Original Article

SHORT TERM OUTCOME OF TREATMENT OF FEMORAL SHAFT FRACTURES IN CHILDREN BY TWO METHODS: TRACTION PLUS CASTING, VERSUS INTRAMEDULLARY PIN FIXATION – A COMPARATIVE STUDY

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ABSTRACT

Objective: There is no consensus on treatment of closed femoral shaft fractures in children 6-12 years old .The aim of this study was to evaluate and compare the short term results of pediatric femoral shaft fractures at above ages with two different methods of treatment: skeletal traction followed by a hip spica cast and surgical treatment by intramedullary pin fixation and to determine which of these methods results in earlier union of fracture and independent ambulation of the patients.

Methodology: This study was performed prospectively at two hospitals during a period of 32 months from 2003 through 2006. Sixty six children with closed fractures of the femoral shaft were treated and followed at least through the time of fracture healing, spica cast removal and onset of unprotected walking in two separate groups: (A) skeletal traction by 90 – 90 technique followed by spica cast (n=30), (B) open reduction and internal fixation with intramedullary pin and cast (n=36). The length of hospital stay, casting period, union of fractures, time to start walking and the rate of complications was evaluated and compared using Chi-Squar test.

Results: Mean age of all patients was 7.4 years old. Average follow-up was 6 months. Healing of the fractures was observed in all cases of both groups between 8 and 12 weeks. The length of immobilization was longer in traction versus surgery group. Average treatment duration from admission to hospital till independent walking was 75.3 days for the traction and 61.2 days for surgery group. Limb shortening and malrotation were more in traction versus intramedullary pin patients.

Conclusion: Both methods of traction plus spica casting and intramedullary pinning can be used to treat femoral shaft fractures in 6-11 years old children**.** Intramedullary pin due to its less hospital stay, earlier walking and less complication rates can be used as the first choice in treatment of this fracture at school aged children.

KEYWORDS: Femoral shaft fracture, Skeletal traction, Spica cast, Intramedullary pin.

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INTRODUCTION

Femoral fractures consist 1.6% of all children fractures. Their prevalence in boys is 2.6:1 fold of girls, can be seen at any age and among the long bone fractures, is responsible for the longest hospital stay, immobilization in cast, and absence from school and daily activities.[1-3] Femur is the longest bone of the body and main weight bearing and movement tolerating bone, thus, complications of this fracture can be catastrophic for the child and the family. In

younger ages and before school, child abuse or falling down is the main cause of this fracture.[4] In older children, the fractures is mainly due to sport events, on foot care contacts, or driving accident. As the age increases and bones are stiffened, fracture causing force must be more severe.[5,6] Until now, a variety of treatment methods have been used, but none of them is the standard method. In the past, almost all of these fractures have been treated conservatively by traction and spica cast and now this method also is being used for younger children only.[7]

During recent years, there has been a considerable increase in closed or open reduction and internal fixation using intramedullary pin or rod to treat femoral shaft fractures in children. This can be related to technical advancements specially development of elastic stable intramedullary nailing (ESIN), or patients intention of short stay in hospital.[8]

The preferred method of treatment for femoral shaft fracture in children younger than six years age is usually by closed reduction and primary spica cast. For children more than 11 years age it is by surgery, but there is no agreement on definite method of treatment between ages 6-12 years and both nonoperative and surgery with internal fixation can be used.[9-11] The current study was performed to evaluate the short term results of management of pediatric femoral shaft fractures and it attempted to compare these two different methods of traction & cast and intramedullary pin fixation, regarding the time till union and unprotected ambulation by comparing the results.

METHODOLOGY

This study was conducted as a prospective and controlled clinical trial during 32 months (May 2003-Feb 2006) at two hospitals (Imam Khomeini and Razi), and all children with closed femoral shaft fracture between the age group of 6-11 years were enrolled in the study. Fracture characteristics for inclusion in the study were, oblique, spiral and transverse closed femoral shaft fractures. Open, pathologic, segmental, trochanteric, multiple trauma and distal epiphyseal fractures were excluded from study. Patient's gender was not involved in the study. Randomizing of patients into two groups was performed consecutively based on their order of presentation and hospitalization. Treatment method was traction in the first group and surgical in the second group. After approval of Ethics committee in our hospitals and complete explanation of treatment plan to parents, a written consent was taken from patient's parents or guardians.

Treatment in the first group: In the operating room, under local anesthesia after insertion a 3 or 4 mm Steinman pin into proximal tibia, 90-90 skeletal traction and leg support with sling was applied. Proper reduction status was determined by serial radiographs. Following primary callus formation and early union that was characterized by loss of pain, tenderness and motion at the fracture site, pin was removed and $1^1/2$ spica cast was applied. Control radiographs were taken at interval of 3,6,12 and 16 weeks. After complete union, cast was removed, physiotherapy was initiated and walking was allowed as soon as the patient could tolerate.

Second group: In the operating room, after preparation, under general anesthesia and in lateral position, fracture site was exposed by a 4-5cm incision. Then a 4-5 mm slightly bent pin was inserted retrograde first, into proximal fragment with the hip in flexion, adduction, and internally rotated and after reduction, into distal fragment. Pin end was bent above the greater trochanter subcutaneously. Control of reduction was performed by a C- arm fluoroscopy. Then, a hip spica cast was applied. Radiographic examination was sone at 4 weeks interval. After union of fracture and removal of the cast, physiotherapy and weight bearing was started when the patient could tolerate. Pins were removed after 20 to 24 weeks (mean 22 weeks) post operatively. Three time periods were considered in evaluation of the patients: (1) duration of hospital stay (2) duration of cast immobilization, (3) period in which patients start walking.

RESULTS

Out of seventy 6-11 years old children who were admitted and treated for closed femoral shaft fractures, four patients were lost to follow up and were excluded from study, but 66 cases (51 boys and 15 girls) were available and followed - up for 6 months.

The cause of fracture was motor/vehicle accident in 30 (45.4%), pedestrian vehicle collision in 19 (28.8%) and falls in 17 (25.75%). Thirty of them were in the first group treated by skeletal traction, and 36 patients in the second group were treated surgically. Out of total 66 patients, 51 were male and 15 were female with male to female ratio of 3.2/1. Mean age of all patients at the time of injury was 7.4 years. Seven point two years for the first, (range, 6.2 - 9.3 y) and 8.1 years for second group (6.5-10.1 y).

The mean duration of hospital stays, casting, ambulation, total course of treatment and results between two groups is summarized in Table-I&II.

Sound unions were achieved between 8 and 12 weeks in all fractures. Total treatment period, from admission time to independent walking was 68-85 days (average 75.3 days) for first group and 57-72 days (average 60.2 days) for second group. No patient had peripheral neurovascular complication.

In the second group (surgery), there was one case of superficial infection which was treated by antibiotics. Six patients complained of pain and discomfort at the pin end site that resolved after extracting the pins. In four patients in the first group, mean shortening of 1cm and one patient of intramedullary pin, shortening of 1cm was observed. In that patient, fracture line was of long obliquity. None of the patients had unacceptable angles of varus or valgus. In comparison with contra lateral normal limb, excessive lateral rotation of leg (average 15 degree) was observed in three patients in the first group. In second group, patients families were more satisfied of surgical treatment and shorter hospital stay. Range of motion of the knee and hip joints were normal at final follow–up in both groups of patients.

DISCUSSION

Treatment of femoral shaft fractures in children is dependent upon age and weight of the patient, location, character of fracture and associated injuries.[12] In children younger than 5 years of age, recommended treatment is non-surgical with primary hip spica cast with or without a period of Russell, s skin traction.

Historically, skeletal traction has been a conventional and safe method of management in older children. It doesn't cause knee stiffness, bone union occurs naturally without risks of surgery, but it may result in malunion or limb shortening, and longer hospital stay, which may not be tolerated by agitated child or parents. In different reports, skeletal traction has been known as an excellent modality.[13] On the other hand, flexible intramedullary pin or nail is a minimal invasive and safe method, which maintains normal bone alignment with high rates of union. Also it can be performed in pathologic and some open fractures. The length of hospital stay is shorter than traction method.[14,15] Uncommon complications of this technique may be the surgical risks, painful bursitis at the nail or pin end site, or avascular necrosis of femoral head.[16-18]

For children over 12 years of age, treatment of femoral shaft fracture is usually as an adult by surgery, using intramedullary nail, external fixator or plate and screw for patients

Table-I: Results of treatment duration at both groups

Mean Duration of treatment (days)	*Skeletal traction (n=30)*	*Intramedullary pin (n=36)*
Hospital stay duration	23.7	4.6
Average period of hip spica casting	45	49.4
Ambulation time	6.6	7.2
Total treatment course	75.3	61.2

Table-II: Complications of femoral shaft fracture in two patient groups.

Complication	*Traction and casting n=30*	*Intramedullary pin+ Casting N=36*	*P.value*
Infection	- - -	1 = (2.7%)	0.364
Shortening	4 = (13%)	1 = (2.7%)	0.000
Malrotation	3= (10%)	- - -	0.002
Pin end irritation	- - -	4 = (11%)	0.012

between 6-12 years of age, both surgical and non-surgical methods can be used. Ligier et al, have used elastic intramedullary nail (ESIN) with kirshner-wires or pins, which was performed retrograde or antegrade.This technique provides a combination of stable and elastic immobilization. Rotational stability is achieved by the curved or bent wires which provides 3-point fixation. Normal tension of surrounding muscles helps this stability and elasticity of the pins help callus formation by allowing fine micro motion at the fracture site.[19,20] In our study we used the principle of ESIP with a single curved wire. Reeve et al, in a comparative study, treated 41 patients with femoral fracture by traction and casting and 49 cases by IMN surgery. Age of patients was between 4 and 12 years old. In their study, complications of traction and casting were more than the operated group.[13]

In another similar study conducted by Kirby et al; on 25 children femoral shaft fracture, which were evaluated in two separate groups of traction plus cast and IMN, shortening of >2.5cm and malunion were reported in traction and casting group.[21]

In studies performed by Arenson, Singer and Herndon, the complication of malunion in traction and cast was more frequent than surgical treatment.[22,23] Flynn et al, while reporting successful results of intramedullary nailing, concluded that most femoral fractures in children can be treated by traction and casting.[24] In our study the total period of treatment until onset of unprotected weight bearing for traction and cast and intramedullary pin fixation was 75.3 days, and 61.2 days respectively. We noted more complications in the traction versus intramedullary pin patients. Malrotation and limb shortening were more in traction group, with the P. value of < 0.05 and these differences were statistically significant. Although the main disadvantage of intramedullary pin was the pin end irritation, and need of the second operation to remove the pin. Both methods resulted in excellent union of fractures.

Overgrowth is a common problem after femoral shaft fractures in children. Its correction is related to the child's age, and up to 2cm of overriding at the fracture site can be acceptable in younger child. The 1cm shortening in 5 patients of this short term study would be expected to resolve as the child grows and remodeling of the bone. To detect this phenomenon, another study with a follow up of two years or longer will be needed.[25]

CONCLUSIONS

Closed pediatric femoral shaft fractures within the ages of 6-11 years can be treated successfully by any methods of skeletal traction or intramedullary pin. However, because of shorter immobilization period and earlier ambulation, we recommend internal fixation with IM pin as the first choice to treat this fracture in school aged children

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