External fixator for trochanteric fractures in elderly high-risk patients
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Background
High-risk geriatric patients with ‘intertrochanteric’ fractures are difficult candidates for open reduction and internal fixation because of restricted availability of modern anaesthetic techniques. The aim of this study was to analyse the results of external fixation of ‘intertrochanteric’ fractures in high-risk geriatric patients as a safer alternative to open internal fixation.

Patients and methods
Thirty patients of an average age of 65.9 years were treated by external fixation for their intertrochanteric fractures. Patients in the study had Evans stable intertrochanteric fractures and unstable fractures that could be reduced to an anatomical or nearly anatomical position by closed manipulation under fluoroscopy. The average follow-up period was 24 months (range 12–40 months).

Results
There were no mortality cases in the early postoperative period, but the number of mortality cases within 6 months after surgery was seven patients (23.3%); three patients missed follow-up and 20 patients completed the follow-up. Sound fracture healing was achieved in all patients. The final result was satisfactory in 90% of patients (40% excellent and 50% good), fair in 5% of patients and poor in another 5% of patients.

Conclusion
Treatment of intertrochanteric fractures by external fixation is a simple noninvasive procedure and can be performed under local anaesthesia together with narcotic analgesic support. It allows early mobilization, and implant removal is easy. Therefore, treatment of intertrochanteric fractures by external fixation is a practical solution in high-risk geriatric patients.

Keywords:
elderly high-risk patients, external fixator, trochanteric fractures

Introduction
Increased life longevity has led to a marked increase in the number of elderly osteoporotic patients with intertrochanteric fractures of the femur. A geriatric patient is susceptible to a number of medical problems such as diabetes, stroke, hypertension, cardiac problems, respiratory ailments and others. The additional trauma of fracture of the major weight-bearing bone plus subsequent treatment by either conservative methods or surgery along with anaesthesia-related complications further increases the mortality and morbidity rates to a significant extent. Because of the dangers of prolonged recumbency, the role of the conservative method is negligible except in terminally ill or nonambulatory patients [1]. Surgical treatment has improved considerably in recent years with the advent of newer fixation devices and better understanding of the mechanics of fracture healing of the osteoporotic bone [2]. However, the goal of treatment remains early mobilization and restoration of patients to their preoperative status as early as possible with the lowest possible morbidity and mortality and with least cost to the patient and the hospital. External fixation carried out under local anaesthesia offers significant advantages in the form of minimal surgical trauma, negligible blood loss, preservation of fracture haematoma, early ambulation for the patient, easy daycare, shorter hospital stay and removal of implants through a simple outpatient procedure [3,4]. This procedure is especially useful for elderly patients who are unfit or for high-risk patients in cases of a major surgical procedure involving internal fixation under general anaesthesia if regional anaesthesia is not possible. Keeping these factors in mind our aim was to analyse the results of this simple and cost-effective procedure in the management of intertrochanteric fractures in high-risk geriatric patients, to mobilize these patients in the hospital as early as possible and rehabilitate them to their preinjury status or as close as possible to it.

Patients and methods
Thirty patients, 18 women and 12 men, with intertrochanteric fractures of the femur were treated by...
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EXTERNAL FIXATOR FOR TROCHANTERIC FRACTURES IN ELDERLY PATIENTS

External fixation between 2003 and 2008 in Benha University Hospitals and Insurance Hospitals.

Fifteen patients had right and 15 had left intertrochanteric fractures.

The mean age of the patients was 65.9 (range between 47 and 90) years. Patients included in the study were elderly with intertrochanteric fracture of the femur who could not be considered for major surgery (open reduction and internal fixation) under anesthesia either because of their being unfit or because of being a high-risk case for major surgery and/or anesthesia as a result of associated medical/surgical problems.

General physical examination and necessary investigations were carried out in all cases to assess their cardiorespiratory, renal and metabolic status. Their preinjury ambulatory status and ability to manage activities of daily living were also recorded Table 1. We did not classify the fractures into stable or unstable groups as the decision to operate was based on the general condition of the patient and not on the type of fracture.

In our study we used different types of external fixators, as shown in Table 2.

Operative technique

The shortest and safest anaesthetic technique was preferred. We used a cocktail of an intramuscular injection of a sedative (5–10 mg diazepam) and a painkiller (50 mg tramadol) 45 min before surgery. Just before surgery 1% xylocaine was injected at the proposed site of pin insertion. With the patient supine on the fracture table the fracture was reduced by gentle traction and abduction in moderate external rotation, followed by gentle internal rotation. The reduction was checked by anteroposterior and lateral X-rays or by image intensifier. Two or three 5.5 mm cancellous Schanz screws were passed in a parallel manner across the fracture site up to the subchondral bone in the femoral head.

Once the fracture site was stabilized by the trochanteric pins, the knee was flexed to 90° and traction was shifted from the foot piece to the tibia; this was followed by insertion of three to four 4.5 mm cortical Schanz screws at right angles into the shaft fragment. All Schanz screws were inserted manually. The clamps and rod were fixed to the pins. Final radiographs were taken and minor adjustments were made at this time. On the first postoperative day patients were assisted in sitting, turning on the bed, knee bending and quadriceps and breathing exercises. By the next day the patients was encouraged to stand and ambulate with the help of a walking aid such as a walker or a pair of crutches. The patients were trained in proper dressing of pin sites, which they had to do daily, and were discharged from the hospital after they were confident of standing and walking with support. Patients with comminuted fractures or whose general condition was not conducive were discharged with a wheelchair. The patients were advised to undertake partial weight bearing activities depending on their tolerance to pain, and full weight bearing was allowed after adequate clinical and radiological signs of fracture union.

Results

The mean follow-up period was 24 months (12–40 months). There were no mortality cases in the early postoperative period. The number of mortality cases 6 months after surgery was seven patients (23.3%).

Twenty of the 30 surviving patients were evaluated clinically and radiographically and three patients were missed during follow-up.

We assessed the results according to Judet’s point system for grading disability (Tables 3 and 4).

Two patients could walk with crutches (one patient was in the same condition before the fracture), 10 could walk with a single crutch (six patients were in the same condition before the fracture) and eight could walk without any support at the last check-up. Fifteen of 20 patients (75%) regained their previous walking ability.

Malunion was detected in three patients (15%). Shortening greater than 2 cm was noted in these patients at the latest follow-up. Regarding knee range of motion, all patients had limited flexion in the postoperative period; however, recovery was seen during follow-up. At the final evaluation, the mean range of motion of the knee was 98° (range, 70–120°). Three patients (15%) had less than 90° range of motion in their knees.

Pin-tract infection was observed in 10 patients (50%). The patients who had grade I (soft tissue inflammation) and grade II (soft tissue infection) pin-tract infections were treated with wound dressing and antibiotic medication. None of the cases developed osteomyelitis. No material failures occurred.
Table 3 Judet's point system for grading disability

<table>
<thead>
<tr>
<th>Pain observation</th>
<th>Grade</th>
<th>Range of motion observation</th>
<th>Grade (%)</th>
<th>Ability to walk observation</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe pain at rest</td>
<td>1</td>
<td>0 (limb in poor position)</td>
<td>1</td>
<td>Bedridden</td>
<td>1</td>
</tr>
<tr>
<td>Severe pain on walking</td>
<td>2</td>
<td>0 (limb in good position)</td>
<td>2</td>
<td>Walking is very limited with or without a cane</td>
<td>2</td>
</tr>
<tr>
<td>Pain tolerable</td>
<td>3</td>
<td>0–70</td>
<td>3</td>
<td>Walking is limited with one cane</td>
<td>3</td>
</tr>
<tr>
<td>Pain with fatigue</td>
<td>4</td>
<td>70–140</td>
<td>4</td>
<td>Long distance with one cane</td>
<td>4</td>
</tr>
<tr>
<td>Slight pain</td>
<td>5</td>
<td>140–200</td>
<td>5</td>
<td>No cane but limp</td>
<td>5</td>
</tr>
<tr>
<td>No pain</td>
<td>6</td>
<td>200–300</td>
<td>6</td>
<td>Normal</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 4 Judet's terminology for rating

Summation of Judet's point | Rating
---|---
8 or less | Bad
9–11 | Fair
12–15 | Good
16 or more | Excellent

Table 5 Assessment of patients

| Patients available for final assessment | 20 patients |
| Hospital stay (mean) | 3 days (range 2–5 days) |
| Surgery time (mean) | 30 min (range 25–40 min) |
| Time of union (mean) | 14 weeks |
| Pain scale at final follow-up | |
| No pain | 6 patients |
| Slight pain | 8 patients |
| Pain with fatigue | 4 patients |
| Tolerable pain | 2 patients |
| Range of knee motion at final follow-up | |
| Normal | 6 patients |
| 90–120 | 11 patients |
| <90 | 3 patients |
| Walking ability at final follow-up | |
| Normal | 6 patients |
| No cane but limp | 2 patients |
| Long distance with one cane | 4 patients |
| Walking limited with a cane | 6 patients |
| Walking very limited with two canes | 2 patients |
| Final results | |
| Excellent | 8 patients (40%) |
| Good | 10 patients (50%) |
| Fair | 1 patient (5%) |
| Poor | 1 patient (5%) |
| Complications | |
| Varus angulation | 2 patients |
| Shortening | 3 patients |
| Pin-tract infection (superficial) | 10 patients |
| Metal failure | 1 |

One patient (5%) had a fair result because of varus deformity and shortening of 2.5 cm and knee stiffness less than 90°. One patient had a poor result because of a septic loosening and removal of the fixator at 6 weeks; the patient continued on traction until union at 4 months.

Our results are summarized in Table 5, Figs 1–4.

Discussion

The most efficient conservative treatment for trochanteric fractures is the modified Hamilton Russell traction. It requires that the patient be hospitalized for at least 2–3 months, and complications such as pneumonia, bed sores, urinary tract infection and so on may be seen. [5]. Open reduction and internal fixation of trochanteric fractures is the routine procedure, but in patients at risk with accompanying pathology, such as ischaemic cardiac disease, chronic obstructive pulmonary disease, diabetes mellitus, or severe anaemia, there is a high risk of anaesthetic or postoperative complications [5–7].

Treatment goals for these patients with intertrochanteric fractures include restoration of anatomic alignment, maintenance of fracture reduction and early rehabilitation. Closed reduction with external fixation has been reported to be a cost-effective way of managing hip fractures in developing countries [8].

A sliding hip screw is the preferred method of treatment for intertrochanteric fractures of the femur [7]. However, several complications such as fixation failure of 4–12% and poor functional outcome due to the associated morbidity can occur. In addition, caution must be exercised because of the use of this fixation system in treatment of osteoporotic hip fractures among the elderly [9].

Vossinakis and Badras [10,11] reported patients with trochanteric fractures fixed with an Orthofix external fixator to have better functional result, less blood loss, less pain and shorter hospital stay compared with patients in whom a sliding hip screw was used. The operative time is also shorter for such patients.

Karn et al. [12] in a comparative study on sliding hip screws and external fixators reported better results with external fixators in terms of blood loss, hospital stay, delay in surgery and duration of surgery, thereby reducing the morbidity associated with these fractures.

Kazakos et al. [13] in a study on 56 elderly patients treated using an external fixator reported no significant difference in motor function before injury and at late postoperative follow-up of 12 weeks. There was significant reduction in postoperative mortality at 6 months compared with other modalities of treatment.

Dhal et al. [5] reported on 154 patients with intertrochanteric fractures who were treated with an external fixator. Good fixation and early ambulation were achieved in all cases.

In our study we treated 30 elderly patients by external fixation under local anaesthesia. All were at high risk for anaesthesia-related complications and major surgery for internal fixation because of associated medical and surgical conditions. The average age was 65.9 years and mean follow-up period was 24 months. Out of our 15 cases, 75% regained their previous walking ability, and all patients (100%) united at 6 months. This compares favourably with the postoperative weight bearing allowed after open reduction and internal fixation. Our mortality rate at 6 months of 23.3% (seven cases) is comparable to that seen in the study by Dhal and colleagues [5] and also...
Figure 1

Female patient 65 years of age with heart failure: (a) preoperatively, (b) 2 months after fixator, (c) 6 months postoperatively.

Figure 2

Male patient 70 years of age with intertrochantric fracture and hepatosplenomegaly: (a) preoperatively, (b) 4 weeks postoperatively, (c) 3 months postoperatively.

Figure 3

Female patient 80 years of age with core pulmonale: (a) preoperatively, (b) 3 months postoperatively, (c) 18 months postoperatively.
comparable to the rate in the series on open reduction and internal fixation.

The overall satisfaction rate was 90% at the end of follow-up (40% excellent and 50% good). The mortality rates were comparable to those in a series on open reduction and internal fixation. One patient (5%) had a fair result because of varus deformity and shortening of 2.5 cm and knee stiffness of less than 90°. One patient had a poor result because of a septic loosening and removal of the fixator at 6 weeks; the patient continued on traction until union at 4 months.

Pin-tract infection and stiffness of the knee have been reported as the most common complications associated with external fixation of intertrochanteric fractures [10,11,14,15]. In our study stiffness of the knee was not a complication, probably because we placed Schanz pins more proximally in the femur and later we started to flex the knee to 90° before inserting the diaphyseal pins so that the vastus lateralis was transfixed in the maximum stretched position. Despite taking such steps the full range of knee motion was not achievable in most cases when the fixator was in place. The recovery of knee range of motion was markedly quick after the removal of the fixator.

We had six patients with nearly full range of motion, 11 patients with 90–120° knee stiffness and three patients with less than 90° stiffness. Superficial pin-tract infection was seen in 10 patients, which resolved with removal of pins. We noted that the incidence was more if the patient was obese or diabetic, as there was undue stretching of skin at the insertion site where the drill sleeve was not used and when there was an offset between the point of entry of the pin into the skin and into the bone. Thermal necrosis caused by high-speed drilling may lead to infection [16]; therefore, we used manual drills.

External fixation is a simple procedure that causes minimal operative trauma and provides early ambulation, which is highly desirable.

Usual internal fixation takes 45–90 min, whereas 30 min (25–40 min) was the average time taken for external fixation in our series. Every effort should be taken to reduce the operative time in a geriatric patient with associated medical problems. Minor pin adjustment if required can be performed later, as done in our study.

In our study proximal pins were passed in a parallel manner, similar to the procedure in the study by Dhal et al. [4]. The average loss of neck shaft angle in our series was 20° and the average shortening was 2 cm. Internal fixation of trochanteric fractures has often failed because of late collapse. Failure rates of 44% for blade plate, 11% for Enders nail and 6% for sliding nail plate were reported by Jensen et al. [17].

In our study the goal of treatment was to maintain near anatomical reduction, acceptable neck shaft angle and minimal shortening, as well as impart earliest possible ambulation to the elderly patient.

Although the patients disliked the concept of carrying the fixator outside for an average period of 16 weeks, 90% were satisfied with the final functional outcome. The low cost associated with this procedure was an attractive feature for the patients.

Overall, this procedure serves the purpose of providing satisfactory early functional results to high-risk geriatric patients by allowing them early ambulation; at the same time it is an inexpensive and simple procedure to perform. The external fixation technique requires shorter anaesthesia time and yields minimal surgical trauma and minimal blood loss. These features contribute substantially to stabilizing the general medical condition in elderly patients and to preventing postoperative complications such as urinary infections, pneumonia, decubitus ulcers and deep venous thrombosis.

**Conclusion**

External fixation of intertrochanteric fractures is less invasive and greatly important for union of bones. It can
be easily carried out through a short surgical session and can be performed under local anaesthesia when necessary. It allows early mobilization, and the fixator can be removed easily through an outpatient procedure. Pin-tract infection, which can be considered as a disadvantage, can be prevented or minimized by introducing the nails with a manual perforator and taking appropriate pin-tract care.

Therefore, it may be considered an alternative treatment modality suitable for high-risk geriatric patients with selected fracture types. This technique is simple, safe and can be performed under regional (LIKE ORIF) and even local anaesthesia, together with narcotic analgesic support when required.

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Conflicts of interest

There are no conflicts of interest.

**References**