Acta Orthop. Belg., 2017, **83**, 351-359

ORIGINAL STUDY

External fixation versus hemiartroplasty in unstable intertrochanteric hip fractures of the elderly

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To compare two alternative methods : external fixation (EF) and hemiarthroplasty (HA) in elderly patients with unstable intertrochanteric hip fractures.
Forty-two patients with Orthopaedic Trauma Association type 31A2-2 or 31A2-3 fractures treated between January 2007 and December 2010 were included. Twenty-two patients underwent hemiarthroplasty and twenty patients underwent external fixation.
The mean length of stay in the operation room was 45 minutes and 108 minutes in the EF and HA groups, respectively ($p<0.05$). The mean postoperative length of hospital stay was 2.7 days in **the EF group and 4.9 days** in **the HA group ($p<0.05$). The total length of hospital stay, functional scores and mortality rates were not different.**
Findings of the current study comparing EF and HA in a limited number of non-randomized elderly patients with unstable intertrochanteric fracture indicated that the EF method, when performed in a sufficiently stable manner, might be a valuable alternative to HA since it is less aggressive and cheaper.

Keywords : Hip fractures ; external fixation ; hemiarthroplasty

INTRODUCTION

The average life expectancy has increased in the last decades with improvements in healthcare, resulting in a substantial rise in the incidence of intertrochanteric fractures of the elderly *(28,31)*. Thus, hip fractures have become a common public health problem in many countries with high mortality and morbidity rates in the elderly *(32)*. With a few exceptions, the current treatment for intertrochanteric hip fractures includes intramedullary nailing or dynamic hip screw *(23)*. Stable intertrochanteric fractures can be successfully treated by osteosynthesis. However, unstable fractures might get complicated with excessive collapse, reduction loss, cut-out of the lag screw etc. *(14)*. Therefore, arthroplasty, used as a salvage procedure in failed cases, is recommended by some surgeons for unstable osteoporotic intertrochanteric fractures in the elderly so as to avoid these complications and allow early postoperative weight-bearing *(7, 10, 12, 33)*.

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No benefits or funds were received in support of this study.
The authors report no conflict of interests.

A significant number of elderly with intertrochanteric hip fractures are rather frail and present a high surgical risk *(15)*. Commonly used surgical procedures for such patients must be contraindicated since the prolongation of operation time and intraoperative blood loss cannot be tolerated well by these patients *(14)*. Since the external fixation method is minimally invasive and causes less tissue damage than the other procedures, the morbidity and mortality risk of frail patients with intertrochanteric hip fractures can be decreased by this method. A shorter operation time and less blood loss are advantages of external fixation *(14, 31)*. Another advantage of this method is that it can be used under local anaesthesia in patients who may not tolerate general or spinal anaesthesia *(14, 31)*. After a sufficiently stable fixation of an intertrochanteric fracture via external fixation, early weight bearing is achieved, and the risk of fixation failure is reduced *(2, 3, 14, 31)*.

In the recent decades, there have been comparative studies of different treatment methods, such as dynamic hip screws versus external fixation, or arthroplasty versus internal fixation *(17, 22, 24, 27, 31)*. External fixation, however, is known to be a less aggressive and cheaper method than arthroplasty, there is no study comparing these two methods used in the treatment of intertrochanteric hip fractures. The objective of this study was to compare the results of arthroplasty and the external fixation method applied to similar types of intertrochanteric hip fractures classified as AO/OTA 31 A2-2, A2-3.

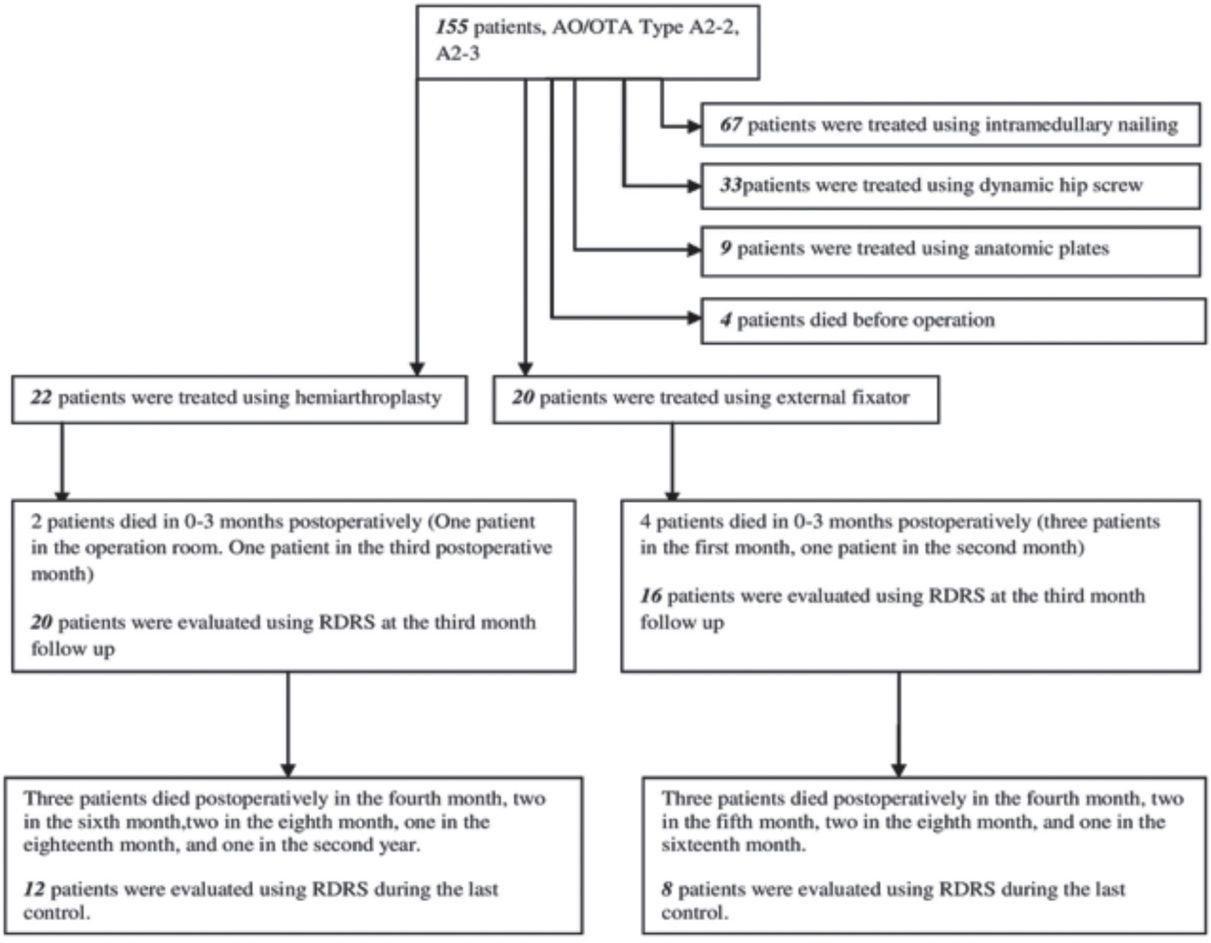

Fig. 1. — Patients inclusion flowchart.

PATIENTS AND METHODS

Intertrochanteric hip fractures of elderly patients classified as AO/OTA 31 A2-2, A2-3 and treated by hemiarthroplasty or external fixation between January 2007 and December 2010 were included in the study. There were 155 patients with this type of fracture hospitalized to our hospital in this period. 22 patients were treated with hemiarthroplasty while 20 patients were treated with external fixation. The method of including patients was described in Figure 1. This study was carried out at a Teaching and Training Hospital, and the treatment method was decided by the clinical council. For the high-risk patients who could not tolerate blood loss and long operation time, the external fixation method was preferred. On the other hand, for those with a relatively lower risk, hemiarthroplasty was considered as an alternative treatment method by taking early full weight bearing into consideration.

HA was performed using an anterolateral skin incision in the supine position. A cemented calcar-replacement femoral stem with bipolar head was used (THP, Hipokrat, Izmir, Turkey) (Fig. 2). Five-mm-diameter ordinary schanz pins were used for the external fixation. Three pins were placed at an angle of approximately 135° through the neck of the femur, and two pins were placed on the femoral shaft. (Fig. 3)

Low molecular weight heparin (LMWH) was used for thromboembolism prophylaxis. Compression stockings or elastic bandages were applied. On the first postoperative day, patients were seated on bed or at the bedside. On the second postoperative day, patients were encouraged to walk. Full weight bearing was allowed in the HA group. In the EF group, partial weight bearing was encouraged according to the patient's tolerance. After radiographic evaluation performed at the first month to see whether there was no cut out or penetration of screws, full weight bearing was allowed. External fixators were removed in the 10^{th} to 12^{th} weeks in outpatient clinic.

After the patients were discharged, family members carried out the wound care and the rehabilitation at home. In January 2012, all patients were invited for the last follow-up visit. Rapid Disability Rating Scale (RDRS) *(15)* was used to assess functional outcomes in the third month and last follow-up. However, the patients dying before the third month follow-up visit could not have been evaluated functionally. RDRS has sixteen parameters (with scores ranging from one to three points) designed to estimate the status of function and cognition, and it is evaluated in four levels ; namely, excellent (16-24 points), good (25-32 points), medium (33-40 points), and poor (41-48 points). The demographic data, comorbid

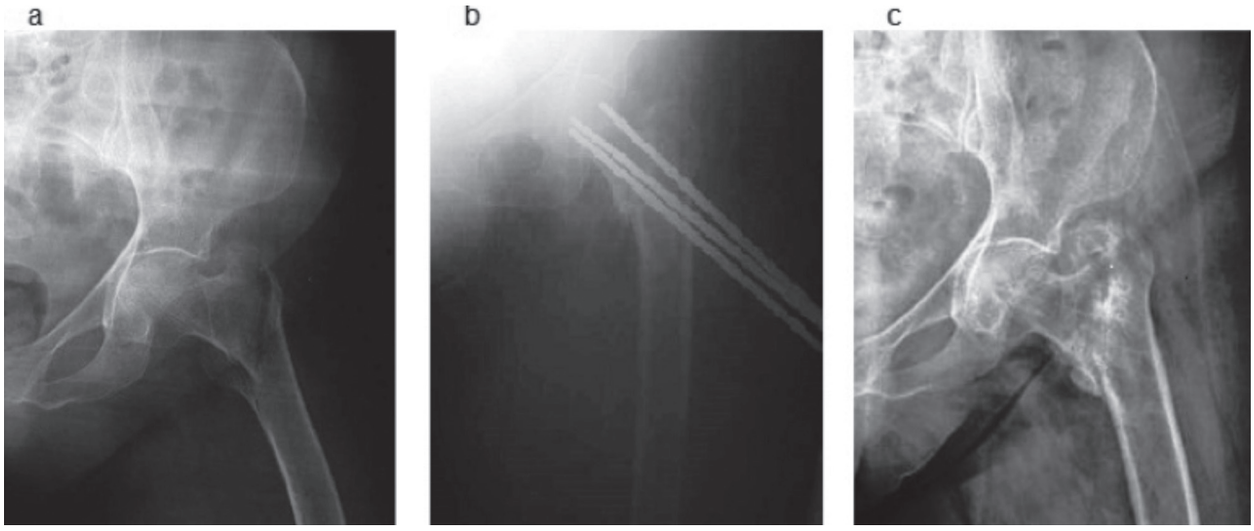

Fig. 2. — Radiographic images of an 82-year-old female treated using external fixator
(a) preoperative, (b) postoperative, (c) after removal of fixator.

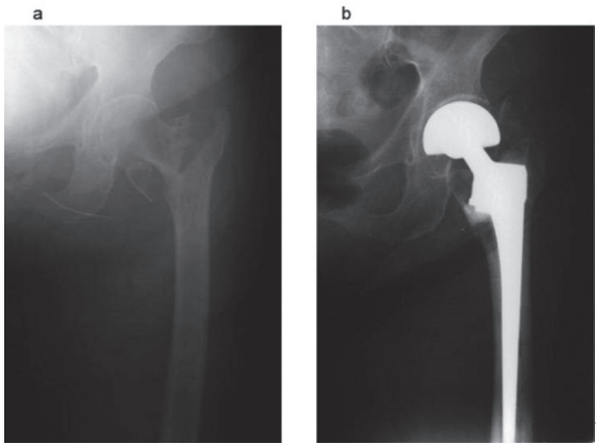

Fig. 3. — Radiographic images of an 86-year-old female treated using partial bipolar calcar replacement endoprosthesis (a) preoperative, (b) postoperative

mean standard deviation was used in normally distributed variables, and a median value was used for non-normally distributed variables. When the data was normally distributed, differences between the two groups in terms of preoperative length of stay and postoperative length of hospitalization, time between injury and discharge, duration in operation room, and RDRS were evaluated using the t-test , and in the case of non-normally distributed data, the Mann-Whitney U test was used . When the expected count was>5, ASA score, anaesthesia type and mortality were compared using Pearson's Chi-square, or when the expected count was ≤5, Fisher's exact test was used. A p-value of <0.05 was considered to be statistically significant.

RESULTS

The mean age was 80.6 ± 6.4 years (72–95) and 82.8 ± 5.6 years (74-97) in the HA and EF groups, respectively. There were 11 males and 11 females in the HA group, and there were 10 males and 10 females in the EF group. In the EF and HA groups, respectively, 95% and 90% of the patients had at least one comorbid disease (Table 1).

Although some of the patients were operated within 1 or 2 days following hospital admission, the mean time between injury and operation was respectively 8.5 (2-18) days and 7 (1-18) days in the EF and HA groups. Both groups had a median ASA score of three. There were fourteen ASA 3 patients and six ASA 4 patients in the EF group, and eighteen ASA 3 and four ASA 4 patients in the HA group. Regional anaesthesia was administered to 12 of 20 patients in the EF group and to 12 of 22 patients in the HA group. General anaesthesia was administered to 8 of 20 patients in the EF group and to 10 of 22 patients in the HA group. There was no difference between the groups in terms of the mean time from injury to operation, ASA scores and anaesthesia methods.

The average length of stay in the operating room was 45 minutes (range : 40-55 minutes) and 108 minutes (range : 95-125 minutes) in the EF and HA

Table I. — Distribution of the comorbid diseases

Comorbid disease	EFgroup	HAgroup
Hypertension	15	12
Diabetes mellitus	3	4
Heart diseases (MI, CAD, arrhythmia, heart failure, pulmonary hypertension, and abdominal aortic aneurysms)	9	7
Neurological diseases (Alzheimer's, CVD, epilepsy, and Parkinson's)	7	6
Pulmonary diseases (COPD, emphysema, bronchitis, and a previous history of TB)	6	5
Urologic diseases (BPH and UTI)	2	5
Nephrologicaldisease (CRF and ARF)	-	1 (CRF)

MI, myocardial infarction; CAD, coronary artery disease; CVD, cerebrovascular disease; COPD, chronic obstructive pulmonary disease; TB, tuberculosis; BPH, benign prostate hyperplasia; UTI, urinary tract infection; CRF, chronic renal failure; ARF, acute renal failure.

Table II. — Mortality rates of the study groups

	EF group mortality (n=20)	*HA group mortality (n=22)*	*p*
Thirdmonth	4	2	0.40
Sixth month	9	7	0.38
First year	11	9	0.36

EF, external fixation ; HA, hemiarthroplasty.

groups, respectively. This was significantly shorter in the EF group ($p < 0.001$). The average postoperative length of hospital stay was 2.7 days (range : 1-8 days) and 4.9 days (range : 2–19 days) in the EF and HA groups, respectively. There was a statistically significant difference between the groups in terms of the postoperative length of stay ($p = 0.008$). Patients in the EF group were discharged from the hospital earlier than those in the HA group. The mean time between injury and discharge from hospital was respectively 11.2 (3-25) days and 11.8 (5-21) days in the EF and HA groups. The mean follow-up period was 16.5 months (range : 1–48 months) and 15 months (range : 1–36 months) in the EF and HA groups, respectively.

Patients were evaluated in terms of hospitalization in intensive care unit and post anesthesia care unit (PACU). There were eleven patients in the EF group hospitalized in these units. Two had a long hospitalization. One of these two was hospitalized for 5 days preoperatively and 4 days postoperatively. The other was hospitalized for 4 days preoperatively and 11 days postoperatively in intensive care unit. One of these 11 patients was hospitalized for two days postoperatively. The remaining eight patients were hospitalized for 1 day in PACU. On the other hand, there were thirteen patients in the HA group hospitalized in PACU and intensive care unit. Nine were hospitalized for 1 day in PACU. One was hospitalized for 3 days preoperatively and two days postoperatively, and two for 2 days postoperatively and one for 5 days postoperatively in intensive care unit. In the EF group, gastrointestinal bleeding was observed in one patient preoperatively, and this patient died within the first postoperative month. Two patients in the EF group died within the first month due to pulmonary embolism. One patient from the HA group died in the operation room. One-year mortality rate was 11/20 and 9/22 in the EF and HA groups, respectively. There was no difference in terms of mortality (Table 2).

All fractures were healed in the EF group. One screw had migrated to the acetabulum when fixator was removed. Varus deformity was observed in 1 patient, and there was no reduction loss in the rest of the patients. Superficial pin tract infections occurred in 8 of 20 patients. One of these eight patients underwent early external fixator removal in the second month, because of deep infection. This patient was healed without requiring another operation. Other infections were treated using dressing and antibiotics.

In the HA group, there were no periprosthetic fractures or prosthesis dislocation. One patient had gastrointestinal bleeding during hospitalization and it was treated conservatively. In the HA group, a symptomatic deep vein thrombosis was observed in one patient, and it was medically treated. In the third month follow-up visit, there were 20 and 16 patients, and in the last follow-up visit 12 and 8 patients alive in the HA and EF groups, respectively. The results of functional evaluation were not different for the third month and last follow-up visit (Table 3).

DISCUSSION

Hip fractures are more commonly seen in the elderly. In developed countries, the average age of people with hip fracture is approximately 80 years *(24)*. Athough significant improvements in surgery and rehabilitation have occurred recently, proximal femoral fractures are still a health problem constituting an important portion of today's orthopaedic trauma surgery cases, especially in countries where the elderly population is increasing day by day (*28*).

Table III. — Comparison of RDRS in the third month and the last follow-up control.

		n	RDRS mean	Excellent	Good	Medium	Poor	p
Third month follow-up	EF	16	31.9 ±9.4(17-47)	3	5	4	4	0.79
	HA	20	32.7 ±8.9(16-46)	2	8	6	4	
Last follow-up	EF	8	27.6±7.6(16-41)	2	5	0	1	0.82
	HA	12	28.8 ±6.6(17-44)	1	7	2	2	

RDRS, Rapid Disability Rating Score ; EF, external fixation ; HA, hemiarthroplasty.

While deciding the treatment method for intertrochanteric fractures, the patient's age, general condition, comorbid diseases, bone quality, and fracture type should be taken into consideration (*6*). Early mobility and immediate achievement of former functional level should be the priority. Patients hospitalized for hip fractures are often frail and medically prone to comorbid conditions. Osteosynthesis through the utilization of intramedullary nailing systems or dynamic hip screws are the preferred treatment methods *(24)*. However, hemiarthroplasty and external fixation are considered to be more useful alternatives than the conventional fixation in some of these patients.

Although pin tract infection is the most frequently encountered problem after external fixation ; biological fracture healing, no bleeding, short operative time, and reduced surgery stress are the prominent advantages of this method (*22, 25, 30*). In a previous study, the mechanical complication rate for external fixation was reported to be less than that of the sliding hip screw and proximal femoral nailing (*31*).

Arthroplasty has been used especially to treat intertrochanteric fractures complicated with insufficient internal fixation. Successful results have been reported in the treatment with arthroplasty having become the primary treatment method in selected patients particularly in those with high-grade osteoporotic and unstable trochanteric fractures (*10, 33*). If full weight bearing is desired, arthroplasty may be preferred to osteosynthesis which may result in implant failure due to high-grade osteoporosis *(7, 8)*.

Approximately 80% of hip fractures were observed in the female sex *(24)*. However, in the present study, the male-female ratio was 50% in each group. Since the patients included in the study had only unstable fractures and were divided into two groups according to the clinical council treatment selection, this ratio did not represent all hip fractures treated in our hospital.

Surgery should be performed as soon as the patient's medical condition is suitable, if the appropriate staff and facilities are available *(25)*. In the present study, the lengths of the periods were estimated starting from the injury time, and a significant number of the patients were referred from district hospitals after some period of hospitalization. In addition, some patients were hospitalized in intensive care unit to stabilize their medical condition, and our anaesthesiology department demands optimal medical stabilization before operating these patients. Therefore, the mean length of preoperative time between injury and discharge from hospital was longer than reported in the literature. In this study, the mean length of the preoperative period was 8.5 days and 7 days in the EF and HA groups, respectively. The mean time between injury and discharge from hospital was 11.2 days and 11.8 days in the EF and HA groups, respectively. Although, in the EF group, the mean postoperative length of hospital stay was shorter than in the HA group, the mean time between injury and discharge did not differ between the two groups. However, there are some studies reporting various findings about the preoperative period. For instance, Zuckerman *et al*. *(34)* reports that,

if surgery is performed after 48 hours, mortality increases within the first year postoperatively. Also in a retrospective study carried out on 406 patients, Kenzora *et al*. *(15)* reports that patients undergoing surgery within the first 24 hours had a first-year mortality rate of 34%, whereas those undergoing surgery within the second, third, fourth, and the fifth day of injury had a rate of 6%, 4.8%, 5.5%, and 11%, respectively. They explain these findings were resulted from the deteriorating balance in the body during the early stage of injury. Vossinakis *et al*. *(31)* used external fixation for intertrochanteric fractures, and their mean total hospitalization time was 8 days. Ozdemir *et al*. *(25)* also used external fixation, and their mean total hospitalization time was 10 days.

In this study, most of the patients had at least one accompanying disease (the EF group : 95%, the HA group : 90%). Additionally, the most common comorbidities in our patients were hypertension and heart diseases. Haentjens *et al*. *(9)* report comorbid diseases at a rate of 80%. Similarly, Akcali *et al*. *(1)* report comorbidities at a rate of 78%. It is clear that mortality rates increase in line with the increase in the number of comorbid diseases *(15, 20)*. Roche *et al*. *(29)* report that regardless of the surgical treatment selected, pneumonia and heart failure, in particular, cause significantly high rates of mortality. They also report that the most common comorbid disease was cardiovascular in nature. Cornwall *et al*. *(4)* report that the independent predictor of mortality is the patient's functional status before the hip fracture. ASA is a system for assessing the fitness of cases preoperatively. The anaesthesiologist provided the scores preoperatively. Although in the current study there were more patients with an ASA score of four in the EF group, there was no difference in terms of ASA scores. Given that there was no data about the patients' preoperative functional status due to the retrospective nature of the study, the mortality risk evaluation may be interpreted as poor. RDRS is used to assess the level of patient disability, especially in the elderly. RDRS results of survivors did not differ from each other in the third month and last follow-up visit.

Pulmonary embolism, pneumonia, deep vein thrombosis, urinary tract infection, decubitus ulcers affect the prognosis adversely and increase mortality *(6,7)*. Some studies have reported that the first-year mortality is not affected by the selected surgical procedure *(15, 16)*. In the present study, there was no difference in the first-year mortality rate between the EF and HA groups. Many studies have reported first-year mortality rates at about 24-45% (*5, 11, 13, 19, 21, 24, 26)*. In addition, mortality rates decrease to a level similar to that of a normal age group after 1 year following the surgery for a hip fracture *(21)*. The higher first-year mortality rate in the present study (11/20 in the EF group and 9/22 in the HA group) may result from two major factors : one is the selection of high-risk patients by the council, and the other is the preoperative delay resulting from district hospitals or optimal medical stabilization period for surgery.

In the present study, similar types of intertrochanteric hip fractures were treated by using two different methods in accordance to the decision of the clinical council. As a result, there were no difference in terms of functional results, mortality rates and other parameters with the exception of duration in operating room. When examined from the viewpoint of certain aspects, EF might be a valuable alternative method instead of hemiarthroplasty. Firstly, most of these elderly patients are defined as "high risk". The operation time of EF is shorter than that of HA. Therefore, EF is more preferrable as it is a closed reduction method reducing surgery stress and blood loss. Secondly, EF is cheaper than HA, and it can be removed after fracture healing. Moreover, it has no risk of dislocation, periprosthetic fracture, prosthesis infection and revision. However, pin tract infection and the necessity of a sufficiently stable fracture fixation in the EF method should be taken into account. The weight bearing seems to be a disadvantage of EF, and this was the basis of clinical council's deliberation in choosing the HA method. Nevertheless, functional results and mortality did not differ from each other in the present study. In order to compare these two methods, prospective and randomized future studies must be designed.

There were more than two limitations in the study. Since the study was not randomized and the clinical council had no clear predefined selection

criteria, heterogeneity became an issue and direct comparisons of these treatment groups became more difficult. Moreover, the small number of patients and the high mortality rate were also issues in terms of functional evaluation of early and last control follow up visits. In addition, the lack of a control group treated by using conventional intra- or extramedullary devices was a major limitation.

CONCLUSIONS

Findings of the current study comparing EF and HA in a limited number of non-randomized elderly patients with unstable intertrochanteric fracture indicated that the EF method, when performed in a sufficiently stable manner, might be a valuable alternative to HA since it is less aggressive and cheaper. EF might be beneficial for frail patients with fractures that are sufficiently stable to be treated with osteosynthesis. On the other hand, since, in current study, a comparison was not performed with more standard treatments, the position of EF compared to the internal fixation remained unclear.

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