefit of “early exercise” in Group B is similar with “bed-ridden exercise” in Group A.

Although PFNA does less surgical injury to patients, there are no significant difference when compare the mortality rates between patients from the 2 groups 12 months after operation. The underlying reason may be that only elderly ITFs patients aged 85 years or more were included (mean age was 88.91 years in our study), whose remaining life expectancy is short even though they do not suffer from the ITFs and PFNA or BPH. However, when analyzing the death reasons within 12 months after operation (Table 4), we find that gastrointestinal dysfunction is the main reason (44.44%, 8/18). So, if we can solve the gastrointestinal dysfunction reasonably, probably we can decrease the mortality rate in elderly patients aged 85 year or more 12 months after operation. But it needs further study.

#### 5. Conclusion

In this study, we found that PFNA and BPH have similar functional outcome and mortality rates, but BPH has more postoperative complications in elderly patients aged 85 years or more with ITFs, BPH is not a good primary treatment for ITFs in elderly patients aged 85 years or more. But there are some limitations in this study, first, our study was a retrospective controlled study, although the patient groups appeared similar, patients were not randomly assigned to the groups. Second, the duration of follow-up is short. Third, although we found that gastrointestinal dysfunction is the main reason for the death reason 12 months after operation, we still do not know how to solve with this situation reasonably.

#### Author contributions

**Acquisition of data:** Jian-Ji Tan, Qing-Bin Guan.

**Analysis and interpretation of data:** Wen-Le Tan, Yan-Xin Shi, Jing-Yi Zhang

**Conceptualization:** Jian-Ji Tan, Qing-Bin Guan.

**Data curation:** Jian-Ji Tan, Qing-Bin Guan.

**Formal analysis:** Wen-Le Tan, Yan-Xin Shi, Jing-Yi Zhang

**Investigation:** Yan-Xin Shi, Jing-Yi Zhang, Chan-Rui, Tang.

**Methodology:** Jian-Ji Tan, Wen-Le Tan, Yan-Xin Shi.

**Project administration:** Jian-Ji Tan, Wen-Le Tan, Yan-Xin Shi.

**Resources:** Jian-Ji Tan, Qing-Bin Guan.

**Supervision:** Jian-Ji Tan, Qing-Bin Guan, Wen-Le Tan.

**Writing – original draft:** Wen-Le Tan.

**Writing – review & editing:** Jian-Ji Tan, Wen-Le Tan.

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