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Management of Pertrochanteric Fractures in Elderly High-Risk Patients with an External Fixation

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Abstract

Background: *Pertrochanteric femur fractures are common in older people. In high-risk patients, especially American Society of Anesthesiologists (ASA) scores 3 and 4, surgery with internal fixation can cause excessive stresses. Fixation of these fractures using multiple Schanz screws (External Fixator) under local anaesthesia without exposure offer adequate stability permitting early ambulation with least risk from medical problems. Therefore, external fixation is a viable option for treating these high risk patients.*

Objective: *The aim of this study was to analyze the results and complications of external fixation of "pertrochanteric" fractures in high-risk geriatric patients with high unacceptable operative risk to withstand conventional osteosynthesis.*

Materials and Methods: *In 60 surgical high-risk patients (ASA grade 3 or 4) pertrochanteric fractures admitted in our hospital (January 2014-November 2015), were treated with an external fixation performed under local anesthesia. There were 26 men and 34 women. Mean age was 76.09 (70–91) years. Epidemiological and radiological data and also complications were recorded at each follow-up and final follow up was done at one year.*

Results: *The average operative time (and SD) was 32.22 ± 5.9 minutes. Hospital stay was short, with an average of 4.2 ± 1.04 days, thus reducing the total cost. No intraoperative complications were encountered. Blood loss was negligible and none of the patients received any blood transfusion. All fractures healed within 18 weeks. The mean time for union was 12.5 ± 1.24 weeks. Complications encountered were superficial pin-tract infection in 18 patients (30%) and deep pin-tract infection in three patients (5%). In 25 (41.66%) patients the fracture united with a shortening of 15 mm or more. Four patients (6.66%) had implant failure (2 pin migration and 2 pin cut-out) and were treated by revision fixation without any complication. Limitation of knee movements were recorded in only two (4%) patients at 12 months. The lower extremity measure score based on daily activities, walking capacity and pain showed no significant difference between the preinjury and the final functional score at 12 months ($p > 0.05$).*

Conclusion: *External fixation of pertrochanteric fractures is an effective, safe and reliable treatment method. It offers minimal operative and anaesthetic risk, no blood loss, short hospital stay, early mobilization and low morbidity and mortality.*

Keywords: *elderly, external fixation, pertrochanteric fracture, local anesthesia, high-risk, osteoporosis.*

Introduction

Pertrochanteric femur fractures are common in older people. Advancing technology and treatment modalities have increased the life expectancies, so the incidence of these fractures is increasing [43]. Furthermore, with existing osteoporosis, bone fractures happen more easily with low intensity trauma. [14, 33, 35] Goals of treatment remains union in a good position with restoration of patient to his / her pre-operative status as early as possible with low morbidity and mortality [26]. The sliding hip screw has been the treatment of choice for

trochanteric hip fractures [22, 39].Nevertheless, the functional results are sometimes unsatisfactory because of failure of fracture reduction, fixation or re-establishment of acceptable hip biomechanics [27, 39, 47, 52]. Geriatric patients with these fractures usually have medical and surgical problems which make them unfit for prolonged anaesthesia and can cause excessive stress. External fixation performed under sedation and local anesthesia offers significant advantages in these patients in the form of minimal blood loss, minimal surgical trauma, minimal radiation exposure, preservation of fracture hematoma, a shorter hospital stay and early ambulation as compared to patients treated conservatively [32, 44, 49]. Varus collapse and shortening are the result of mechanical failure of fixation of unstable or severely osteoporotic intertrochanteric fractures. Badras et al.[3] reported a significantly lower incidence of proximal screw penetration into the joint with the external fixator compared with the dynamic hip screw. In addition,a fixator with compression and distraction capacity at the site of fracture may accelerate fracture healing [39].

External fixation was introduced for the management of trochanteric fractures at about the same time as the first sliding internal fixation devices [46] however, it was initially abandoned because of the high rate of postoperative complications[8,12,13,21,28,]. Improved materials and techniques have decreased these postoperative complications and hence better result [9, 34, 40, 50, 51]. The development of new external fixators and the improvement in the management of complications have encouraged many surgeons to reconsider its use in high-risk elderly patients as a possible treatment option.[37,39,41] Some studies comparing external fixation to sliding hip screws have reported superior outcomes in favor of external fixation. [4,28,39,50] The aim of this study was to assess the postoperative complications and the clinical results after a follow-up of 12 months, using external fixation for pertrochanteric fractures in elderly high-risk patients.

Materials and Methods

Between January 2014 and November 2015, 60 high risk patients patients with pertrochanteric fractures admitted to our department were classified by the anaesthetist as ASA grade 3 (38 patients) or 4 (22 patients) and considered unsuitable for conventional fracture fixation under anesthesia due to associated medical/surgical problems.[17, 45] The medical conditions causing these patients to be considered high risk are shown in Table 1. The mean age was76.09±1.4 years, range 70-91. The male to female ratio was 26:34 and 60% fractures were present on left side. These patients were treated with external fixation under local anesthesia. The fractures were classified as stable or unstable according to the modified Evans classification[18,19]. Unstable reverse oblique fractures were not taken up in the study. The fractures were further classified according to the AO classification system using antero- posterior and lateral radiographs, 25 patients had an AO type A1 fracture and 35 patients had an AO type A2 fracture. All fractures were a result of simple fall (low energy).

The inclusion criteria were age above 65 years, more than one comorbidity (diabetes mellitus, neurological disease, heart failure, coronary disease, respiratory disease or anemia with Hb less than 8 gm/l).

Exclusion criteria included reverse obliquity fractures, grossly unstable fractures, previous hip fracture, pathological fractures, infection at the fracture site, open or multiple fractures, body weight above 80 kg and bone or joint disease that could interfere with rehabilitation. Patients who presented after one week were also excluded. The data recorded for all patients included intraoperative time, duration of hospitalization, need for blood transfusion, visual analog scale (VAS) on the second postoperative day, pin track infection, union time, malunion, varus angulation, shortning, implant failure and range of motion of the hip and knee. The Foster rating system [20] and Lower Extremity Measure [25] modified by Boretto et al [7], based on daily activities,

walking capacity, and pain was used to evaluate the pre-injury and the postoperative functional status at 12 months. In addition we evaluated final clinical outcome with Harris hip score [23]. The Mann-Whitney U test, a non-parametric test, was used for statistical analysis of the difference between the pre-injury and the final functional status. For all tests, $P < 0.05$ was considered significant.

Technique

The patient was placed on a fracture table and a closed reduction of the fracture was performed under image intensification and acceptable reduction in both AP and Lateral view was confirmed. The reduction was considered to be anatomical if the neck-shaft angle was reproduced and the gap at the fracture site was less than 2 mm in both anteroposterior and lateral views. 1% lidocaine was infiltrated at proposed sites of pin insertion. Two 4.5 mm cancellous Schanz screws were passed across the fracture site percutaneously along the axis of the neck of femur at an angle of 130° (approximately) with the shaft using a hand drill. Both pins were parallel or slightly convergent in AP view and central in lateral view. The superior pin was passed just above the center of the neck and head, and the inferior pin was passed along the inferior part of the neck and head. Pins were advanced to a point 5 mm short of the subchondral bone of the head. Two 4.5mm cortical Schanz screws were inserted into the femoral diaphysis with threads beyond the opposite cortex as checked under fluoroscopy and pins were connected through universal clamp and tubular connecting rod. The patients were given first-generation cephalosporins intravenously for 24 hours postoperatively as antibiotic prophylaxis and discharged from the hospital on 2^{nd} or 3^{rd} day depending on tolerance to pain and confidence of standing.

After surgery patients were assisted in sitting, knee bending and quadriceps exercise from the second day of surgery and and partial weight-bearing with a walker was encouraged. Full weight bearing was allowed at 10-14 weeks after adequate clinical and radiological signs of fracture union were seen. Pin sites were dressed daily with saline and the families of the patients were given instructions for continuing care after discharge. Outpatient visits were arranged every two weeks till union. Fixator was removed at 12-16 weeks after surgery without anesthesia (mean 92 days). Final follow-up was at 12 months for clinical and radiological evaluation.

Summary of Results

The average age at operation was 76.09±1.4 years (range 70-91). Mean operative time was 32.22±5.9 minutes. No intraoperative complications were encountered. Injury to surgery mean interval was 2.63 ±
1.76 days. Blood loss was minimal (20–30 mL) and none of the patients required blood transfusion. Average (mean) hospital stay was 4.2 ± 1.04days (range 3 to 7 days)

VAS on 2^{nd} post operative day was was 5.7 (range 3-9)

None of the fracture failed to unite. Average (mean) time of union was 12.5 ± 1.24 weeks (range10 to
18 weeks). Nature and incidence of postoperative complications is summarized in Table2. No complications occurred in 22 patients. The remaining 38 patients had some complications after surgery we encountered implant failure in four patients (6.66%) (2 pin migration and 2 pin cut-out). There were three cases of pin loosening. Twenty five patients (41.66%) had limb shortening of 15 mm or more due to some impaction (16%) and/or collapse in varus (84%) that occurred in some unstable fractures. Shortning because of impaction without varus was present in 4(16%) patients. Among 21 patients who developed varus angulation 12 developed 10°, 6 developed 20° and 3 developed 30° angulation approximately. Eighteen patients (30%) developed superficial pin tract infection, out of which 12 (66.66%) patients had grade 1

infection (only marginal inflammation treated with frequent pin care) and
6 patients (33.33%) had grade 2 infection (serous discharge of pin site; all treated with frequent pin care plus oral antibiotics). Signs of osteolysis or osteomyelitis was observed around the Schanz pins in three cases. Eight of 21(38%) patients with pin tract infections had varus malunion and shortening after union. Ten patients died during follow-up due to medical causes unrelated to the surgical procedure, six during the first 6 months and 4 during the last 6 month. Eight of the ten patients who were lost to final follow up were ASA grade 4. So only 50 patients were available for final assessment and scoring at
12 months. However, none of the patients was lost prior to union.
Most of the 50 surviving patients returned to their prefracture ambulatory status at one year. Walking ability was normal in 22(44%) patients while 24(48%) patients used stick to go out. Only four patients who used a stick preoperatively had to use a walker at the last follow-up. Initial knee stiffness noticed at the time of removal of fixator was present in 26(43.33%) but eventually only two (4%) patients persisted with loss of knee flexion by 20° at 12 months. At the final follow up (50 patients) HHS score was 68 (range; 46-90), 30 patients were pain free, 10 had slight pain 6 pain with fatigue while 4 had tolerable pain. Final results were excellent in 27(54%) patients based on lower extremity measure score (Table 3). There was no significant difference between the preinjury and the final functional score ($p > 0.05$). Excellent results in functional grading and anatomical grading were obtained in Foster rating system in 44% and 65% patients respectively. The present study confirms the advantages of external fixation for management of pertrochanteric fractures in elderly, high-risk patients.

Table 1 Pre-injury health status of the patients

Comorbidity	**Number of patients(%)**
Heart failure	16 (26.6%)
Coronary disease	18 (30%)
Hypertension	26 (43.33%)
Renal disease	7 (11.66%)
Respiratory disease	12 (20%)
Diabetes mellitus	15 (25%)
Neurological disease	10 (16.66%)
Anaemia	23 (38.33%)
Malignancy	3 (5%)
Total patients/comorbidity	**60/120**

Table 2 Nature and incidence of postoperative complications

Complications	**Number of patients (%)**
None	22 (36.66)
Superficial pin-tract infection	18 (30)
Deep pin-tract infection 7	3 (5)
Varus malunion	21 (35)
Pin loosening	3 (5)
Shortening	25 (41.66)
Death	10 (16.66)
Migration	2 (3.33)
Cut out	2 (3.33)
Bed sore	4 (6.66)
Total 60	Total 38 patients with complications
Multiple complications were present in some patients Only 50 livepatients evaluated for final scoring at 12 months	

Table 3 Lower Extremity Measure Score

Score	No. Of Patients (initial)	No. Of Patients (12 months)	P value
100 Excellent function	32	27	
85-99 Very good function	13	10	
55-84 Good function	9	5	
26-54 Fair function	4	5	
25Poor function	1	3	
Total patients	60	50	>0.05(NS)

Table 4 Functional and anatomical results (Foster rating system)

Functional grading		**Anatomical grading**	
Grade	Frequency**(50)** (%)	Grade	Frequency**(60)** (%)
Excellent: Walks as well as before the operation No limp or pain	22 (44)	Excellent: Union in perfect position	39 (65)
Good: Walks well, uses stick to go out	24 (48)	Good: With less than 10° of varus and minimal shortening)	12 (20)
Fair: Requires stick, considerable limp or pain	4 (8)	Fair: With 10–25° of varus, and half an inch to one inch of shortening	6 (10)
Poor: Bedridden or confined to chair	0	Poor: Severe malunion, varus deformity of 25° or more, or over an inch of shortening	3 (5)

Pintract Infection

Limited knee flexion 12 months

Fixator pins head and shaft of femur

Photograph of patient with fixator

Loosning femur pins (deep pin tract infection)

Preop. AP X ray (patient XXX)

Fixator in place (patient XXX)

Union at removal of fixator (patient XXX)

Discussion

Given the high mortality and morbidity rates of pertrochantric fractures [10,24], especially in older people, there are always concerns about surgical treatment options. Furthermore, osteoporosis causes mechanical complications such as shortening, collapse, and pin penetration increasing the concerns about the stability of fixation methods. Because they have superior mechanical properties and less mechanical complications in compared to external fixation.[38] The gold standard treatments of pertrochanteric fractures have been DHS/DCS fixation systems or proximal femoral intramedullary nails [6, 36]. Elderly patients with significant comorbidities and high anaesthetic risk, who sustain trochanteric fractures, are a big challenge to treat. Similarly conservative methods are associated with complications like thromboembolism, bed sores, pneumonia etc[21,33]. Because of prolonged recumbency which has a high mortality rate external fixation is a viable option which requires minimal invasion, shorter operating time, less blood loss, less pain, less hospitalization and early ambulation and hence reduced morbidity and mortality in high risk geriatric patients [28, 30, 40, 50 51]. Tomak et al.[48] argued to operate elderly high risk patients in the shortest time, with the least blood loss and using low-risk anaesthetic procedures, the perfect fracture reduction being of secondary importance Main complicationin using external fixator for pertrochantric fracture are pin

traction infection, varus deformity in grossly unstable fractures and knee stiffness. Pin tract infection is an important complication because of the high postoperative incidence [15, 42]. However, treatment is relatively easy, especially after pin removal. In our study, Pin tract infection was seen in 21 patients but this was reduced in most patients with regular saline washes, antiseptic dressing, and finally with the removal of pins at 12 to 18 weeks. Moroni and colleagues XX [38, 39] did not encounter any superficial infections on using hydroxyapatite-coated pins and although we did not use these pins in our study, we strongly believe that their use would considerably improve the outcome and reduce the risk of pin-tract infection.

Other complications noted in our study included deep pin-tract infection in 3(5%) of cases, with subsequent loosening of at least one pin in these of patients. These were managed successfully with daily dressings and oral antibiotics. Cases of deep infection that required pin removal or repositioning have been reported [16, 21, 28]. The mean operative time in the present study was 32.22 ± 5.97 min, which was similar to that recorded by Kazakos et al. [31], Boghdady et al. [5] and Vossinakis and Badras [50] The mean hospitalization time in our study was 4.2 ± 1.04 days, which is shorter than the average time recorded in published studies (6–8 days) [29, 31, 39, 48, 50]. The short average time between hospital admission and operative fixation in this study (2.63 ± 1.76 days). Together with the short operative time and early postoperative mobilization, all contributed towards early hospital discharge, faster recover, reduced morbidity and mortality and considerable decrease in the overall cost of treatment. The short intraoperative time, the short hospitalisation and the absence of need for peroperative blood transfusion were in accordance with previous studies[1,2,8,9,12,13,28,30,34,44,50,51].All fractures showed union, with an average union time of 12.5 ± 1. 24 weeks, which is consistent with the published average range (11–14 weeks) [12,13, 28,39, 40, 50].

Another well-described problem associated with external fixation in the femur is postoperative knee stiffness caused by fixation of the facia lata and vastus lateralis by the distal pins [4, 13, 28]. No permanent knee stiffness was reported at 12 months except in two, which is in agreement with recent studies concerning modern external fixation devices(9,50). The incidence of knee stiffness was less in our study, possibly due to more proximal placement of femoral shaft Schanz pins and flexion of the knee before this was performed. The range of motion of hip was normal at final follow-up in our series. Shortening because of collapse and varisation of the femoral neck is a well-recognized complication of both internal and external fixation in unstable fractures or in the presence of severe osteoporosi[11,13, 36]. Varus angulation was seen in 21 of 54 patients which led to shortening. Varisation and impaction are mechanical complications commonly reported after either internal or external fixation of unstable or severely osteoporotic intertrohanteric fractures.

The mortality rate was 10% at 6 months and 16.6% at 12 months which is comparatively lower than previous literature who reported a mortality rate of 14 to 27%, at 6 months [1 9,34 ,50, 51], even higher mortality rates were reported after open reduction and internal fixation [36], although these series were not limited to high risk patients. Functional outcome at one year in most of our patients was good to excellent, as was seen in various other studies.

Conclusion

The best treatment for trochanteric fracture in geriatric patients with the associated medical and surgical problem is controversial but external fixator might be the possible solution for those patients who are at high risk for open surgery due to anaesthetic risks and blood loss. The technique is simple, safe and reliable, economical and effective. Moreover, the surgical stress for the patient was minimal and antibiotic administration was very rare. This procedure

causes less blood loss and complications associated with prolonged recumbency and open reduction and internal fixation are avoided Postoperative pain was minimal and easily controllable, making the nursing and mobilizing of the patients easier. External fixation offers minimal operative and anaesthetic risks, no blood loss, early mobilization and a short hospital stay, with low morbidity and mortality. It can be done under local anaesthesia, and yields equivalent union rates and final functional outcome.

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