Research Article

# External fixation of compound femoral shaft fractures in knee flexion position

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## Abstract

**Background:** Compound femoral shaft fracture (open fracture) are unsuitable to be treated by internal fixation primarily, in these situation external fixation is the treatment of choice.

**Aim of the study:** The aim of this method (fixation of compound femoral shaft fractures using external fixators in knee flexion position) is to have a good range of knee movements immediately, post operation and later on, in comparism to classical method (external fixation in knee extension).

**Methods:** The role of external fixation in the management of compound femoral shaft fractures is reviewed based on a study of 40 patients with compound femoral shaft fractures managed by an A O external fixator in extended knee position ( 20 patients during the period from 2003 – 2005 ) and knee flexion position ( 20 patients during the period from 2006 – 2009 ).

**Results:** Results showed that those patients with fixation in knee flexion position have much better range of knee joint movements compared with those with knee extension position at time of fixation , without any significant differences in the of fracture healing between the 2 groups.

**Conclusion:** External fixation of femoral fractures in knee flexion position give good range of knee motion in early and late follow up over fixation in knee extension.

***Key words: compound fracture, external fixation, knee flexion, knee extension.***

## INTRODUCTION

Patients with open fractures may have multiple injuries; a rapid general assessment is the first step and any life threatening conditions are addressed. The open fracture may draw attention away from other more important conditions and it is essential that the step-by-step approach in advanced trauma life support not be forgotten. When the fracture is ready to be dealt with, the wound is first carefully inspected; any gross contamination is removed, the wound is photographed with a polaroid or digital camera to record the injury and the area then covered with a saline-soaked dressing under an impervious seal to prevent desiccation. This is left undisturbed until the patient is in the operating theatre. The patient is given antibiotics, usually, co-amoxiclav or cefuroxime, but clindamycin if the patient is allergic to penicillin. Tetanus prophylaxis is administered:toxoid for those previously immunized, human antiserum if not. The limb is then splinted until surgeryis undertaken.[1] The limb circulation and distal neurological status will need checking repeatedly, particularly after any fracture reduction maneuvers. Compartment syndromeis not prevented by there being an open fracture;vigilance for this complication is wise.[1] Treatment is determined by the type of fracture, the nature of the soft-tissue injury (including the wound size) and the degree of contamination. Gustilo's classification of open fractures is widely used (Gustilo etal., 1984)[1], Gustilo and Anderson in 1976 described their treatment of 1025 open fractures with application of a grading system that offered prognostic information about the outcome of infected fractures. In 1984, this system was modified, and their results were updated. The modified classification is based on the size of the wound, periosteal soft-tissue damage, periosteal stripping, and vascular injury. [2]

**Gustilo's classification of open fractures**:

| *Grade Wound* | *Soft-tissue injury* | *Bone injury* |
|---|---|---|
| **I** <1 cm long | Minimal | Simple low-energy fractures |
| **II** >1 cm long | Moderate some muscle damage | Moderate comminution |
| **IIIA**>1 cm long | Severe deep contusion; + compartment syndrome | High-energy fracture patterns; comminuted but soft- tissue cover possible |
| **IIIB**>10 cm long | Severe loss of soft-tissue cover | Requires soft-tissue reconstruction for cover |
| **IIIC**>10 cm long | As IIIB with vascular Injury | Requires soft-tissue reconstruction or cover |

**Principles of treatment**

All open fractures, no matter how trivial they may seem, must be assumed to be contaminated; it is important to try to prevent them from becominginfected. The four essentials are:

- Antibiotic prophylaxis.
- Urgent wound debridement.
- Stabilization of the fracture.
- Early definitive wound cover. [1,2]

**External fixation**

Rigid external fixation received wide recognition in the United States in the 1960s. Numerous authors from North America published their results for the use of external fixation of long bone fractures, with a renewal of enthusiasm for this technique in specifically indicated situations. This renewed interest in the technique occurred for several reasons, including the development of a variety of frame sizes and configurations, larger and stronger pins, better metals, and better knowledge of the techniques and indications.[2]

The external fixation method provides rigid fixation of the bones in cases in which other forms of immobilization, for one reason or another, are inappropriate. This is most common in severe, open type II and III fractures in which cast or traction methods would not permit access for management of the soft-tissue wounds and in which exposure and dissection to implant an internal fixation appliance would devitalize and contaminate larger areas and might significantly increase the risk of infection or loss of the limb itself.[1,2]

Compression, neutralization, or fixed distraction of the fracture fragments is possible with external fixation, as dictated by the fracture configuration. Uncomminuted transverse fractures can be optimally compressed, length can be maintained in comminuted fractures by pins in the major proximal and distal fragments (neutralization mode), or fixed distraction can be obtained in fractures with bone loss in one of paired bones, such as the radius or ulna, or in leg-lengthening procedures.[2]

The method allows direct surveillance of the limb and wound status, including wound healing, neurovascular status, viability of skin flaps, and tense muscle compartments. Associated treatment (e.g., dressing changes, skin grafting, bone grafting, and irrigation) is possible without disturbing the fracture alignment or fixation. Rigid external fixation allows aggressive and simultaneous treatment of bone and soft tissues.[2]

Immediate motion of the proximal and distal joints is allowed. This aids in reduction of edema and nutrition of articular surfaces and retards capsular fibrosis, joint stiffening, muscle atrophy, and osteoporosis. The extremity is elevated without pressure on the posterior soft tissues. The pins and frames can be suspended by ropes from overhead frames on the bed, aiding edema resolution and relieving pressure on the posterior soft-tissue part.External fixation can be used in infected, acute fractures External fixation of the bone fragments in infected fractures or in infected established nonunions is a critical factor in controlling and obliterating the infection. This is rarely possible with casting or traction methods, and implantation of internal fixation devices is often ill advised. Modern external fixators in such instances can provide rigidity not afforded by other methods. Rigid fixation of failed, infected arthroplasties in which joint reconstruction is not possible and in which arthrodesis is desired can be achieved.[2,3]

Joint stiffness may occur if the fracture requires that the fixator immobilize the adjacent joint. This is most common with fractures involving the proximal or distal limits of the bone, with the major fragment affording insufficient pin purchase and dictating a set of pins and frame above the joint. [2,3]

**Complications**

Widespread use has brought about a series of unique complications. As with every other technique, however, adherence to basic principles and use of proper technique can keep complications to a minimum :[3,4,5,6,7,8,9,10,11,12]

1-Pin Track Infection.
2-Neurovascular Impalement .
3- Muscle or tendon impalement.
4- Refracture.
5-Limitation of Future Alternatives.
6-Delayed union & mal- union.

## PATIENTS AND METHODS

At the Orthopedic Department in AL-Yarmouk Teaching hospital from the period ( 2003-2009), forty- four

patients with compound femoral shaft fractures were treated by AO external fixator, of these 44 patients treated , follow up was possible in 40, the follow up ranged from ( 7-10) months. We divided into two group: **First group;** we treated 20 patients (19 males & 1 female) presented with compound comminuted femoral shaft fractures due to bullet injuries, 16 patients their ages (25 – 35) years, 4 patients their ages (36- 45) years from the period of 2003 till 2005 in the following way:

**.**We did gradual reduction of the fracture using skeletal traction (whether in the distal femur or proximal tibia) for 1 week with the knee in extension position as in Fig 1.

**.**After obtaining a satisfactory alignment &reduction we did closed external fixation of the fracture under floruscopy control (under GA), continuous skeletal traction and the knee in extension position.

**.**After finishing the surgery we checked the stability of the fixation clinically & radiologically (floruscopic control) .

**In second group**; we treated 20 patients ( 18 males & 2 females ) presented with compound comminuted femoral shaft fractures due to bullet injuries, 14 patients their ages ( 25 - 35 ) years , 6 patients their ages (36 - 45 ) years from the period of 2006 till 2009 in the following way :

We did gradual reduction of the fracture using skeletal traction (whether in the distal femur or proximal tibia) for 1 week with the knee flexed up to 45-50 degrees. **.**After obtaining a satisfactory alignment & reduction we did closed external fixation of the fracture under screen (under GA) with continuous skeletal traction, with the knee in more flexion position and in some cases we reached up to 90 degrees of flexion. After finishing the surgery we checked the stability of the fixation as well as the range of the knee movement clinically & radiologically, which was satisfactory. At the day post-surgery we advised the patient to sit on the side of the bed with the knee of the injured limb flexed which may reach up to 80-90 degrees of flexion and to continue his physiotherapy.

**Figure 1. Skeletal traction with the knee in extension position**

**Table 1. Sex and age distribution of the study sample.**

| | No.of males | No.of females | No.of patients(25-35 years old ) | No.of patients (36-45 years old) | Total No. |
|---|---|---|---|---|---|
| Group 1 | 19 (95%) | 1(5%) | 16(80%) | 4(20%) | 20(100%) |
| Group 2 | 18 (90%) | 2(10%) | 14(70%) | 6(30%) | 20(100%) |

## RESULT

Overall results were based on objective radiographic and functional data as well as on subjective assessments. The total number of cases was 40 patients with an average follow up of 9 months, we found in early follow up of knee flexion ranging (15-20) degrees in group 1 & ranging (70-80) degrees in group 2,which is statistically highly significant difference (P value 0.0001* ) .In late follow up (7-10) months , range of knee flexion (25-35) degrees in group 1 & ranging (75-85) degrees in group 2 also it's highly significant difference (P value 0.0001* ) , so a major complication was a decrease in the range of motion of the knee joint in group1 as in compared to group 2 ,as mentioned in (Table 2), Fractures were considered to be united by clinical examination, in the absence of movement and pain on stress at the fracture site. Radiologically union was achieved in the presence of continuous ossification of callus, with consolidation and development of trabeculae across the fracture site. Pin tract problems were frequently encountered but did not influence the outcome of our study.

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**Table 2. Type of injury and its management among study groups**

| | Classification of injury | Type of Ex. Fixation | Ex.Fix. in flexion or extension | Findings of early follow up of knee flexion ( Range) | Date of late follow up | findings of late follow up of knee flexion ( Range) |
|---|---|---|---|---|---|---|
| Group 1 | Gustilo IIIA with inlet & outlet wound | AO | Extension | 15 – 20 degrees | 7 – 10 months | **25 – 35 degrees** |
| Group 2 | Gustilo IIIA with inlet & outlet wound | AO | 70 – 80 degrees knee flexion ( the mean) | 70 – 80 degrees | 7 – 10 months | **75 – 85 degrees** |
| | P value | - | - | 0.0001* | - | **0.0001*** |

- **Significant**

## DISCUSSION

External fixation with it's minimal invasiveness remans in wide use to treat of compound femoral shaft fracures , in some countries it is the cheapest option and, therefore, is widely used. Our study shows that, if no conversion to intramedullary nailing is performed, definitive external fixation of femoral shaft fractures yields reasonable results. this correspond to study done by Alonso et al.[13]

Decreased range of motion of the knee joint can be significant after external fixation of femoral shaft fractures, especially when the external fixator is applied across the knee , so in treatment of compound fractures of femoral shaft using the external fixation in the (traditional) supine position with knee straight there will be limitation of knee flexion postoperatively. Murphy et al. reported an average flexion of 91°, with 44% of patients achieving less than 90° [15].Dabezies et al. reported full range of motion in 50% of their patients, the other 50% having an average loss of flexion of 50° [16].Kessel L reported a loss of extension of less than 5° and a minimum amount of flexion of 90°[14], with a mean of 120° occurring in 64% of their patients.& this correspond to our study in which an average loss of flexion of 90◦ when used external fixation in knee extension,and to solve this problem we send the patient for physiotherapy which in most cases yield no satisfactory results and necissate manipulation under anesthesia after removal of the fixator .In this study we randomly treated 40 patients presented with compound comminuted femoral shaft fractures using the AO external fixator , with the knee in the ( traditional ) extended position in 20 patients , and putting the knee in flexion position in another 20 patients and we assessed the range of knee joint movements ( mainly flexion) in both groups ,we noticed that in those patients for whom the external fixation done in the extended knee position (which is the usual traditional way of fixation ) have got limitations of knee movement which persist despite continuous physiotherapy while those patients for whom we did the fixation in knee flexion position have much better range of movement and the more the degree of knee flexion during the fixation the better the range of movement postoperatively and in the later follow-up . This finding we think it belongs to the tightness of the soft tissues (especially the illiotibial band ) during fixation in knee extended position as compared to its slackness in flexion position .

We don't claim that we solve all the problems related to the limitations of knee movements with the use of external fixation of compound femoral shaft fractures , because we agree that the sample size is small and the problem is multifactorial in that there are factors related to the efficiency of the physiotherapist and his equipments , as well as factors related to the patient himself including his positive role and cooperation with the surgeon and the physiotherapist , but we think that using this method may help to solve some of this problem especially in those localities where there are limitations of physiotherapy and further or definitive surgeries .

In conclusion external fixation of femoral fractures in knee flexion position give good range of knee motion in early and late follow up over fixation in knee extension.

Recommendation

We recommend this way of femoral shaft fixation when using the external fixation (fixation with knee flexion ) , for the reasons mentioned before. We hope this study open the door for further studies to solve similar problems related to the use of the external fixation on other parts of the skeleton.

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