

Closed femoral shaft fracture treatment in children: plate and screws versus external fixation in Thi-Qar

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Abstract— Background: Fractures of the femur are popular problems among children and adults, A proper modality of treatment that is the external fixation with minimally invasive technique is less cost and easily applied as an available option that can be regarded as a well-tolerated definitive procedure until complete union of the fracture specially in resource constrained centers in developing countries where specialized implant and instrumentation is not always available. **Aim:** To study the method of treatment of femoral shaft fracture in children at the age of more than 7 yrs. old, and to select the proper modality that is always present and easy to get in our city and also to check the efficacy of external fixation in compared to internal fixation by plate and screws, and to determine the management outcome. **Material and method:** A comparative analytical study extended all over the past three years, including all children exposed from femoral shaft fracture, where 1st group composed of 15 children underwent external fixation, while the 2nd group was of 10 children, who underwent internal fixation. The socio-demographic characters chosen to be nearly was of no significance difference, the outcome was the targeted subjects inform of infection, leg length discrepancy, gait abnormality...etc, link of association and difference studied by SPSS version 25. **Results:** Gender show no significant difference where Chi-Square=0.108a, P value =.534, odds ratio= 1.114, regarding mechanisms of injury where high percentage in external fixation was due to Motor vehicle accident (40%), while for the internal fixation was of no difference. oblique type was the most common one in both group, pin infection and osteomyelitis were, to some extent, higher among external fixation modality and had significant statistical difference. **Conclusion:** The external fixation can be regarded as one of a proper method of treatment in children suffers from femoral shaft fracture beside other modalities of treatment with non-serious and with minimal complications.

Keywords: External fixation, Pediatric, femoral shaft fracture, Thi-Qar.

Introduction:

Femoral shaft fractures involve (2%) of all fractures in children and adolescents. The fractures are more common the younger the child [1]. A small child can afford a fracture via a simple fall on level ground while playing, but the older child a stronger force is required. Generally fractures are displaced and

agents that must be considered for select of treatment are age, type of injury linked injuries, type and location of the fracture, psychological and social situation and the capacity of the family to take care of the child[2]. For several years, conservative treatment with traction and or casting has been the gold standard for all femoral fractures in children with comparatively good results. Pediatric femoral shaft fractures unite fast regardless of the fracture type, location and treatment given[3]. Thus the management of femoral shaft fractures in children is largely steer via the age, fracture style. As the treatment ways have developed, the trend has been moving away from non-operative methods such as traction and Spica casting towards operative methods such as open/minimally invasive plating, external fixation, and flexible/rigid intramedullary nailing. Each ways has its set offeature and disadvantage. There is a clear consensus on the non-operative treatment of pediatric femoral shaft fractures, in the Spica casting with or without initial traction, in children less than 6yrs of age. For children more than (12 years) of age operative treatment, usually in the form of rigid intramedullary nailing or plating is recommended. Several studies advocating different lines of treatment ranging from immediate conservative treatment to delayed surgical intervention, the age group of (3-12) years remains a controversial area[4]. Generally fractures of the femoral shaft have some degree of alerts, though it is not never apparent on x-ray. Small bone fragments, or a single large 'butterfly fragment, might split at the fracture line but usually stay linked to the adjacent soft tissue and retain their blood supply[5]. Traction with a splint is first aid for a patient with a femoral shaft fracture. It is utilized at the site of the accident, and before the patient is moved[6]. While definitive treatment the selective of closed way depends largely on the age and weight of the child. As children get older and larger, fractures take longer time to heal and the treatment is more likely to result in problems related with long hospitalization and increase the risk of mal-union, coupled to this is the cost of protracted bed occupancy[7].

Aim : To study the method of treatment of femoral fracture in children at the age of more than 7 yrs. old, and to select the proper modality that is always present and easy to get in our city, also to check the efficacy of external fixation in compared to internal fixation by plate and screws, and to determine the management outcome and to prove this procedure can achieved anatomical reduction and holding this reduction until fracture is completely united and minimization of complications, and not be interfere with the growth epiphysis. And also to prove this surgical procedure is simple, technically less demanding, and suitable in peripheral hospital in developing countries.

Material and method:

A comparative analytical study extended all over the past four years, from January 2016-December 2019 in Al- Husain teaching hospital of Nasiriya city in Orthopedics department, with average follow up duration of (10) months, ranged from 3- 36 months. Including all children exposed from femoral shaft fracture, where they divided into 2 groups, 1st group composed of 15 children underwent external

fixation, while the 2nd group was of 10 children, who underwent internal fixation. patients with inadequate follow-up, incomplete medical records, or death as a result of associated injuries all were excluded. The socio-demographic characters chosen to be nearly was of no significance difference, the outcome was the targeted subjects inform of infection, leg length discrepancy, gait abnormality...etc. A well prepared questionnaire had been filled for each patient enrolled in this study, where age, gender, mechanism of injury: [Sport Accidents (SA), Motor cycle accident (MCA), Fall from a height (FFH), Vehicles hit a Pedestrian (VHP), Passenger in Vehicles Accident (PVA)], fracture configuration (transverse, oblique, segmental, spiral and comminuted), time from injury till operation, time of removal of external fixation, time of radiological consolidation, secondary operation (if need) and complications as listed below:

- 1- Pin tract infection
- 2- Pin loosening
- 3- Leg length discrepancy
- 4- Re- fracture
- 5- General complication (post operative medical complication)
- 6- Mal union, Non- union and delayed union.
- 7- Need for bone graft
- 8- Gait abnormalities
- 9- knee joint stiffness.
- 10-osteomyelitis

Follow up period until the fracture healed. The entire patients were resuscitated in the emergency room. A written consent had been taken from the parents of the children, who were recruited in this study.

Statistical analysis: SPSS version 23 had been used for the analysis of the collected data, frequency, percentages, and proper statistical test used for the determining the differences and to relate the variables independently with outcome

Results :

In Figure(1) the results show the distribution of patients according to gender where the highest percentage was in male (62.5%), where Pearson Chi-Square=0.116, P value = 0.530, odds ratio=1.333, Spearman Correlation=.068, significance =0.998

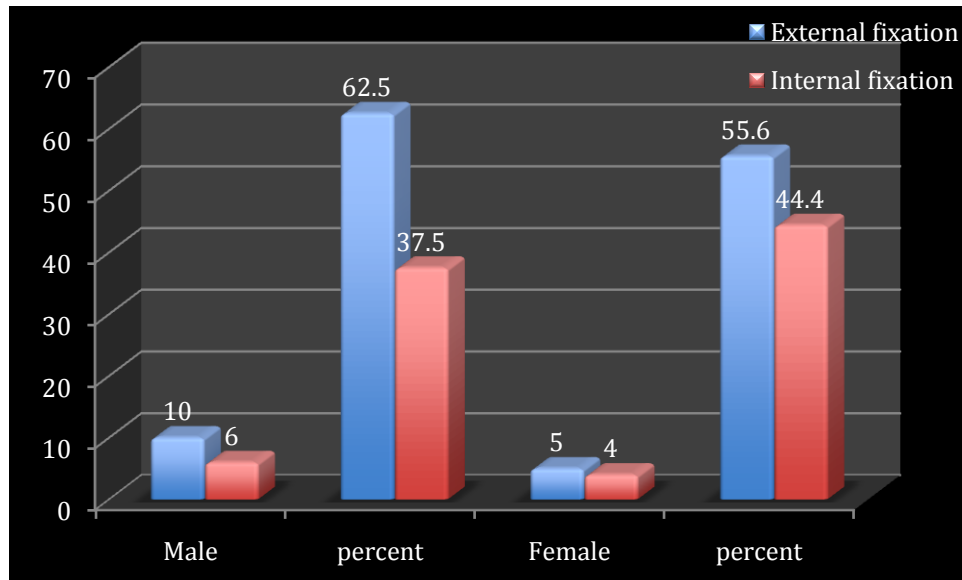


Figure 1: Gender distribution of the studied children

The (table1) referring to that the distribution of studied groups according to mechanisms of in injury where high percentage in external fixation (57.1%) falling from high.

| Table 1: Distribution of studied groups according to mechanisms of in injury | | | | | |
|--|------------------------|--------------------|-------------------|-------------|----------------------------------|
| | | Comparative groups | | Total | Pearson Chi-Square, Significance |
| | | External fixation | Internal fixation | | |
| Mechanism of injury | Falling from height | 4 57.1% | 3 42.9% | 7 100.0% | 1.017 ^a .907 |
| | Motor cycle accident | 3 50.0% | 3 50.0% | 6 100.0% | |
| | Motor vehicle accident | 6 66.7% | 3 33.3% | 9 100.0% | |
| | Sport injury | 2 66.7% | 1 33.3% | 3 100.0% | |
| Total | Count | 15 | 10 | 25 | |
| | % | 60.0% | 40.0% | 100.0% | |

In Figure(2) the results show the distribution of patients according to side of fracture distribution and management modality, where Pearson Chi-Square=0.108^a, P value =.534 , odds ratio= 1.114.

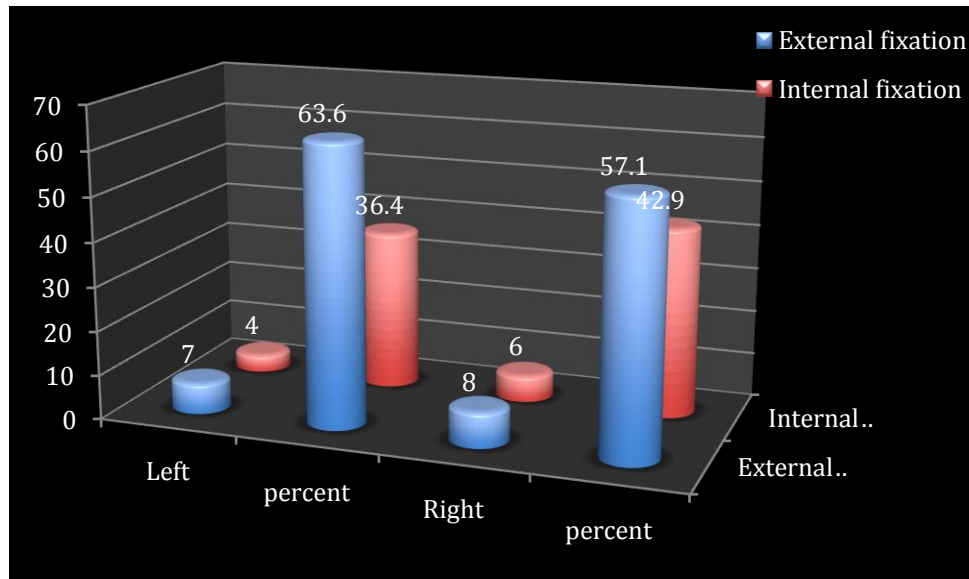


Figure2: Distribution Side of injury.

The (table2) referring to that the distribution of studied groups according to fracture configuration where high percentage of external fixation when compared with internal fixation and there are no significant differences in fracture configuration were found.

| Table 2: Distribution of studied groups according to fracture configuration | | | | | |
|---|------------|-------------------|-------------------|--------|--------------------|
| Fracture configuration | | | | Total | Pearson Chi-Square |
| | | External fixation | Internal fixation | | Significance |
| Fracture configuration | Comminuted | 3 | 1 | 4 | 0.473 ^a |
| | | 75.0% | 25.0% | 100.0% | 0.948 ^b |
| | Oblique | 5 | 4 | 9 | |
| | | 55.6% | 44.4% | 100.0% | |
| Spiral | 3 | 2 | 5 | | |
| | 60.0% | 40.0% | 100.0% | | |
| | Transverse | 4 | 3 | 7 | |

| | | | | | |
|-------|-------------------|-------|-------|--------|--|
| | | 57.1% | 42.9% | 100.0% | |
| Total | Count | 15 | 10 | 25 | |
| | % within fracture | 60.0% | 40.0% | 100.0% | |
| | Configuration | | | | |

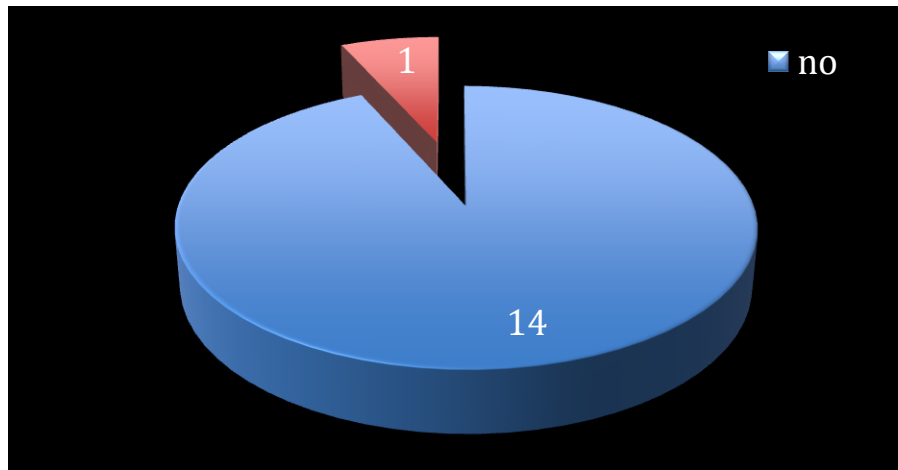


Figure 3:Pin losing in external fixation group.

Table 3: Fracture complications and their relation to types of fixation

| Complication | | External fixation | Internal fixation | Total | Chi square P value |
|------------------------|--------------|-------------------|-------------------|--------|-----------------------------|
| Pin or plate infection | Sever | 1 | 0 | 1 | 4.85 .0.021 |
| | | 100.0% | 0.0% | 100.0% | |
| | Mild | 2 | 1 | 3 | |
| | | 66.7% | 33.3% | 100.0% | |
| Leg length discrepancy | NO | 12 | 9 | 21 | 1.488 ^a 0.685 |
| | | 57.1% | 42.9% | 100.0% | |
| | Long 1 Cm | 1 | 0 | 1 | |
| | | 100.0% | 0.0% | 100.0% | |
| | NONE | 12 | 9 | 21 | |
| | | 57.1% | 42.9% | 100.0% | |
| Shortening 2 | Short 1C | 1 | 1 | 2 | |
| | | 50.0% | 50.0% | 100.0% | |
| | Shortening 2 | 1 | 0 | 1 | |

| | | | | | |
|------------------|----------|-------|--------|--------|----------------------------|
| | cm | | | | |
| | | 100% | 0 | 100% | |
| Re-fracture | NO | 15 | 9 | 24 | 1.563 ^a , 0.211 |
| | | 62.5% | 37.5% | 100.0% | |
| Gait abnormality | Yes | 0 | 1 | 1 | 0.504, 0.625 |
| | | 0.0% | 100.0% | 100.0% | |
| | No | 12 | 9 | 21 | |
| Joint stiffness | | 57.1% | 42.9% | 100.0% | 0.139, 0.932 |
| | Yes | 3 | 1 | 4 | |
| | Mild | 75.0% | 25.0% | 100.0% | |
| | | 1 | 1 | 2 | |
| | moderate | 50.0% | 50.0% | 100.0% | |
| | | 2 | 1 | 3 | |
| Osteomyelitis | | 66.7% | 33.3% | 100.0% | 3.974 0.039 |
| | No | 12 | 8 | 20 | |
| | | 60.0% | 40.0% | 100.0% | |
| | Mild | 1 | 1 | 2 | |
| Total | | 50.0% | 50.0% | 100.0% | |
| | NONE | 14 | 9 | 23 | |
| | | 60.9% | 39.1% | 100.0% | |
| | Percent | 60.0% | 40.0% | | |

Pin infection and osteomyelitis were only the 2 complications that had significant statistical differences among the studied comparative groups with p value (0.021 and 0.039) respectively.

Discussion:

Though femoral shaft fractures constitute less than (2%) of all pediatric fractures, the selective of treatment remains a constant challenge to orthopedic surgeons. Various methods of treatment can be utilized successfully depend on upon the age of the children and the type of fracture. There are a broad diversity of surgical and non-surgical treatment options are obtainable as early spica casting, traction followed by casting, external fixation, plate fixation, intramedullary inter locking nails and pliable

intramedullary nails with no clear consensus as to the preferred treatment. With the possibility for fast union and remodel in children's bones staller results are predictable, after conservative treatment for pediatric femoral shaft fracture[8]. Treatment for pediatric femoral shaft fractures has varied dramatically over the past various decades. The spica casting or operative fixation has reduce lengths of hospitalization and the time to return to normal actions, various treatment techniques are utilized, depend on the age and body mass of the patient, as well as on the type of fracture, and the surgeon should be ready to choose the optimal way for each given clinical situation[9]. The fixation of femur fractures in pediatric patients include external fixation, plating, ante grade locked nailing, and flexible intramedullary nailing. Although support for each of these methods exists in the researches, each way has specified advantages and more importantly, specific complications that might be linked with that. External fixation, first advocated for patients with open fractures. Ender rod fixation for fractures in the pediatric population is simple, active, and minimally invasive. It allows stabilized fixation, fast healing and a prompt return of the children to normal activity. Effective results are good and complications are minor. The utilize of ender rod fixation in femur fractures in child allows the features of surgical fixation without many of the risks linked with other techniques[10]. Several different techniques could be action in the management of femoral fractures in this age group. Each technique has its potential advantages and disadvantages. though there is some risk for complications, and though good early results have been reported with elastic intramedullary nails, plate fixation continues to be a viable alternate in the surgical treatment of femoral shaft fractures in children[11]. In evaluating a children with a femoral fracture, decision working for management is depending on the risks and benefits of each treatment method and the functional needs of the patient. Preschool age child may be best treated with an early Spica cast. For the school age child mostly one with high energy trauma or linked injuries surgery is distinguish. where making treatment recommendations, the surgeon should consider the existence of linked injuries or multiple trauma, the fracture individuality, acceptable age appropriate reduction, family issues, and cost. Complications include but are not limited to leg length discrepancy, rotational malunion, angular deformity, compartment syndrome and delayed union and nonunion[12]. The treatment selective should be individualized for each patient depend on age, fracture type, and environmental factors, the family's social and psychological circumstances, all the risks and benefits of each treatment option should be thoroughly discussed with the family, to help them and the physician make the best treatment decision for each patient[13]. In a previous study conducted by Chena *et al.*, (2020) confirmed that in conclusion ESIN should be a priority selective for the treatment of pediatric femoral shaft fractures as it several advantages, include reliable curative effect, shorter hospital time, faster fracture healing, and fewer complications. External fixation is recommended for fractures with serious injury of the soft tissue to avoid intramedullary infection. The present study is consistent with a previous study conducted by Li *et al.*, (2020) External fixation is superior than locking plate in terms of

union operation time phrases and intraoperative blood loss. External fixation techniques are best options for treating displaced supracondylar femoral fracture in children. This study had several limitations aside from comparatively low numbers of patients and significant difference in age between two groups. The selective of external fixation for open fractures results in selective bias in grouping. For open fractures, the conventional view is that internal fixation such as locking plate is simple to raise the risk of infection, while external fixation is suitable for open fractures[15]. External fixation can be utilized in non-complicated femoral fractures in children (3 to 15) years old. The temporary solidity of the knee through treatment resolved with physiotherapy. In past researches all children weight bearing without crutches at the end of the treatment and no external protection was utilized after removal of the external fixator. The best treatment option would probably go toward flexible nails, especially for cross fractures that can cause problems as seen in this study. In long spiral and comminuted fractures, external fixation can yet be a good alternative to minimize shortening and knee problems[16]. Treatment of pediatric locked femoral fractures with external fixation has declined in favor of internal fixation over the past decade across all geographic regions and in both teaching and nonteaching hospitals in the United States. This deny in external fixation occurred more fast in pediatric hospitals contrast to non-pediatric hospitals. The clinical and financial impact of this change in practice needs further realization. The study was conducted via Pollak, *et al* in 1994 and reported higher incidence of loss of reduction and malunion in Spica casting group, all actions before concluded that early union and weight bearing is the key to recovery to routine work and school, Similar milestones were recognized via Griesberg, *et al*[17]. suggested by Krettek *et al.* (1991) the use of an external fixator, which provides good stability and early mobilization, but one fourth of his patients advanced, an infection at the site of the screws and one fifth of the patients were unhappy with the device. Surgical treatment of femoral shaft fractures is seldom considered in patients, less than (4 years) of age in whom early reduction and immobilization in a (spica cast or traction) are well established methods. In older children, such treatment may be beneficial to avert complications, such as delayed union, malunion, rotational deformity, refracture, knee stiffness, limb-length discrepancy and psychosocial problems[18].

Conclusion:

The external fixation can be regarded as one of a proper method of treatment in children suffers from femoral shaft fracture beside other modalities of treatment with non-serious and with minimal complications.

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