

## **TREATMENT OF FEMORAL SHAFT FRACTURES IN CHILDREN BY CLOSED REDUCTION AND EXTERNAL FIXATION**

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### **Abstract**

This is a prospective study performed from December 2005 to November 2007 on 25 children with closed traumatic femoral shaft fractures admitted to the orthopedic department of Sulemani Teaching and Causality Hospital. Their ages ranged from 3 to 13 years with male to female ratio of 17:8. All cases were treated by gentle fracture reduction and application of monolateral external fixation by the closed method. The average time needed for the fracture to unite was 72.6 days (ranged from 45 – 121 days). The complications reported in the study were: 12 % pin tract infection, 8% of temporary knee joint stiffness and 4% of heterotopic ossification at the site of pin insertion. Neither bone refracture or clinical shortening of the injured limb were reported. The study concluded that unilateral external fixation is a good method of holding femoral shaft fractures in children. The treatment is associated with minimum morbidity and will result in satisfactory bony union, low rates of complications, and early return to school.

### **Introduction**

Femoral shaft fractures are the most common major injury treated by pediatric orthopedists. These fractures typically occur either in early childhood, when weak woven bone is changing to the stronger lamellar bone, or during adolescence, when children (4 to 15 years) are subjected to high-energy trauma from sports and motor vehicle accidents. Child abuse must be considered, especially in infants<sup>1</sup>. Pathological fractures are common in generalized disorders such as spina bifida and osteogenesis imperfecta and local lesion e.g. a benign cyst or tumors<sup>2</sup>. The Winquist and Hansen (1984) classifications system<sup>3</sup> for femoral shaft fractures is based on the diameter of bone that is comminuted. It consists of 4 types. Type I and II fractures are axially stable, whereas type III and IV fractures are both axially and rotationally unstable. Patients with femoral shaft fracture are unable to

walk and are in extreme pain with an obvious swelling of the thigh. Physical examinations are sufficient for documentation of the presence of fractures. Swelling, instability, crepitus and tenderness are usually present<sup>4</sup>. The diagnosis is more difficult in patient with multiple trauma or head injury and in non-ambulatory, and severely disabled children. Anteroposterior (AP) and lateral views are usually adequate in demonstrating the fracture. Stress fractures of the femoral shaft may not be visualized on these routine views. Hip and knee joints should be included in X-ray taken as there is a significant incidence of associated injury<sup>5</sup>. Treatment of femoral shaft fracture is age dependent with considerable overlap between age groups<sup>6</sup>. Other important factors to consider in the treatment are family concerns and whether the fracture is complicated or uncomplicated (table I).

Age	Recommended Treatment
Birth to 6 years	Immediate spica casting Traction followed by spica casting
6 to 10 years	Traction followed by spica casting External fixation Fixation with flexible nonreamed intramedullary rods
11 years or older Children with multiple fractures or head injury	Locked intramedullary nailing

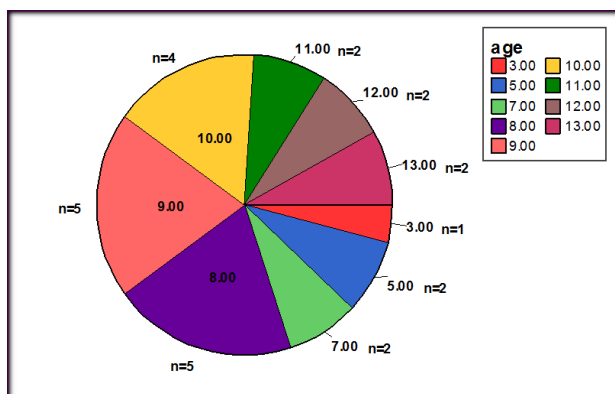
**Table I: Treatment options according to the patient age 6.**

The most common complication after femoral shaft fractures in children is limb length discrepancy, usually resulting from "overgrowth" of the injured femur. Although some angular deformity occurs after femoral shaft fractures in children, it usually remodels with growth. The acceptable amount of angular deformity is controversial, but as a general guideline, angulation of more than 15 degrees in the coronal plane or lateral and 20 degrees in the sagittal plane or anteroposterior is unacceptable. Delayed union and nonunion of femoral shaft

fractures are rare in children and occur most often after open fractures<sup>7</sup>.

**Patients and methods**

A prospective study was carried out at the Department of Orthopedics and Traumatology of the Sulemani teaching and casualty Hospitals during the period from Dec. 2005 to Nov. 2007. A total number of 25 children with 25 closed fractures shaft femur were evaluated and surgically treated by closed external fixation. Their ages ranged from 3 to 13 years (Fig. 1). There were 17 boys and 8 girls.

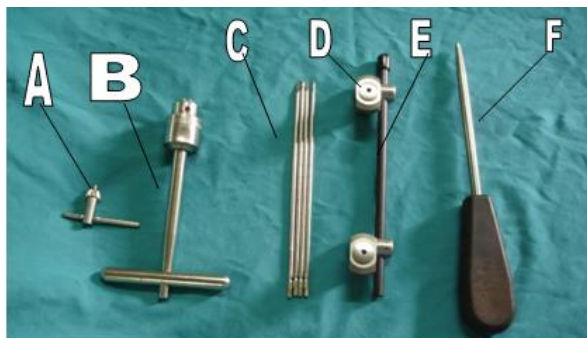


**Figure 1: Age distribution in years.**

**Operative technique**

The operation was performed under general anesthesia on an ordinary operation table without the use of fluoroscopy. Preparation of the skin over entire lower limb with usual antiseptic solution (aqueous povidone-iodine) and draping were done. Sustained manual

traction was first applied to the injured limb to restore its normal length followed by closed manipulation of the fracture and application of monolateral external fixation. The external fixator device used in the study was of the Orthofix type (made in USA) figure 2.



**Figure 2: External fixator apparatus: A: Jacob chuck, B: T-shaped handle, C: Schanz pins, D: Clamps, E: Bar or Tube, F: Allen key.**

A total number of four Schanz pins were used in every patient. For better control and reproducibility, we prefer hand insertion of the pins as opposed to self-drilling pins inserted with a motorized power unit. First pin was inserted proximally at approximately the level of lesser trochanter, the second pin was inserted distally into lower femoral metaphysis several centimeters away from the epiphyseal plate. Two more

Schanz pins were placed both proximal and distal to fracture site. These pins should be placed perpendicular to the anatomic axis of each segment of the fractured femur. Then they were fastened with one parallel lateral bar. Stability of fracture reduction and fixation and the ability to obtain passive knee flexion greater than 90° was tested in every patient following completion of Surgery (Fig.3).



**Figure 3: Clinical testing while the patient is still anesthetized. a: The external fixation in situ, limb alignment is checked. b: testing passive knee flexion. c: Checking length of the injured limb.**

### Post operative treatment

From the first postoperative day, isometric exercises of the thigh and active movements of the ankle were encouraged together with gentle passive movement of the patella by the child's mother.

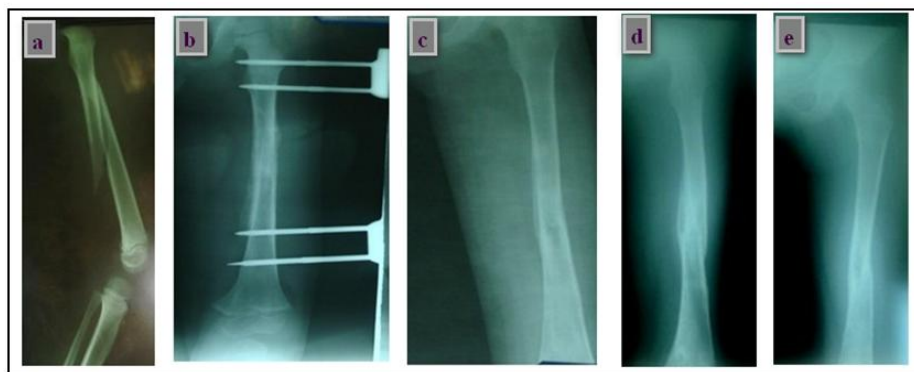
A daily pin insertion site cleaning and dressing was started. The patient is encouraged to stand on the sound site but without weight bearing on the fractured limb. The main hospital stay was 1.5 days and it ranged from 1-3 days. Follow-up

visits were arranged to evaluate the progress of the fracture healing and to monitor the patient and the limb for possible complications.

The first follow-up visit was arranged two weeks post operatively and then at a monthly interval till there is union of the fracture.

Special emphasis was on monitoring of limb alignment, limb length discrepancy (up to 1.5 cm shortening was accepted), pin sites for pin track infection, thigh

muscles power and range of hip and knee movements. Radiological monitoring for fracture union and callus formation was performed at each visit. (see Figure 4).



**Figure 4: Radiographic monitoring of the same patient. a: Initial radiograph. b: 2 weeks postoperative showing early signs of union. c to e after removal of the external fixation at 6,10 and 12 weeks (postoperatively) showed progression to complete bony union.**

Partial weight bearing was allowed 3-5 days postoperatively and full weight bearing after 2 weeks.

The time period of holding the fracture by the external fixator had ranged from 45-121 days and the average was 72.6 days. Follow-up was continued after

removal of the device with the first visit being after two weeks and a second last visit at 6 months. Limb length, alignment of the injured limb and range of active and passive movements of hip and knee joints of the involved limb are checked in the follow up visits (fig.5).

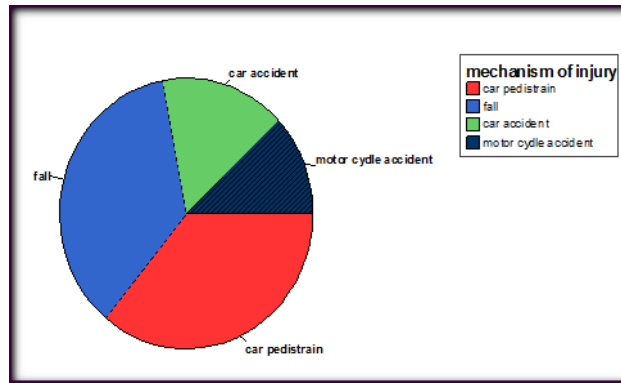


**Figure 5: Clinical evaluation of the same patient after removal of the external fixation.**

## Results

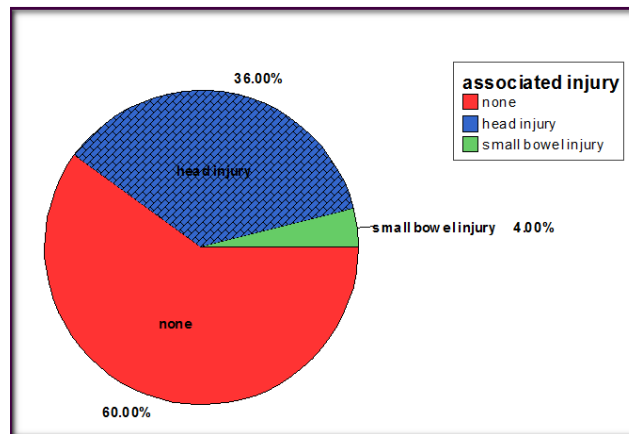
The most frequent mechanisms of trauma were as follows: 9 cases (36%) car-pedestrian accidents, 9 cases (36%) fall

from height, 4 cases (16%) car accidents, and 3 cases (12%) motorcycle accidents, as shown in figure 6.



**Figure 6: Mechanisms of injury.**

The most frequent injury associated with femoral shaft fracture in the present study was head injury which was reported in 9 cases (36%). Small bowel injury was reported in another one patient for whom laprotomy had been done (Fig. 7).



**Figure 7: Associated injuries**

Time needed to complete operation ranged from 10 to 25 minutes. It was 10-15 minutes in 64% of cases, 16-20 minutes in 28% and 21-25 minutes in the remaining 2 patients (see Table 2).

Time of operation (minutes)	Frequency	Percent
10-15	16	64
16-20	7	28
21-25	2	8
<b>Total</b>	<b>25</b>	<b>100</b>

**Table II: Time to complete operations.**

Three patients (12 %) developed pin track infection which was successfully treated with daily dressings and the administration of oral cephalixin antibiotic for one week with. No patient developed osteomyelitis. Intravenous antibiotic therapy was not needed in any patient. Temporary stiffness of the knee joint was seen in two

patients (8%). It persisted after removal of the external fixator for about one month. Joint mobility returned to normal following intensive physiotherapy. Heterotopic ossification at the site of pin tracts was seen in one patient (4%). Figure (8) shows the complications that had developed during the treatment.

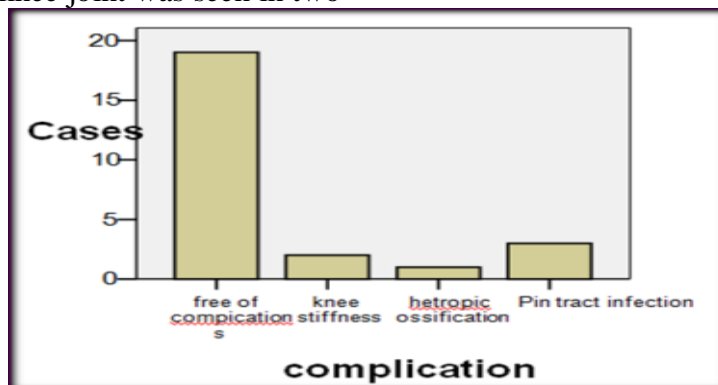


Figure 8: Complications

All fractures had united with in average time of 72.6 days with good callus formation and no sign of delayed or non union. The external fixation device was removed after confirmation of solid fracture union both clinically and

radiographically. The time needed until removal of the fixation device had ranged from 45 to 121 days with a mean of 72.6 days (fig. 9). At the operation’s room with the patient under narcosis, the fixator was removed on an outpatient basis.

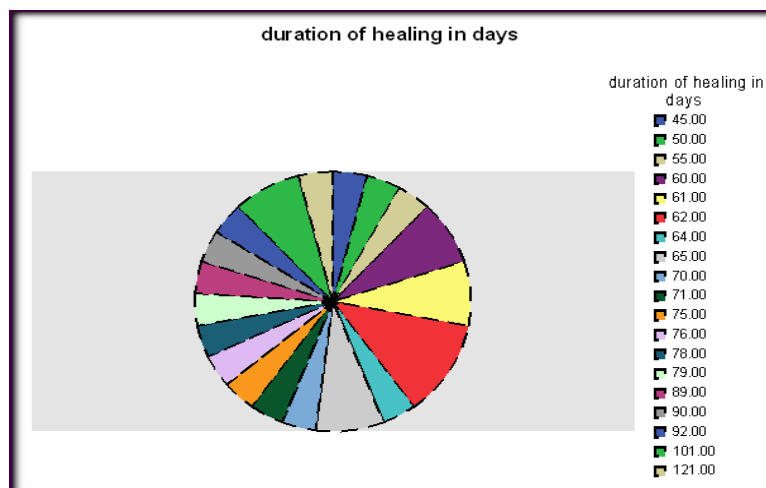


Figure 9: Time of fracture healing (days).

No visible angular or rotational deformities of the injured limb were seen. Limb length measurements were carried out six months after removal of fixator without the development of limb length discrepancy in any patient. All patients

had regained full hip and knee mobility within 3 months after removal of the external fixation following a course of active and passive exercises. No patient had developed refracture of the femur following implant removal.

## Discussion

The treatment of femoral shaft fractures in children is controversial. Different modalities of conservative and operative treatment are available. Each method of treatment has its own advantages and disadvantages. The most frequent complication of treatment is malunion manifested as displacement, angulation, rotation and limb length discrepancy which can complicate any form of treatment. The best treatment of femoral shaft fracture is still unsettled. Under four years of age, most surgeons would advise traction or hip spica. After age ten, most surgeons would recommend operative fixation. Operative fixation is also appropriate for children with complicated fractures, such as those with head injury, multiple injuries, floating knee, and open fractures. Fracture pattern can also affect treatment choices. External fixation is probably best when the fracture has more than 50% comminution or when the fracture is in the proximal or distal femur with a long oblique or spiral pattern. In these fractures, flexible nails may allow shortening and angulation. External fixation has low rates of malunion, but has the disadvantages of pin tract infection and re-fracture. This study showed that the majority of patients were boys representing 68% as compared to only 32% girls. This is in agreement with other studies such as the one performed by Gluaracy C. Filho<sup>8</sup> who reported 79% male gender and 21% females. This probably reflects the fact that in our community boys are playing outside their homes which make them more prone to road traffic accidents and other types of severe trauma. The operative time in the current study was relatively short, average of 10 minutes. This will obviously reduce patient morbidity and risks of general anesthesia. In a study done by Shashank D chitgopkar<sup>9</sup> who studied the intramedullary kirschner wire fixation for fracture femur the time for operation was 40 minutes on average.

The average time of hospital stay of patient in this study was 1-3 days with mean of 1.5 day. This has financial and social advantages to the family and allowed the child to return home quickly. This is a relatively short time when compared to another study<sup>9</sup> in which the mean hospital stay was 8.7 day because open fractures were also included in that study.

All fractures in this study had united uneventfully. Closed reduction of the fracture that avoids injury to the periosteum and keeps fracture hematoma undisturbed were among the factors that resulted fracture healing and the absence of any case of osteomyelitis in the study. The time needed for fracture to heal and thus for external fixation device to be removed in the study ranged from 45 to 121 days. This was in agreement with a study performed by Aronson J. and Tursky EA<sup>10</sup> in which the average time for fracture union was 70 days and the range was from 42-117 days. In another study done by Gluaracy C. Filho<sup>8</sup>, the average time for union was 87 days, while in a study by Hedin<sup>11</sup> the average union time was 61 days. Refracture of femur following removal of external fixation device was reported in the literatures. Hedin<sup>11</sup> reported that 3% of his cases had developed refracture, and in a study done by Gluaracy C. Filho<sup>8</sup>, 17% of the cases developed re-fracture after removal of the external fixation which was probably due to bad technique. In the current study no case of refracture was reported probably because weight bearing was encouraged so early, within 3-5 days following surgery. We agree with Kesemenli<sup>12</sup> that external fixation per se is not a risk factor for refracture.

Limb length measurements were carried out six months after removal of fixator with the most of patient were normal but 3 patient show shortening of 1-1.5 cm with evidences of radiological over lap.

Permanent knee stiffness was not reported in this study but in two cases temporary stiffness was reported in which the child and parent are not so co-operative for doing physiotherapy. All 25 cases we did full knee flexion when the patient was still under general anesthesia this indicating that there was no mechanical obstacle for knee flexion and after removal of fixator they were all normal. While in study done by Gluaracy C. Filho<sup>8</sup> there was 1/22 case of knee stiffness.

**Conclusions:** the study concluded that unilateral external fixation is a useful method of holding femoral shaft fractures in children 3–13 years of age. It can be used even in children below school age. The benefits of a shorter operative time and hospital stay with early mobilization

reduces both patient's morbidity and cost of treatment and also minimizes the child days out of school.

The treatment provides satisfactory bone healing in a relatively short period of time, with a low rate of major complications like osteomyelitis, implant failure, limb length discrepancy and joint stiffness.

## Recommendations

The study recommends the use of closed reduction and external fixation as a primary treatment of pediatric femoral shaft fractures. External fixation devices of appropriate sizes to suit pediatric age group should be made available in orthopedic units treating such fractures.

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