ORIGINAL ARTICLE

The effects of two fixation methods on blood loss in patients with trochanteric fracture: dynamic hip screw vs. proximal femoral nail anti-rotation

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ABSTRACT

Aim The two most commonly used implants for treatment of trochanteric fractures are the dynamic hip screw (DHS) and proximal femoral nail antirotation (PFNA). The aim of this study was to evaluate blood loss in patients with trochanteric fracture treated with DHS or PFNA.

Methods This retrospective comparative study included 61 patients with trochanteric fracture, who were divided according to a surgical method into DHS and PFNA groups. In the PFNA group, a short third generation gamma-nail was used for osteosynthesis (Supernail GT, Lima Corporate, Italy), and in the DHS group a dynamic hip screw was used (Synthes, Oberdorf, Switzerland). Complete blood count with haemoglobin and haematocrit values was taken preoperatively and on the first day postoperatively and a number of red blood cell transfusions (RBC) were evaluated. Electronic medical records from 2022 were used to collect patient data.

Results There were no significant differences in terms of gender and age between the groups (p=0.510 and p=0.087, respectively), as well as in the fracture type distribution (p=0.886). The duration of postoperative hospitalisation was similar between the groups (p=0.643). There was no statistically significant association between the number of RBC transfusions and fixation method (p=0.091), as well as in postoperative haemoglobin and haematocrit levels between the groups (p=0.180 and p=0.225, respectively).

Conclusion Both DHS and PFNA implants are safe surgical techniques for the treatment of trochanteric fractures, with similar blood loss, number of blood transfusions and hospital stay.

Key words: haemorrhage, intramedullary nailing, sliding hip screw, trochanteric fractures

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INTRODUCTION

Hip fractures represent the leading cause of morbidity, mortality, disability, pain, and hospitalisation in the geriatric population, and are the leading source of healthcare costs (1). Due to the increasing life expectancy, the incidence of proximal femur fractures is rising. It is estimated that by the year 2050, there will be 6.26 million hip fractures worldwide (2). One-year mortality rate for patients with hip fractures was reported to be up to 20–24% and has remained unchanged over the years (3).

Hip fractures can broadly be classified into intracapsular and extracapsular, described relative to the joint capsule. Trochanteric fractures are extracapsular fractures which account for half of all hip fractures. Extracapsular hip fractures are associated with low-energy trauma in older age patients and high-energy trauma in young patients, resulting in similar fracture patterns. Some conditions may cause a predisposition to fractures in this area, such as fat distribution or hip osteoarthritis (4,5).

For the treatment of trochanteric fractures, intramedullary or extramedullary fixation can be used where implant choices include proximal femoral nail antirotation (PFNA) or a dynamic hip screw (DHS) (6). This type of fracture is associated with considerable postoperative blood loss. Postoperative anaemia is a strong negative prognostic factor in patients with hip fracture. It is associated with increased postoperative mortality, poor physical performance, and increased length of hospitalisation (7). Red blood cell (RBC) transfusions, besides the potential for transfusion complications, can be immunosuppressive, and transfusions per se have been linked to an increased risk of bacterial infections in patients who have undergone hip surgery (8). In order to decrease blood loss and the need for blood transfusion, authors have investigated the effects of tranexamic acid (9). Many comparative studies have been conducted to compare PFNA and DHS, with controversial results in terms of blood loss. Many of these studies have not revealed any differences between the two implants (10).

The aim of this study was to evaluate the blood loss in patients with trochanteric fractures treated with DHS or PFNA.

PATIENTS AND METHODS

Patients and study design

A retrospective, single-centre comparative study was conducted. It included 61 patients with trochanteric fracture who were treated operatively in the year 2022 at the Orthopaedics and Traumatology Clinic of the Clinical Centre of the University of Sarajevo. An independent observer blinded to the surgical treatment classified the fractures on the preoperative X-rays according to the Arbeitsgemeinschaft für Osteosynthesefragen/Orthopaedic Trauma Association classification (AO/OTA) (11). According to the surgical method, the patients were divided into 2 groups: the DHS group and the PFNA group. There were 30 and 31 patients in the DHS and PFNA groups, respectively. The inclusion criteria were: fractures of the proximal femur types 31.A1 and 31.A2, according to the AO/OTA classification, patients able to give full consent to the study, injury less than two weeks old, patients without previous anaemia. The exclusion criteria were: fracture type 31.A3, previous operations on the ipsilateral hip, associated fractures, pathological fractures, coagulation disorders, oncology patients, any contraindication to surgery.

The study was approved and supported by the Ethical Committee of the Clinical Centre of the University of Sarajevo. Patient records and information were anonymous and de-identified prior to the analysis.

Methods

In the preoperative assessment of patients, the American Society of Anaesthesiology Scale was used (12). All the operations were performed under general or spinal anaesthesia, and all patients received 2 g of cefazolin as a prophylactic antibiotic, half an hour before the incision and for two days postoperatively twice daily. In the PFNA group, a short gamma-nail of the third generation was used for osteosynthesis (Supernail GT, Lima Corporate, Italy), and in the DHS group a dynamic hip screw (Synthes, Oberdorf, Switzerland). Patients received 60 mg or 6000 IU of enoxaparin-sodium subcutaneously as a thromboprophylactic agent. The indication for administration of RBC transfusion was a haemoglobin level under 80 g/L or haematocrit value 0.30 or lower. The complete blood count with haemoglobin and haematocrit values were taken preoperatively and on the first postoperative day, and the number of red blood cell transfusions (RBC) was evaluated. Electronic medical records from the year 2022 were used to collect patient data.

Surgical techniques. PFNA group: the patient was positioned on the traction fracture table, appropriate reduction was performed, and fluoroscopy confirmed that the fracture reduction was satisfactory. The operation area was prepared and draped. Through a small incision of 4–5 cm proximal to the greater trochanter, the skin, subcutaneous tissue, and deep fascia were incised, and the lateral femoral muscle group bluntly separated to fully expose the greater trochanter and cortex of the femur. After that, the greater trochanter was drilled at the apex level with a cannulated tip and the guide wire was introduced. A radiographic examination of the two views was recommended. If the guide wire was well positioned, a cannulated starting reamer was manually introduced through a protection sleeve to prepare only the proximal portion of the femoral canal. After that, the nail was inserted into the femoral canal and the guide wire was removed. A lateral incision on the thigh, in line with the anteversion position of the nail guide, was performed. At this point, the guide wire cannula was inserted to introduce the cephalic reamer and the cephalic screw in the standard position. Then, an anti-rotational screw was inserted to allow the sliding of the cephalic screw; a distal static blocking screw was positioned by means of a specific kit. C-arm fluoroscopy confirmed fracture reduction and good internal fixation position. After repeated flushing, we placed drainage and sutured the incision.

DHS group: the reduction process was the same as in the PFNA group. After acceptable reduction, the skin, subcutaneous tissue, and deep fascia were incised, the lateral femoral muscle group bluntly separated, and the greater femur and cortex entirely exposed through a 10-cm incision on the lateral side of the greater trochanter. After reaming and measuring the depth in the direction of the guide wire, the suitable DHS screw was driven in, and a sleeve plate attached and screwed to the lateral cortex of the femoral shaft. C-arm fluoroscopy confirmed fracture reduction and good internal fixation position. After repeated flushing, we placed drainage and sutured the incision.

Statistical analysis

The demographic characteristics of the patients were evaluated using descriptive statistics. Data that did not show normal distribution were presented as median with interquartile range, except for age which was presented as median with minimum and maximum. Data that followed a normal distribution were expressed as mean ± standard deviation. The $\chi 2$ test was used to compare differences between categorical variables. The independent two sided Student t- test was used for continuous variables with normal distribution. The nonparametric Mann-U-Whitney test was used in cases without normal distribution. Statistical significance was set at $p<0.05$.

RESULTS

Out of 61 patients included in the study, 30 were in the DHS group and 31 in the PFNA group. There were 16 males and 45 females (p=0.510). The mean age of the patients was 78.5 (54-88) and 73 (38-90) years in the DHS and gamma nail group, respectively. Patients in the DHS group were older than patients in the PFNA group (p=0.087) (Table1).

The patients in the DHS group had similar time to surgical intervention as patients in the PFNA group (p=0.521). The duration of postoperative hospitalisation was similar in both groups (p=0.643) (Table 1).

The patients in the gamma nail group received more RBC transfusions than the patients in the

Table 1. Baseline characteristics of the patients, length of pre- and postoperative hospitalisation, number of red blood cell transfusions, and fracture type across the groups

Variables	DHS (30)	PFNA (31)	p
Gender (No)			
Males	9	7	0.510
Females	21	24	
Median age (minimum-maximum) (years)	78.5 (54-88)	73 (38-90)	0.087
Median preoperative hospital stay (range) (days)	5 (3.5-6.5)	5(3.5-6.5)	0.521
Median postoperative hospital stay (range) (days)	6 (5-7)	6 (5-7)	0.643
Blood transfusion No (%)			
No	20 (32.8 %)	14 (22.9)	0.091
Yes	10 (16.4%)	17 (27.8)	
Fracture type (AO/OTA) (No)			
31.A1	13	14	0.886
31.A2	17	17	

DHS, dynamic hip screw; PFNA, proximal femoral nail antirotation; AO/OTA, Arbeitsgemeinschaft für Osteosynthesefragen/Orthopaedic Trauma Association classification (11)

DHS group (27.8% vs. 16.4 (p=0.091) (Table 1).

There were no significant differences in fracture type distribution according to the AO/OTA classification between the DHS and PFNA group (p=0.886) (Table 1).

There were no statistically significant differences in preoperative haemoglobin levels between the groups (p=0.091). The median values of haemoglobin levels on the first postoperative day were lower in the PFNA compared to the DHS group, at 96.71±3.93) g/L and 102±16.47) g/L, respectively, but without significant difference (p=0.180) (Table 2).

Haematocrit values did not differ statistically significantly between the groups preoperatively (p=0.070). On the first postoperative day haematocrit values were 0.31 (±0.047) L/L in the DHS group and 0.30 (±0.041) L/L in the PFNA group. The differences in haematocrit value were not statistically significant between the groups postoperatively (p=0.225) (Table 2).

Table 2: Differences in median values of pre- and postoperative haemoglobin level and haematocrit values between the groups

Variables	Fixation method	Mean (±SD)	p
Haemoglobin (g/L)			
Preoperatively	DHS	127.40 (±15.45)	0.091
	PFNA	120.35 (±16.53)	
Postoperatively	DHS	102 (±16.47)	0.180
	PFNA	96.71 (±3.93)	
Haematocrit (L/L)			
Preoperatively	DHS	0.39 (±0.041)	0.070
	PFNA	0.37 (±0,045)	
Postoperatively	DHS	0.31 (±0.047)	0.225
	PFNA	0.30 (±0.041)	

DHS, dynamic hip screw; PFNA, proximal femoral nail antirotation

DISCUSSION

The demographic characteristics of the patients in this study are similar to other studies. Proximal femur fractures mostly occur in patients above the age of 70 years. The prevalence of this injury is 2–3 times higher in females than in males (13). The median age of the patients in our study population was 75 years, and there were 16 males and 45 females.

In the retrospective study by Tian et al., which also compared PFNA and DHS, less intraoperative blood loss was found in the PFNA group compared to the DHS group with a significant difference (14). In our study, postoperative haemoglobin and haematocrit values were lower in the PFNA group compared to the DHS group but without a statistically significant difference.

The prospective study by Carulli et al. found higher estimated blood loss and longer hospital stay in the DHS group compared to the PFNA group, with significant differences. The mean number of postoperative blood bags administered was not significantly different between the groups (15). No significant difference between the DHS and PFNA groups in the number of postoperative RBC transfusions and the length of postoperative hospital stay was found in our study. Different results between the studies could be explained by differences in the surgical technique. In our patients, reaming was done prior to insertion of a cephalic screw, which could have led to more blood loss in comparison with the study by Carulli et al. (15), where helicoidal blade was used, and which was introduced mostly by impaction.

Moreover, in a study by Kumar et al., which compared screw and helical proximal femoral nail (PFN), mean blood loss was not significant in either of the study groups but it was significantly lesser in the helical PFN group as compared to the screw PFN group (16).

Fu et al. (17) reported that there were no significant differences between the groups in intraoperative blood loss and blood replacement in a study which compared the dynamic hip screw with the trochanter-stabilising plate (TSP) and PFNA; they noted a lower postoperative decrease in haemoglobin in the DHS+TSP group despite the fact that it was a more invasive procedure. These findings are similar to our results where a lower postoperative haemoglobin decrease was also noted in the DHS group.

However, in a study by Ronga et al. (10) lower blood loss was observed in the DHS group compared to the gamma nail group: they hypothesised that higher blood loss in the Gamma nail group, among several other factors, such as the damage to the gluteus medius, peritrochanteric blood vessels and displacing the bone fragments through the approach and reaming, may be caused by distal locking which could damage the perforating vessels. In a retrospective study by Lazetti et al., which compared locked and unlocked intramedullary nails, a low incidence of a decrease in haemoglobin was found in the unlocked group, probably due to the fact that the distal screw is positioned in the proximity of the perforating branches and an accidental lesion during drilling can cause abundant postoperative bleeding (18).

A meta-analysis of 24 studies, which compared five surgical methods by blood loss and operation time, observed the lowest amount of blood loss in the DHS group in comparison to the PFNA group. Unlike in our study they also observed lower blood loss when gamma nail was used compared to the DHS, but according to the amount of blood loss gamma nail was ranked third after PFNA and percutaneous compression plate (PCCP) (19). The results of a Bayesian network meta-analysis based on 36 randomised controlled trials showed that, compared with the compression hip screw and DHS group, PFNA exhibited a beneficial role in reducing the blood loss (20).

A limitation of our study is its retrospective design. Although the absolute difference in number of blood transfusions was not significantly different between the groups, the value of 11.4% is quite noticeable, and the small sample size may have led to this nonsignificant difference. The lower postoperative haemoglobin levels, which were noted in the PFNA group, were not significantly different from the DHS group, but this nonsignificance may also be due to the small number of patients. A larger number of patients and methods of calculating blood volume and blood loss, such as Nadler`s and Gross` formulas (21,22), are required to compare the differences in intraoperative blood loss between the groups more precisely. A longer follow-up is needed to compare clinical outcomes and evaluate clinical significance.

In conclusion, our results show that blood loss, the need for blood transfusion and hospital stay were similar in the two groups. Both DHS and PFNA implants are safe surgical techniques for the treatment of trochanteric fractures.

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TRANSPARENCY DECLARATION

Competing interests: None to declare.

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