External Fixation vs. Skeletal Traction for Treatment of Intertrochanteric Fractures in the Elderly

Gholam Hossein Kazemian,[1] Mohammad Emami,[1] Alireza Manafi,[1] Farideh Najafi,[1,*] and Mohammad Amin Najafi[2]

[1]Department of Orthopedic Surgery, Imam Hossein Hospital, Shahid Beheshti University of Medical Sciences, Tehran, IR Iran
[2]Medical Student Research Center, Isfahan University of Medical Sciences, Isfahan, IR Iran

Corresponding author: Farideh Najafi, Department of Orthopedic Surgery, Imam Hossein Hospital, Shahid Beheshti University of Medical Sciences, Tehran, IR Iran. Tel: + 98-9123055582, Fax: +98-3136273910, E-mail: faridehnajafi1@gmail.com

Background: Hip fractures are one of the causes of disability amongst elderly patients. External fixator and skeletal traction are two modes of treatment.

Objectives: The aim of this study is to compare two different treatment modes for intertrochanteric fractures in elderly patients.

Patients and Methods: Sixty elderly patients with intertrochanteric fractures were randomized for treatment with either skeletal traction (Group A) or an external fixation (Group B). In this study patients at least 60 years of age, with AO/OTA A1 or A2 type fracture and intertrochanteric fracture as a result of minor trauma, were enrolled.

Results: Acceptable reduction was achieved in eight and 26 patients of group A and B, respectively. The mean duration of hospitalization in Group A and Group B was 14.3 ± 1.1 and 2.2 ± 0.6 days, respectively. Significant differences between the two groups were observed, regarding acceptable reduction and duration of hospitalization. Less pain was observed in group B, at five days and twelve months after surgery; the average HHS was 57 and 66, in group A and B, respectively (P > 0.05).

Conclusions: Treatment with an external fixator is an effective treatment modality for intertrochanteric fractures in elderly high-risk patients. The advantages include rapid and simple application, insignificant blood loss, less radiation exposure, adequate fixation, pain reduction, early discharge from the hospital, low cost and more favorable functional outcome.

Keywords: External Fixators; Hip Fractures; Traction

1. Background

Hip fractures are one of the causes of disability amongst elderly patients. Compression hip screw, fixed angle blade plate, intramedullary nailing and external fixator are several methods of management of intertrochanteric fractures (1).

External fixation was introduced for the management of intertrochanteric fractures, in the 1950's (2). At first, many studies reported the use of this method, yet high prevalences of complications such as infection, loosening of pin and failure of the external fixator caused the discontinuation of this method (2). Hydroxyapatite-coated external fixators encouraged surgeons to reconsider this method as a suitable option for the treatment of high-risk elderly patients (3-5).

2. Objectives

The aim of this randomized study was to compare the use of skeletal traction and external fixator for treatment of osteoporotic intertrochanteric fracture patients.

3. Patients and Methods

The study design was approved by the ethics commit-tee, Between June 2011 and August 2012. There were 60 patients, 21 (35%) men and 39 (65%) women, with an average age of 78 years (range 61-98 years).

The inclusion criteria were an age above 60, an AO/OTA A1 or A2 type fracture from low energy trauma. Exclusion criteria included reverse obliquity fractures, previous hip fracture, pathological fractures, infection at the fracture site and open or multiple fractures. All of our patients had comorbidities such as heart failure, coronary artery disease, hypertension, renal failure, malignancy, thyroid disease, anemia or pulmonary disease (Table 1).

Table 1. Comorbidities in the Patients of Our Study

Concomitant Disease	No. (%)
Heart failure/Coronary artery disease	34 (56)
Hypertension	45 (75)
Renal disease	10 (16)
Thyroid disease	7 (11)
Anemia	36 (60)
Pulmonary disease	28 (46)
Malignancy	3 (5)

Patients were informed about the objectives and randomization process of the study and consents were filled out by each patient. The patients were randomized by a computer-generated list to be treated either by skeletal traction (group A; n = 30) or external fixation secured with four pins (Synthes, Switzerland) (group B; n = 30). In group A, 11 patients had an A1 type and 19 patients had an A2 type fracture. In group B, 13 patients had an A1 and 17 patients had an A2 type fracture. Initially no significant difference in fracture type was observed between the two groups in this double blind study.

3.1. Surgical Technique

Preoperatively and then every eight hours, cephalosporin (1 g intravenously) was administered for the first postoperative day.

In the skeletal traction group, a 5-mm pin was inserted from lateral, 2.5 cm posterior and 2.5 cm distal to tibial tubercle under local anesthesia and traction of 10% of body weight was applied (6).

In the external fixator group, patients received local anesthesia. With the patient in a supine position on an operating table, hanging their leg from the table from the proximal tibia, (Figure 1), reduction of fracture was approved under C-Arm in antroposterior (AP) and frog leg view.

Translation of less than five millimeters and a difference in neck shaft angle of less than 15 degrees in comparison with the other leg were considered as a sufficient reduction on the anteroposterior view. In the lateral plane, less than 20 degrees of angulation was acceptable (7).

Next, two pins were inserted into the femoral head (numbers 1 and 2) and two pins into the proximal femoral shaft (numbers 3 and 4) (Figure 2). The pins implanted into the femoral head were parallel or slightly convergent (8). Pins 1 and 2 were inserted 5 mm below the articular surface of the femoral head (9), and pins 3 and 4 were inserted two screw threads beyond the opposite cortex (Figure 3).

### 3.2. Postoperative Management

Mean time under traction was 42 days for patients in Group A. For the first 14 days they were kept at hospital. When the hip pain was reduced they were discharged to have skeletal traction at home for the remaining 28 days, when the proximal tibial pin was removed in an outpatient department. After the appearance of clinical and radiological signs of fracture union, weight-bearing was allowed. Group B patients were mobilized on the first day after surgery and sat on their bed, and on the second postoperative day, patients were asked to walk without weight-bearing. On average 73 days after surgery, the external fixator was removed without hospitalization under local anesthesia after confirmation of radiological imaging about fracture union (range 69-77 days) (10), and at this point full weight-bearing was allowed. When the

Figure 1. Position of Patient for Fracture Reduction Before Applying the External Fixator
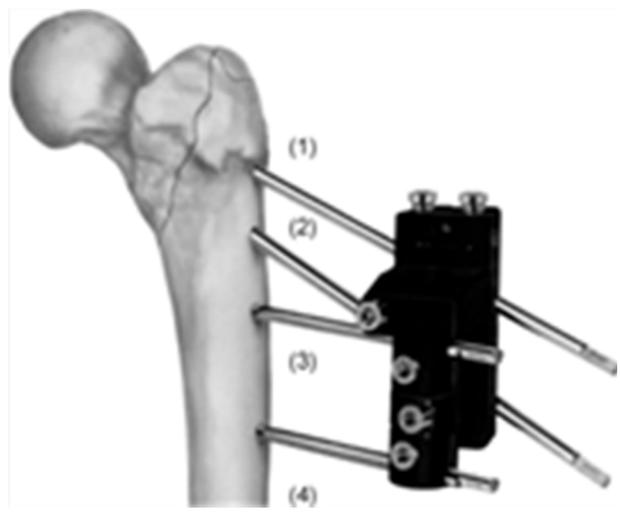
Figure 2. Pin Position in the External Fixator
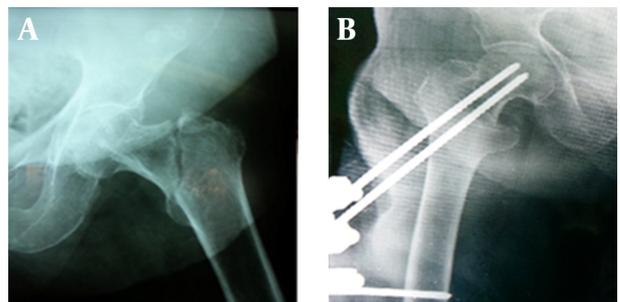
Figure 3. A) Anteroposterior View of an Intertrochanteric Fracture in an 81-Year-Old Man, B) Anteroposterior View Following Fixation of the Fracture With the Fixator

fixators were removed, pin tract classification was done on a scale of 0 to 5, according to the system of Dhal (11). Pin entry sites were cleaned with saline solution every two days. Low molecular weight heparin (enoxaparin

40 mg/0.4 mL, daily) (12) was also administered in both groups for 28 days, for deep vein thrombosis prevention. Follow-up visits were scheduled at 14, 45, 90, 180 and 360 days after surgery and X-rays were performed during each follow up. Radiographic union was defined by observation of bridging trabeculae or periosteal callus within the fracture line (10). Patient data also included pre-fracture and postoperative ability to walk independently, number of blood transfusions, postoperative complications, degree of pain assessed by a visual analog scale (VAS) on the third postoperative day and during hospitalization. Clinical outcomes were evaluated with the Harris hip score (HHS) (13), 12 months after surgery.

3.3. Statistical Analysis

The Pearson chi-square test and the t-test were performed to investigate the grouping variables. For all tests, P < 0.05 was considered significant. Statistical analysis was carried out with the SPSS v. 21.

4. Results

The average age of the skeletal traction group and external fixator group was 82 years (range 63-98 years) and 77 years (range 61-96 years), respectively. In both groups blood loss during operation was minimal and postoperative and preoperative hemoglobin levels were similar. No blood transfusion was required. The average intraoperative time was 15 minutes in patients treated by an external fixator. During the 12-month follow-up period, 13 patients (8 patients in group A and 5 in group B) died because of unrelated reasons to the fracture (P > 0.05). All fractures healed uneventfully in both groups. For fractures with extension to the subtrochanteric area and with comminution of the medial cortex, more time to heal was required. Decrease in the range of motion of hip or knee was observed in nine patients (33%) of group A and three patients (10%) of group B (P > 0.05). In patients of group A, eight fractures (36.36%) that were

all AO type A1 were acceptably reduced whereas 14 fractures (63.63%) were reduced with valgus angulation or translation. In group B patients, 26 fractures (86.66%) were acceptably reduced and four fractures (13.33%) were reduced with valgus angulation or translation. This difference was statistically significant (P < 0.05). In one patient of group B, the reduction was lost because of cutout and varus collapse, as indicated by comparisons with the radiographs taken immediately after surgery. The fixator was well accepted in group B patients and sitting or lying was not difficult for any of the subjects. The average VAS score was 5.7 (range 2-9) for group A and 5.3 for group B (range 3-9) (P > 0.05), the average Harris Hip Score was 57 (range 47-88) for group A and 66 (range 41-90) for group B after the 12 months follow up, showing no statistically significant difference between the two groups (P > 0.05). Length of hospitalization was between 10 and 16 days (mean 14.3 days) in group A and 2.2 days (range 1-4 days) in group B patients, showing a statistically significant difference between groups A and B (P < 0.05), (Table 2). Pin tract complications developed in group B patients; 21 patients (70%) had grade 1 infection (only marginal inflammation treated with frequent pin care) and 9 patients (30%) had grade 2 infection (serous discharge of pin site; all treated with frequent pin care plus oral antibiotics (13)). No sign of osteolysis was observed around the Schanz pins. Nine patients (30%) in group A and four patients (13%) in group B developed bedsores (P > 0.05). Postoperative complications included pneumonia in four patients (6.6%), urinary tract infection in five patients (8.3%), and deep venous thrombosis in four patients (6.6%); the difference between the two groups was not statistically significant.

5. Discussion

Fifty to sixty percent of intertrochanteric fractures are unstable (7, 14) and several methods have been introduced for fixation of these fractures. External fixation was first described by Scott (2) for the treatment of these

Table 2. Postoperative Results of Patients Treated by External Fixator vs. Skeletal Traction [a,b]

	Group A (Skeletal Traction)	Group B (External Fixator)	P value
Death from unrelated causes	8 (26)	5 (16)	P > 0.05
Limitation of hip or knee motion	9 (30)	3 (10)	P > 0.05
Acceptable reduction	8 (26)	26 (86)	P < 0.05
VAS	5.7 ± 1.4	5.3 ± 1.1	P > 0.05
HHS	57	66	P > 0.05
Bed sore	9 (30)	4 (13)	P > 0.05
Independent walking	6 (20)	12 (40)	P > 0.05
Duration of hospitalization	14.3 ± 1.1	2.2 ± 0.6	P < 0.05

[a] Abbreviations: HHS, Harris hip score; VAS, visual analog scale.
[b] Data are presented as mean ± SD or No. (%).

fractures. Since then, studies have been done on this type of treatment, but results were not conclusive (2, 15, 16). However, in recent articles, intertrochanteric fractures treated with developed external fixators showed better results (4, 17-19). All these studies reported on the benefits of external fixation such as simple application, insignificant blood loss, less radiation exposure, pain lessening, satisfactory stability and early mobilization. Intertrochanteric external fixators have been mainly used in elderly high-risk patients (15, 16, 20) and in multiple trauma patients (21, 22). Our results are in accordance with the aforementioned studies. Limitations of hip or knee joint motion, and bed sores were lower in group B patients. The visual analog scale and Harris hip score were higher for patients treated by an external fixator, although no statistically significant difference from group A patients was found. On the other hand, a statistically significant difference was found in acceptable reduction and duration of hospitalization between the two groups; with group B having more acceptable reduction, earlier discharge and less costs than group A. The present study confirms the advantages of external fixation for management of intertrochanteric fractures in elderly, high-risk patients. In agreement with previous studies, the mean intraoperative time for application of the fixator was about 0.2 times less than other methods, such as compression hip screw and intramedullary nailing (23-25). No blood transfusion was required (24, 26). These advantages are of high importance for these patients. These benefits have not been found with other less invasive methods (26). Another advantage of external fixation was the possibility of application under local anesthesia for patients with poor general health (15, 22). There was no need for a fracture table to achieve acceptable reduction in the external fixator group and reduction was accomplished only by hanging the proximal tibia off the operating table instead of consuming time for setting up the fracture table. The external fixator offers additional advantages, leading to minimal radiation exposure (Vekris et al. (8) found similar results). An additional advantage of the external fixator is less postoperative pain according to patient reports. As a result, the probability of resuming the former level of activity is higher. Although functional results were slightly better in the external fixator group, it was not significantly different between the two groups, and the mean HHS was low in both groups. In accordance to the study by Vossinakis and Badras (19), nine of our patients had grade 2 pin tract infection (serous discharge of pin site) and were all treated with frequent pin care plus oral antibiotics (11). However, pin-tract infection did not occur in the study by Moroni et al. (5). We think that better results of their study were attributed to the application of hydroxyapatite-coated pins, as revealed by bone ingrowth in histological sections. Varus collapse and shortening are the result

of mechanical failure of fixation of unstable or severely osteoporotic intertrochanteric fractures. Even though most of the fractures in our study were osteoporotic, low mechanical failure was noticed in the group treated with the external fixator compared to the skeletal traction group and the difference was statistically significant. Badras et al. (20) reported a significantly lower incidence of proximal screw penetration into the joint with the external fixator compared with the dynamic hip screw. In these cases, as indicated by Vekris et al. (8), retraction of the screw without the need for anesthesia can be performed. In our cases we did not have any migration in the proximal screw, and we only had one cut out from the superior cortex. That was a reverse oblique type of intertrochanteric fracture and due to the poor condition of the patient it was treated conservatively. Difficulty in assessment of fracture-healing is a potential disadvantage of external fixation. Using improved diagnostic tools or application of radiolucent fixators may help solve this problem. In addition, a fixator with compression and distraction capacity at the site of fracture may accelerate fracture healing (4). The optimum study design of this randomized clinical trial restricted the possibility of confounding clinical variables. However, non-blinded assessments of the radiographic variables as well as evaluation of the pin tracts are potential reasons for bias. In conclusion, our study suggests the use of external fixation as an option for the treatment of pertrochanteric fractures in elderly high-risk patients. It is applicable under local anesthesia and does not need any fracture table and with this method radiation exposure is minimal, operative time is short, blood loss is negligible, reduction is acceptable and stable, limitation of hip/knee motion is not appreciable, bed sore rate is low, duration of hospitalization is short, costs are low and functional outcomes are favorable.

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Authors' Contributions

Study concept and design: Farideh Najafi and Gholam Hossein Kazemian; acquisition of data: Gholam Hossein Kazemian, Alireza Manafi and Farideh Najafi; analysis and interpretation of data: Farideh Najafi and Mohmmad Amin Najafi; drafting of the manuscript: Farideh Najafi and Mohammad Amin Najafi; critical revision of the manuscript for important intellectual content: Gholam Hossein Kazemian, Alireza Manafi and Farideh Najafi; statistical analysis: Mohammad Amin Najafi and Farideh Najafi; administrative, technical and material support: Gholam Hossein Kazemian, Mohammad Emami, Alireza Manafi and Farideh Najafi; study supervision: Gholam Hossein Kazemian and Alireza Manafi.

References

1. Lindskog DM, Baumgaertner MR. Unstable intertrochanteric hip fractures in the elderly. *J Am Acad Orthop Surg.* 2004;**12**(3):179–90.
2. Scott IH. Treatment of intertrochanteric fractures by skeletal pinning and external fixation. *Clin Orthop.* 1957;**10**:326–34.
3. Magyar G, Toksvig-Larsen S, Moroni A. Hydroxyapatite coating of threaded pins enhances fixation. *J Bone Joint Surg Br.* 1997;**79**(3):487–9.
4. Moroni A, Faldini C, Pegreffi F, Hoang-Kim A, Vannini F, Giannini S. Dynamic hip screw compared with external fixation for treatment of osteoporotic pertrochanteric fractures. A prospective, randomized study. *J Bone Joint Surg Am.* 2005;**87**(4):753–9.
5. Moroni A, Heikkila J, Magyar G, Toksvig-Larsen S, Giannini S. Fixation strength and pin tract infection of hydroxyapatite-coated tapered pins. *Clin Orthop Relat Res.* 2001;(388):209–17.
6. Wang JQ, Hu L, Su YG, Zhao CP, Wang BB, Zhong XD, et al. [Primary clinical application of traction reductor for lower limb fracture]. *Zhonghua Wai Ke Za Zhi.* 2010;**48**(18):1425–9.
7. Baumgaertner MR, Curtin SL, Lindskog DM, Keggi JM. The value of the tip-apex distance in predicting failure of fixation of peritrochanteric fractures of the hip. *J Bone Joint Surg Am.* 1995;**77**(7):1058–64.
8. Vekris MD, Lykissas MG, Manoudis G, Mavrodontidis AN, Papageorgiou CD, Korompilias AV, et al. Proximal screws placement in intertrochanteric fractures treated with external fixation: comparison of two different techniques. *J Orthop Surg Res.* 2011;**6**:48.
9. *The Orthofix Pertrochanteric Fixator. Operative technique.* Italy: Orthofix; 1998.
10. Parker MJ. Cutting-out of the dynamic hip screw related to its position. *J Bone Joint Surg Br.* 1992;**74**(4):625.
11. Dahl MT, Gulli B, Berg T. Complications of limb lengthening. A learning curve. *Clin Orthop Relat Res.* 1994;(301):10–8.
12. Hamidi V, Ringerike T, Hagen G, Reikvam A, Klemp M. New anticoagulants as thromboprophylaxis after total hip or knee replacement. *Int J Technol Assess Health Care.* 2013;**29**(3):234–43.
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**(4):737–55.
14. Cole PA, Bhandari M. What's new in orthopaedic trauma. *J Bone Joint Surg Am.* 2006;**88**(11):2545–61.
15. Gotfried Y, Frish E, Mendes DG, Roffman M. Intertrochanteric fractures in high risk geriatric patients treated by external fixation. *Orthopedics.* 1985;**8**(6):769–74.
16. Kamble KT, Murthy BS, Pal V, Ráo KS. External fixation in unstable intertrochanteric fractures of femur. *Injury.* 1996;**27**(2):139–42.
17. Christodoulou NA, Sdrenias CV. External fixation of select intertrochanteric fractures with single hip screw. *Clin Orthop Relat Res.* 2000;(381):204–11.
18. Vossinakis IC, Badras LS. Management of pertrochanteric fractures in high-risk patients with an external fixation. *Int Orthop.* 2001;**25**(4):219–22.
19. Vossinakis IC, Badras LS. The external fixator compared with the sliding hip screw for pertrochanteric fractures of the femur. *J Bone Joint Surg Br.* 2002;**84**(1):23–9.
20. Badras L, Skretas E, Vayanos ED. The use of external fixation in the treatment of trochanteric fractures. *Rev Chir Orthop .* 1997;**83**:461–5.
21. Buckley JR, Caiach SM. External fixation in comminuted upper femoral fractures. *Injury.* 1993;**24**(7):476–8.
22. Dhal A, Singh SS. Biological fixation of subtrochanteric fractures by external fixation. *Injury.* 1996;**27**(10):723–31.
23. Bridle SH, Patel AD, Bircher M, Calvert PT. Fixation of intertrochanteric fractures of the femur. A randomised prospective comparison of the gamma nail and the dynamic hip screw. *J Bone Joint Surg Br.* 1991;**73**(2):330–4.
24. Grosse A, Taglalang G. *Gamma locking nail: surgical technique.* London: Howmedica; 1992.
25. Friedman BA. An analysis of surgical blood use in United States hospitals with application to the maximum surgical blood order schedule. *Transfusion.* 1979;**19**(3):268–78.
26. Adams CI, Robinson CM, Court-Brown CM, McQueen MM. Prospective Randomized Controlled Trial of an Intramedullary Nail Versus Dynamic Screw and Plate for Intertrochanteric Fractures of the Femur. *Journal of Orthopaedic Trauma.* 2001;**15**(6):394–400.